ALASKA OYSTER GROWER'S MANUAL

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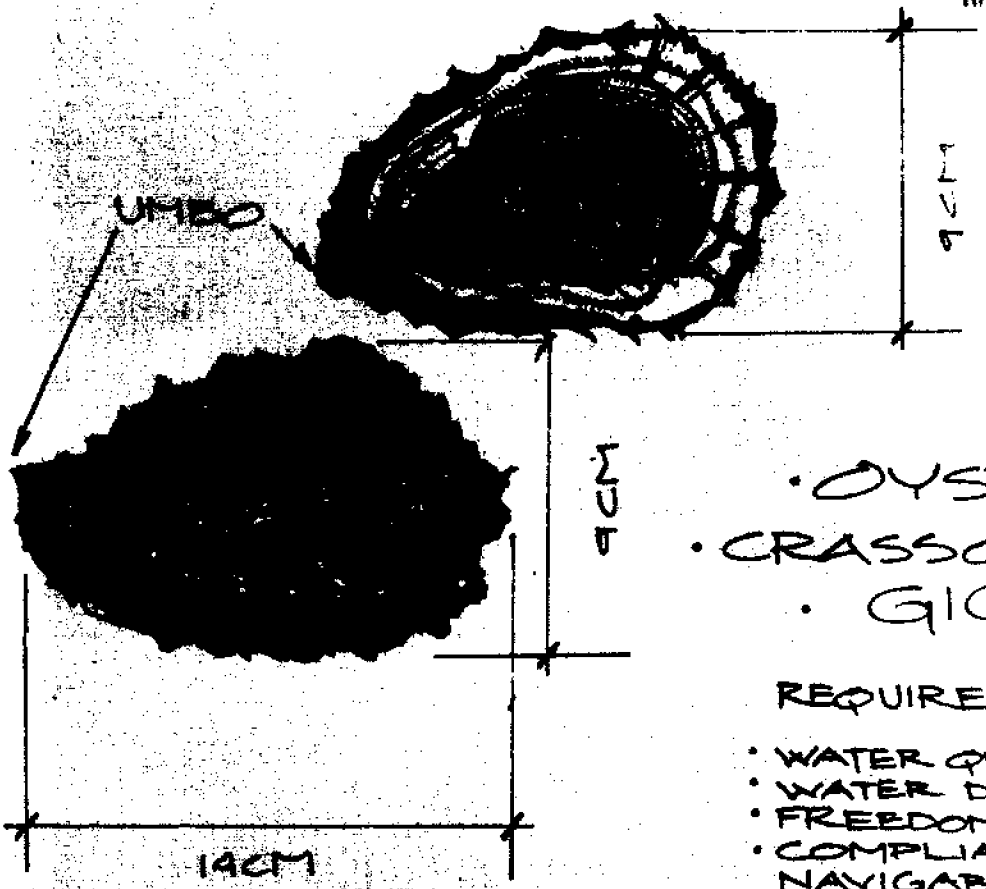

·OYSTER·
·CRASSOSTREA·
· GIGAS ·

REQUIREMENTS:

- WATER QUALITY
- WATER DEPTH
- FREEDOM FROM ICE
- COMPLIANCE W/ NAVIGABLE WATERS ACT
- PROXIMITY TO MARKETS
- EASE OF SURVEILLANCE

University of Alaska
Alaska Sea Grant Program

Marine Advisory Bulletin 17

May 1985

University of Alaska
Alaska Sea Grant College Program
590 University Avenue, Suite 102
Fairbanks, Alaska 99701

ALASKA OYSTER GROWER'S MANUAL
Second Edition

Compiled by

Page Virginia Else
Wrangell, Alaska

Edited by

T. Frady
Alaska Sea Grant
Fairbanks, Alaska

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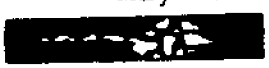

ACKNOWLEDGEMENTS

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Manual development and printing of the first edition were funded by the Alaska Department of Commerce and Economic Development, Office of Commercial Fisheries Development; with matching funds contributed by Mr. John Church of Clearwater Seafoods.

The Alaska Marine Advisory Program was extremely supportive. Petersburg Marine Advisory agent Brian Paust and his secretary Celia Forrest assisted with research, editing, manuscript preparation, and printing for the first edition. Lance Craighead of Ecologystics in Wrangell, Alaska, made his word processor available for our use at that time.

I would also like to thank the many people in state agencies and the oyster farmers for their willingness to help provide information. Robin Larsson, president of the Alaska Shellfish Growers Association and Cliff James of James and Company in Wrangell, Alaska, provided valuable input in reviewing this manuscript.

The Alaska Sea Grant College Program's communications staff managed, helped edit and published this second edition. I would like to thank reviewers for this volume: Mr. Terry Nosho, aquaculture specialist for the University of Washington Sea Grant College Program; Mr. Harold Heinkel of the Alaska Department of Fish and Game, Fisheries Resource Enhancement Division; and Mike Ostasz of the Alaska Department of Environmental Conservation, Department of Seafood and Animal Industries.

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FOREWORD

This volume is somewhat eclectic, being in part a collection of papers from a meeting and in part supplemental information on oyster growing that makes it into a manual.

Major sections are listed in the table of contents and indicated by a centered upper-case heading in the text. Reference and contact sections following some sections are places to go for additional information. Those sections with authors are from formal papers.

The bulk of this manual is in the appendices. These are listed in the table of contents and clearly labeled by subject. Forms for government-required permits, PSP data for Alaskan waters, and the complete text of the National Shellfish Sanitation Program are among the documents gathered in these sections for one stop references to many common questions about oyster culturing in Alaska.

INTRODUCTION

Southeast Alaska has only one native oyster, Ostrea lurida, also called the Olympic oyster. It is usually 2 to 3 in. long, and although its numbers are significant in Southeast, it is seldom found in dense populations. Because of its apparent slow growth rate, it is unsuitable for commercial culturing in Alaska.

The Japanese oyster, Crassostrea gigas, was introduced to Southeast in the early 1900s near Ketchikan. Using traditional bottom-culturing, this oyster required three years to reach market size. Mortality was about 60 percent (Yancey 1966)[1]. From 1938 to 1960, between 110 and 227 acres were leased for oyster production in Southeast. In 1955, the North Gem Oyster Company conducted a pilot experiment in raft culture, producing 6.5 in. long oysters in two years.

Alaska's small-scale oyster farms have been sporadically developed, usually by inexperienced aquaculturists in under-capitalized firms (Yancey 1966). Today's Alaskan oyster farmer is often a fisherman or trapper: someone with other sources of income, but who wants to diversify and help develop a new resource. At this time, there are seventeen leases for oyster farms in Alaska (Ballentine, personal communication). Several of these have oysters in the water and three have started limited marketing in compliance with all state permits.

Current markets for Alaskan oysters are underdeveloped. It is likely that local market demand will absorb most or all of the initial supply. Resourceful use of these local and intrastate markets could help ease cash flow problems to be expected while gaining interstate marketing certification. A small-scale local market would also cut transportation costs.

Developing interstate and international markets will be slow, but not unlikely. Investor interest in Alaska oyster farms has been low because there are productive farms in other U.S. states, in Canada, and elsewhere. Also, the return on investment in oyster farms is decidedly slow. However, many of the world's productive farms are severely threatened by water pollution and their production may fall. If this condition persists while Alaska's waters remain pristine, the U.S. demand for oysters will open markets for Alaskan product.

Oyster farming in Alaska has unique features, some positive and some negative for the farmer. On the positive side is a lack of territorial limitation. Alaskan farmers can spread out at the surface, where water temperature and food concentrations are best for oyster growing. In contrast available space is quite limited for Japanese culturers and must be intensively used.

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[1] Yancy, R.M. 1966. Review of oyster culture in Alaska, 1910-1961. In Proceedings of the National Shellfish Association, 61:20-23.

Alaska's colder water temperature is the factor causing most of the negative physical factors, but it also provides a few benefits. Colder temperatures mean the oysters grow more slowly, taking two to three years. But slower growing time also means higher quality meat. Oysters can't spawn in water at Alaskan temperatures, so spat must be imported. This means the additional headaches of permits and health inspections, not to mention mortality suffered in transportation. But it also means that Alaskan oysters are more consistently in marketable condition since they don't undergo the body energy depletion that is normal after spawning.

Another factor with mixed effect is where farms are located. Alaska's remote locations seem best suited for oyster farms, and that means considerable expense in setting up and protecting facilities. Sites are selected not only to meet the needs of initial operating plans, but also for their suitability for development. Water quality standards must be met and maintained or harvesting will be restricted by the Alaska Department of Environmental Conservation (DEC). This department plays a critical role in oyster farm development and should be contacted in the early stages of farm planning and site selection.

Finally, paralytic shellfish poisoning (PSP) is widespread in Alaska. It has been one of the major deterrents to development of the shellfish industry.

Because Alaska oyster farmers and leaseholders are quite individualistic, and because the editor knows most of them personally, this manual may rightfully be suspected of having a "cottage industry" bias. It is not intended to discourage larger company or investor interest. Alaska does have great potential for profitable ventures. Such investors would have the resources to go beyond this manual in examining equipment and techniques.

This manual is intended to acquaint interested people with oyster farming operations in Alaska and the steps involved in starting a farm here. Such information is valuable to both the small and large investor. Low-cost alternatives in facilities are often emphasized. Addresses for state permits, information, seed suppliers, equipment dealers and resource people are listed. Much has already been published on culture and other methods, so only brief overviews of these are included, with emphasis on supplying sources for reference. Paralytic shellfish poisoning is discussed extensively by two members of the state agency responsible for protecting the public from PSP.

Both large and small investors are encouraged to emphasize good business and management practices in the venture. The complexities of live produce development demand caution in selecting the site, culture techniques, and time management. Best wishes for a profitable venture are hereby extended.

BIOLOGY

The oyster commonly grown commercially in Alaska is the Japanese oyster Crassostrea gigas, a member of the Molluska phylum. This bivalve feeds by filtering food from the water. Floating plant cells (phytoplankton) make up most of its diet, but it may also eat suspended detritus. The sexes are separate in the Japanese oyster, but may change from year to year. This oyster cannot reproduce in Alaska's cold waters, so seed must be imported. See Appendix A for a list of seed suppliers.

The oyster's shell has two valves. The right valve is the upper and usually smaller valve. The lower is somewhat cupped and will grow along the contours of the substrate. A single adductor muscle is attached to each valve, about two-thirds of the distance from the umbos, or narrow ends of the valves.

Lying along the ventral, or bottom, side of the body are four long, finely ridged, beige-colored appendages. These are for respiration and food collecting. The stomach contains a clear rod called the Crystalline Style. This is the reservoir of digestive enzymes and may not always be present, depending on the food supply.

Growth is extremely variable, in both rate and amount (Quayle and Smith 1976). In Alaskan waters, expect to wait two to four years for oysters of marketable size.

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Quayle, D.B. and D.W. Smith. 1976. Guide to oyster farming. Victoria, B.C.: Marine Resources Branch, Department of Recreation and Travel Industry.

PERIODICALS

British Columbia Shellfish Mariculture Newsletter
Marine Resources Branch
2569 Kenworth Rd.
Nanaimo, B.C.
V9T 4P7
CANADA
(604) 758-3951

ECONOMIC CONSIDERATIONS

This manual will not attempt to deal with all the economic considerations required to plan a successful oyster farm. Prospective farmers unfamiliar with designing profitable business operations should familiarize themselves with bookkeeping methods and profit analysis. Three sources for information on developing a good financial analysis method for your business are Bissel (1970), Smith (1975), and Wiese (1982). The Alaska Department of Commerce and Economic Development, Office of Commercial Fisheries Development may be contacted for a listing of state agencies and programs that encourage small businesses.

FACTORS AFFECTING COSTS AND RISKS

Oyster farming is a long term investment. The first crops will not be salable for two to four years. Currently, Alaska operations range from a $1,000 investment holding 10,000 oysters and transporting by canoe, to a $30,000 investment with $12,000 in annual expenditures and no hope of significant income until export permits are secured.

Alaska's oyster farmers will face higher than average costs for operation, maintenance and construction because most prime oyster sites are in remote locations. Remote facilities require protection from vandalism and pollution, and a constant caretaker. Further, sites must be leased and lease renewal is not guaranteed.

Alaska's bouts with paralytic shellfish poisoning (PSP) are another factor that can significantly affect profits. Oysters may not be salable as planned because of PSP episodes.

MARKETS

The farmer will be developing his own markets from the very beginning. It is a good idea to plan on selling the first crops in-state. This avoids the higher transportation and promotion costs associated with outside sales competition.

Alaska's oysters bound for the half-shell trade now bring about between $.50 and $.70 each. New farmers can look for other markets and other product forms. More traditional products include oysters in the shell for the half-shell market and shelled oysters hermetically sealed in various consumer packages. The market size of Pacific oysters is determined by the number of shucked oysters required to make a gallon, varying between 100 and 150, depending on the particular market supplied.

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Wiese, C.S. 1982. Financial statements and business calculations for commercial fishermen: A do-it-yourself guide. Marine Advisory Bulletin #14. Fairbanks: University of Alaska Sea Grant College Program.

PERMITS

Oyster operations must be certified and receive permits from at least five government agencies. These permits cover land and water use, use of public waterways, product quality assurance, environmental protection and a protection of existing native shellfish from disease. Stops on the permit "trail" for prospective farmers are listed next.

1. ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

- Shellfish grower's permit
- Certificate of reasonable assurance for the Clean Water Act
- Certification of site culture waters
- Interstate shipping list

Before marketing, all oysters must have certification from the DEC. Violators of the shellfish grower's permit are subject to confiscation of goods and criminal prosecution.

2. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS

- Permit assuring that you are not obstructing navigable waterways.

Permit fee is payable to FAO, ASACE, Alaska district. Violators of the Corps of Engineers permit are subject to criminal and/or civil court action, fines of $50 to $50,000 per day, imprisonment for up to two years, and liability for removal of structures and materials.

3. ALASKA DEPARTMENT OF FISH AND GAME

- Fish transportation permit (Title 16, 5AAC 41.005-41.100)
- Permit for mechanical harvester, if present;

> "Oysters are the only shellfish which may be imported into the state and there are restrictions on where they may originate. The place of origin is restricted because there are catastrophic diseases of oysters endemic to many places and detecting these diseases prior to importation would probably not always be successful. Once established in Alaska, they would probably be impossible to eliminate. Thus imports may come from only those areas which appear to be free of these diseases. We know fairly little about the diseases other shellfish may be carrying and therefore we are unwilling to put our native shellfish in jeopardy by exposing them to some unidentified exotic disease."
>
> Dr. Joseph R. Sullivan, Ph.D.; Alaska Department of Fish and Game, F.R.E.D., Fish Pathology Section; 333 Raspberry Rd.,; Anchorage, AK 99502.

4. ALASKA DEPARTMENT OF NATURAL RESOURCES, DIVISION OF LAND AND WATER MANAGEMENT

- Tideland use application and permit
- Log salvage permit (if in this jurisdiction)

5. U.S. FOREST SERVICE (OR OTHER UPLAND OWNER)

- Permission to construct caretaker's cabin or other structure
- Log salvage permit (if in this jurisdiction)

USFS homesite permits are for one-quarter acre, secured with a $150 annua fee, and renewed every five years.

ADDRESSES

Alaska Dept. of Environmental Conservation
P.O. Box 2420
9000 Glacier Highway
Jordan Center
Juneau, Alaska 99801
or:
Alaska Dept. of Environmental Conservation
State Office Bldg.
415 Main St.
Ketchikan, Alaska 99901
(907) 225-6200

Dept. of Army, Alaska District
Corps of Engineers, Regulatory Functions Branch
Permit Processing Section
NPACO-FR(c)
Anchorage, Alaska 99506

Pathologist
Alaska Dept. of Fish and Game
333 Raspberry Road
Anchorage, Alaska 99502
(907) 344-0541

Dept. of Natural Resources, Div. of Land and Water Management
Southeast District Office
230 South Franklin
Room 407
Juneau, Alaska 99801
(907) 465-3400

Dave Riemer
U.S. Forest Service
Box 1328
Petersburg, Alaska 99833
(907) 772-3841

The following agencies review the applications: U.S. Environmental Protection Agency; U.S. Dept. of Commerce, NOAA, NMFS; Alaska Coastal Management Program through the Division of Governmental Coordination (DGC), Office of Management and Budget, Office of the Governor; Alaska Dept. of Fish and Game; U.S. Dept. of Agriculture; U.S. Dept. of Commerce; U.S. Dept. of the Interior; Alaska Dept. of Transportation; Legislative Representative for the area; Alaska Dept. of Commerce and Economic Development, Office of Management and Budget; Alaska Dept. of Community and Regional Affairs; Alaska Office of Policy and Development Planning. Concerns are: cultural resources, endangered species, flood plain management, and clean water.

See Appendix B for copies of some of the permit application forms.

GUIDELINES TO TIDELAND PERMITS

by
Bob Palmer
Dept. of Natural Resources
230 S. Franklin St., Room 407
Juneau, Alaska 99801

A "permit" is an authorization for temporary use of state tidelands. No right or interest in the land is conveyed; only a guarantee that as long as the use follows the terms of the permit, the user is immune from prosecution for trespass. It does not automatically waive adherence to other state laws regarding trespass, waste, pollution, etc. Any threat to public safety or welfare is not allowable. Other permits or authorizations that may be necessary must be obtained.

A permit may not exceed one year in length. A permit may not be renewed but may be re-issued. Permits are not transferable. The activity should preferably be of short duration and involve a minimum of expenditure on the part of the applicant. A permit may be revoked with 30 days notice by the state, with or without cause. A permit from the Army Corps of Engineers is also required.

Permanent structures are prohibited on a permit. Any structure placed on a permit area must be readily removable. The applicant must be aware that he gains no right nor title to a structure placed on a permit area.

There are two basic types of tideland permits: exclusive and non-exclusive.

An exclusive permit carries a fee of $50.00 per acre or a minimum of $100 per year. Payment of this fee gives the permittee the right of exclusive use of the area and he may prohibit or prevent access and use by the general public.

A non-exclusive permit carries no use fee; however, it does not guarantee private use of any constructed facility. The permittee would have no legal right to prevent access or use by the general public.

A person owning shoreline property may place a mooring buoy, dock or float for recreational, non-commercial use adjacent to their property under "generally permitted activities". If this is done by the upland owner, a permit is not required and no application need be made. However, any construction under this category would be considered non-exclusive in use and the upland owner could not prevent the general public from utilizing the dock or buoy or float.

If a person desired to place a float or buoy in an area of shoreline property which he or she doesn't own, a permit is required. This permit may be exclusive or non-exclusive as he requests.

ALL commercial activities require application and a permit.

A description of the permit area desired will be required. This should show township, range, section, and a sketch of the requested area and planned development.

Upon expiration of the permit, all improvements must be removed and clean up of the site is required.

A $20 filing fee and a development plan must accompany the application.

SHORT-TERM LEASE. This lease provides for short-term (five years or less) use of a site with permanent improvements to be constructed. This would include fill and any structure held in place or supported by pilings or dolphins.

At the discretion of the Department of Natural Resources (DNR), a short-term lease permit may be used to provide time for a field survey to be completed in preparation of a long-term lease application.

At the discretion of the Department of Natural Resources, a permit for a maximum of one year may be issued to the applicant after the lease application has been made, an approved paper plat and the required notification and comment period have been completed. Permit fees will be effective and assessed on the area during this period. For example $50 per acre or a minimum of $100 per year.

Allow a minimum of one year processing time: A paper plat meeting the requirements for Alaska Tideline Survey (ATS) plats with 1:5,000 closure accuracy is required. Disposal method can be by negotiated lease; otherwise, requires public auction following an appraisal (with a development plan required).

A DNR annual rental will be assessed based on an appraisal at fair market value. The fee is a percentage of this value. Appraisal is done by a staff appraiser or a contract appraiser.

Upon cancellation or closure of the lease, clean-up of the site and removal of all improvements are required. Certain permanent improvements may be left in place at the discretion of the Division of Forest, Land and Water Management after obtaining written permission from the director of that Division.

LONG-TERM LEASE. Use of a tideland site for longer than five years constitutes a long-term lease. Maximum term of the lease is 55 years. However, a permit will not generally be issued for a period exceeding applicants anticipated use of the site, or the duration of any upland lease, permit or operation.

The permit may be issued for periods less than anticipated by the applicant. This will be decided on a discretionary basis when responsible management requires review at an earlier date or dictates shorter-term use is preferred.

On a discretionary basis, a permit for a maximum of one year may be issued for early entry after the lease application, approved paper plat, and required notification and comment period have been completed. Permit fees will be effective during this period of "early entry" at the rate of $50 per acre or a minimum of $100 per year.

Allow a minimum of one year for lease issuance. A field survey with documentation and a plat (mylar and five blackline prints) meeting requirements for Alaska Tideland Survey (ATS) with 1:5,000 closure accuracy is required.

Public auction with a development plan and construction schedule is required to qualify as a bidder upon disposal.

Annual rental will be based on a percentage of an appraisal done at fair market value by a staff appraiser of the Division of Forest, Land and Water Management. A contract appraiser may be used with prior approval.

Upon cancellation of the lease or closure, clean-up of the site and removal of the improvements are required. Certain permanent improvements may be left in place at the discretion of the Division of the Forest, Land and Water Management upon containing written permission from the director of that division.

application checklist

General

- ☐ Submit one original or good quality reproducible set of all drawings on 8" x 10-½" tracing cloth, tracing film or paper. Submit the fewest number of sheets necessary to adequately show the proposed activity. Drawings should be prepared in accordance with the general format of the samples. Block style lettering should be used.
- ☐ A 1-inch margin should be left at the top edge of each sheet for purposes of reproduction and binding. A ½-inch margin is required on the three other edges.
- ☐ Title block of each sheet submitted should identify the proposed activity and contain the name of the body of water; river mile, if applicable; name of county and state; name of applicant or agent; number of the sheet and total number of sheets in set; and date the drawing was prepared.
- ☐ Drawings should not reflect the approval, non-objection, or action of other agencies.
- ☐ Since drawings must be reproduced photographically, color shading cannot be used. Drawings must show work as a dot shading, hatching, or similar graphic symbols.

Vicinity Map. Identify the map or chart from which the vicinity map was taken and show the following:

- ☐ Location of the activity site including latitude and longitude and river mile, if known.
- ☐ Name of waterway.
- ☐ All applicable political (county, borough, town, city, etc.) boundary lines.
- ☐ Name of and distance to local town, community, or other identifying location.
- ☐ Names of all roads in the vicinity of the site.
- ☐ Graphic scale.
- ☐ North arrow.

Plan View. The plan view of the proposed activity should show the following:

- ☐ Existing shorelines.
- ☐ Ebb and flood in tidal waters and direction of flow in rivers.
- ☐ North arrow.
- ☐ Graphic or numerical scale.
- ☐ Mean high and low water lines if the proposed activity is located in tidal areas on the Atlantic and Gulf coasts.
- ☐ Mean higher high water and mean lower low water lines if the proposed activity is located in tidal areas on the Pacific coast.
- ☐ Ordinary high water line and ordinary low water line if the proposed activity is on a lake or ordinary high water if on a stream.

- ☐ Water depths around the project.
- ☐ Principal dimensions of the structure or work and extent of encroachment beyond the applicable high water line.
- ☐ Waterward dimension from an existing permanent fixed structure or object.
- ☐ Distances to nearby federal projects, if applicable.
- ☐ Number of cubic yards, type of material, method of handling, and location of fill or spoil disposal area if applicable. If spoil material is to be placed in approved dumping grounds, a separate map showing the location of the dumping grounds should be attached. The drawing must indicate proposed retention levees, weirs, and/or other devices for retaining hydraulically placed materials.
- ☐ Distance between proposed activity and navigation channel, where applicable.
- ☐ Federal harbor lines, if established and if known.
- ☐ Location of structures, if any, in navigable waters immediately adjacent to the proposed activity, including permit numbers, if known. Identify purpose of all structures.
- ☐ Location of any wetlands, swamps, marshes, etc. Identify.

Elevation and/or Section View. The elevation and/or section view of the proposed project should show the following:

- ☐ Same water elevations as in the plan view.
- ☐ Depth at waterward face of proposed work, or if dredging is proposed, show dredging grade.
- ☐ Dimensions from applicable high water line for proposed fill, float, or pile supported platform. Identify any structures to be erected thereon.
- ☐ Graphic or numerical scale.
- ☐ Cross-section of excavation or fill, including approximate side slopes.
- ☐ Elevation of spoil areas.

Notes on Drawings

- ☐ List names of adjacent property owners whose property also adjoins the water and are not shown on plan view.
- ☐ State purpose (private use, commercial, etc.) of proposed activity.
- ☐ State datum used in plan and elevation views. Use mean low water, mean lower low water, National Ocean Survey Datum or National Geodetic Vertical Datum of 1929.

FACTORS TO CONSIDER IN SITE SELECTION
(after Quayle 1971)

WATER QUALITY

- Temperatures greater than 9°C (48°F) are usually cited as necessary for rapid growth. In most Southeast Alaska coves, winter temperatures will descend to 4°C (39°F) or lower and oysters have been found to feed at temperatures of only 4.5°C.
- Salinity greater than 15 ppt (full strength sea water is approximately 35 ppt)
- Adequate food supply (See research chapter.)
- Freedom from excessive fouling by debris and marine life, and silt.
- Area should be traditionally free from paralytic shellfish poisoning (best determined by samples).
- Freedom from sewage and industrial pollution (State land disposal plans and USFS plans may be consulted for conflicts.)

PSP history and pollution are the prime criteria for site selection by the Alaska Department of Environmental Conservation.

PHYSICAL FACTORS

- Protection from wave action
- Sufficient water depth (Suspended oysters must not touch bottom.)
- Proximity to a small staging area for temporarily holding oysters and constructing rafts
- Freedom from ice
- Freshwater stream nearby (valuable for human needs and anti-fouling treatment but must not decrease salinity too much)

OTHER REQUIREMENTS

- Compliance with Navigable Waters Act
- Proximity to markets
- Ease of surveillance

Site selection is obviously one of the most critical steps in the oyster business. Proceed with caution and investigate all possibilities thoroughly. Start small and set sample gear in several locations if possible. Sites within the same bay can have critical differences. In other sections of the manual, the importance of these factors will be emphasized.

A number of state agencies can assist aquaculturists looking for potential lease sites. At minimum, prospective oyster farmers can get confidential and strategic assistance from appropriate representatives of the Alaska Department of Fish and Game, the Alaska Department of Environmental Conservation, the Alaska Department of Natural Resources, and the University of Alaska Marine Advisory Program.

OYSTER CULTURING METHODS

Much of the material for the culturing and fouling sections was written by Mr. John Church of Clearwater Seafoods in Wrangell, Alaska. In his own operation, Church began with submerged Nestier trays (the use of trade names in this publication does not in any way constitute an endorsement). He is now adding surface trays to enhance circulation and growth, since Nestier trays have very small openings. Suppliers for various equipment mentioned are listed in Appendix C.

SUBMERGED TRAYS OR NETS SUSPENDED FROM FLOATS (after Humphries 1978)

This method is somewhat new. There are many designs, each using different arrays of stacking systems so that oysters can be at various levels in the water column in the same array. Prospective systems should be evaluated with regard to the ease of water circulation, cleaning, and access. Oysters should not touch each other or the corners. This will cause them to clump together or become misshapen.

VERTICAL LONGLINE SUSPENDED FROM FLOTATION DEVICES (after Biggs 1981)

In this method, oyster spat is attached to bits of shell. The shells are then inserted in the longline or wired to it. Polypropylene (3/16 in., 3-strand) is recommended for inserting in the shell holding the oyster spat. Oysters on the line have different growing conditions and thus different growth rates. Because of this, the line will have to be handled many times, since the oysters will not all be harvestable on the same date. If the line touches the bottom, starfish predation will become a problem.

An operation at Annette Island in southeastern Alaska is a good example of this method. A 24 ft square raft with 209 wires was built. Each wire held seven shells with seed and spacers. The strings were 5 to 6 ft long and held 5,900 oysters. Estimating a production of 200 oysters per gal., this raft would produce about 30 gal. of shucked meat (Biggs 1981). Quayle (1971) cites 25 rafts per acre, covering 25 percent of the area. With 100 shell strings, each with 15 shells, production would be 2,400 gal. (about 20,000 lbs of meat.)

HORIZONTAL LONGLINES USING SURFACE FLOATS OR POSTS DRIVEN INTO THE BOTTOM (Quayle 1971)

This is similar to the vertical method described above as far as inserting the clutch into the longline. Horizontal placement takes advantage of the preferred growing conditions nearer to the water's surface. Oysters are placed in a more uniform way and therefore mature at about the same time, thus reducing the amount of longline handling during maturation caused when harvest times vary.

SURFACE TRAYS

Surface trays involve some type of suspension, usually mesh or netting, attached to floats. The mesh size should be just small enough to hold the

oyster, assuring maximum water circulation. As the oyster grows, mesh sizes will have to increase so that good water circulation continues.

Oysters should be placed 6 to 12 in. from the surface of the water. Trays usually need some type of cover to protect them from predators. Mesh, plywood, even moderate amounts of seaweed have proven effective covers. Covers should not restrict water circulation.

Alaskan growers are having excellent results with trays, which take advantage of the higher water temperature and food availability at the surface. Detailed production figures are not available, but area may be calculated on the basis of 3 to 5 in. oysters, stacked one deep without touching one another.

DIRECT PLACEMENT ON THE BOTTOM
(after Quayle and Smith 1976)

Oysters held below the tideline are extremely susceptible to predation and are difficult to harvest, so this method is rarely used.

The traditional method on both U.S. coasts and in British Columbia is beach culturing. Oysters are held on the beach at the +3 to +5 range. Siltation and starfish predation are problems in this operation. Also, less food is available than in other methods. In 1980, the average oyster production per acre of bottom culture in B.C. was 27 gal. per acre. The most efficient grower produced 160 gal. per acre per year (Anonymous 1981). In Alaska, most of the shoreline is too rocky and steep for beach culturing.

Raft culture, however, is becoming more prevalent in B.C. as the advantages of increased production are made evident.

Bissell (1970) lists the following advantages and disadvantages for raft culture when compared with beach culture:

Advantages

- Can be harvested in response to market demands, not as the tide dictates
- Large harvesting crews are not needed
- Does not require acreage directly on the waterfront
- Growth is quicker, predation is less
- Results in a higher quality product
- Not necessary to find suitable substrate

Disadvantages

- Larger capital outlay
- Holding operations still require tideland properties
- Extensive manual labor required to prepare, lay and maintain strings

Purchasing Oyster Seed

Seed oysters may be purchased either attached to pieces of material such as oyster shell (known as a clutch), or as separate small oysters. See the permit section for description of import permit.

Eyed larvae may be purchased for approximately $100 per 1,000,000. These larvae require water temperatures above 65°F for several weeks and must be nurtured through the setting process. Thus they are not very practical for the Alaskan oyster grower who does not have access to a setting tank. Seed oysters 2 mm in size sell for about $100 per 30,000 and high mortalities may be encountered. Spat 15 mm in size sell for $100 per 5,000. One-year-old clutchless spat sell for $50 per 1,000.

Transporting oysters from the hatchery to the farm can result in high or total mortalities if delays occur. The spat should be kept on ice and warmed gradually to the ambient or working temperature. Loose oysters may be suspended in trays with fine mesh window screen or 1/8 in. Vexar. Fiberglass mosquito netting has also been used for tray construction.

It is best to start the oysters in spring and summer to take advantage of the plentiful planktonic food supply occurring during these seasons. The mesh will need to be cleaned frequently because fine material clogs readily with debris and growth. The oysters should be thinned twice a year but frequent handling must be avoided in order to avoid damage to the thin growing edge of the shell.

The trays should be suspended below wave action. After a summer of growth, the immature oysters may be poured through a screen in order to separate sizes. The mesh size of the grow-out trays may then be increased to promote better circulation and growth.

Oysters purchased attached to clutch may be cultured using one of the aforementioned longline methods.

Necessary Equipment
(a general list of some of the more significant items)

- **Boats:** Should be seaworthy, workable around beaches, and have a tow bitt. Small boats such as punts may be useful for attending and cleaning the oysters.
- **Floats:** Logs are often used as floats and in raft construction. They have a short useful life (two to five seasons) but if they are periodically allowed to freeze and dry high on a beach, their lifespan can be greatly extended. If they can be obtained by beach salvage, they are also inexpensive (see permits). A variety of plastic floats are sold commercially and addresses for some suppliers are listed at the end of the fouling chapter. When purchasing plastic floats, pay attention to appendages or longline attachment. Foam logs with a great deal of flotation, are also available. Durability is an important factor. Logs that chip can pollute the water. Ferro-cement floats are also available and are long-lasting.
- **Tools:** Chainsaw, mallet, log branding hammer, peavey, pike pole, froe, wire brushes, scrapers, bristle brushes, flat coal shovel, staple gun with bronze staples, hoist, netting needle, thermometer, scales.
- **Anchors:** Anchor chain and line, shackles, log staples, chain, thimbles, swivels, smaller lines and twine needed in large amounts.

Tray and Raft Construction and Dimensions

It is not necessary to purchase commercial trays or floats. Home-built models are very effective. Make your trays simple and easy to maintain. Good water circulation through the trays is essential. Avoid designs with excessive cross bracing that will make it difficult to remove fouling organisms. Trays should not be too wide (approximately 3 ft) or it will be difficult to attend to the oysters in the middle. The trays will need covers to keep out birds, poachers, and, at some sites, bears.

Logs used as floats in quiet water should be at least 4 to 6 inches in diameter. A corral of boomsticks surrounding the raft and tray arrays will quiet wave action and discourage poachers. The raft design might include a hoist to lift trays or lines out of the water. The farmer might choose to have a moveable hoist on a separate float or his boat that can go from raft to raft.

Homemade surface trays have provided very encouraging results for Alaskan growers at a very low cost. The line method has also produced good growth. The farmer is advised not to invest substantial time or money in any particular design or gear until a variety of methods have been tested at the farm. Do not become over-extended until you see what works. Remember that growth decreases with increased depth of holding, or increased exposure to air or fouling.

During the growing season the farmer needs to check the surface trays at least once a week to remove the accumulated algae and debris against the sides of the tray. Lines should be checked periodically to make sure no predators have become attached. Periodic thinning of the trays promotes fast, even growth. Fastenings and knots should always be watched because they may start to work loose or chafe through.

Living at the farm keeps the daily work load down and insures that developing problems will be caught in time to prevent damage. It also prevents poaching, which can be a tremendous financial problem in remote, unattended farms. Poaching has been the downfall of several farms in the past. Storm damage is another threat to farm security. Rafts must be securely fastened with heavy anchors. A two-log raft 60 ft long should have a 130 lb anchor (1 cubic foot of concrete) attached at both ends of the raft in order to prevent twisting and fouling of lines. Predation by birds and other animals also needs to be watched. Starfish larvae may become caught in trays and grow too large to get out, feeding on your oysters as they grow.

Oyster Diseases and Causes of Mortality

The oyster drill is a snail which cuts through the oyster shell and eats the meat. Three species have been found in British Columbia; one native, one introduced with eastern oysters, and one introduced with Japanese oysters.

The drill native to British Columbia is posing more of a problem to clam and mussel growers. Drills have not as yet been reported to be a problem in Alaska. However, eastern drills have been found at Prince of Wales Island. Importation of disease-free, certified spat should control the pest. Use of suspended culture methods is also a deterrent (Clayton 1981).

High mortality has been found during the summer months in Japan and Washington. No cause has been proven but these outbreaks may be due to the weakened state of the oyster after spawning (Perdue 1979). If so, the problem is not likely to occur in Alaska! Note that the Alaska Department of Fish and Game; Department of Pathology, has offered to examine any diseased oysters.

Denman disease is identified by deep pustules on the surface of the body and mantle or by pus-filled blood vessels. The digestive gland becomes beige. A fungus has been suggested as the cause of this disease. Denman disease has been reported in British Columbia but has only rarely caused serious mortalities. The disease is not harmful to humans. Older oysters are most affected. Outbreaks are seasonal, in the spring (Quayle 1982).

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PROSPECTS FOR OYSTER CULTURE IN NORTHERN ALASKA

Environmental conditions north of the Alaska panhandle are quite extreme for oyster culturing. As yet, no permits have been submitted for northern sites. Oyster plantings in several areas have been attempted but were not successful. Colder water temperatures and the possibility of freeze-up pose problems at many otherwise suitable sites. Glacial siltation is another problem. Oysters apparently cannot discriminate between food and nonfood particles and they would not be able to feed adequately.

A planting of the Olympia oyster (Ostrea lurida) was recently attempted in Prince William Sound but failed. The general conclusion is that the commercial oyster culturing north of Yakutat might not be possible. (A.J. Paul, Seward Marine Station, Seward, Alaska, 12/19/83, pers. comm.). Those seeking alternate species might consider culturing weathervane and rock scallops.

FOULING

by John Church
P.O. Box 1528
Wrangell, Alaska 99929

Any surface left in the ocean will soon become encrusted with life. Farmed oysters are no exception. This encrustation, or "fouling", ranges from algae scum deposited on trays to flatworms that eat oyster flesh or starfish that can destroy entire trays of your investment.

LIKELY CAUSES OF FOULING

Unchecked fouling leads to reduced growth, inferior shell quality, and even oyster mortality. Fouling will become worse as water quality in an area deteriorates. Preventative actions should be timed with the life cycle of the fouling organisms. In Japan the following setting times have been observed (Arakawa 1980):

sea squirt:	June to October
barnacles:	June to mid-September
mussels:	June to July
fanworm:	mid-September

Of course, these are studies from other regions and timing and setting behavior may be different in Alaska. The farmer must observe the situation at the farm to establish the local cycle.

Mussels and barnacles tend to set more heavily in the upper 10 ft (3 m) of the water. Fanworms prefer 10 to 20 ft (3 to 6 m). Sea squirts are even deeper, from 150 to 30 ft (5 to 10 m). Fanworms can be a pollution indicator for inner bays (Arakawa 1980). In the Strait of Georgia, B.C., the barnacle set has been found to be 10 days before to 10 days after April 1 (Quayle 1971).

Thus, effective fouling control might take the form of a two-phase program occurring in mid-June and mid-October.

Algae is particularly prevalent near the surface for the same reason you want your oysters there--more sunlight and food. Large red, brown, and green seaweeds will attach in the fall and winter and have their best growth in the spring.

Simple animal forms like corals, bryozoans, and hydroids will also appear along with small, hard calcium tubes containing sipunculid worms. Ribbon worms, polychaete worms, flatworms, neried worms, and echiuroid worms may settle when trays are left unattended for too long.

Occasionally, a sea anemone is found, but a more common problem is tunicates. These non-mobile animals have a soft, often clear body with two holes through which water is continually strained for plankton. If these tunicates fill the spaces between oysters, water circulation can be severely restricted.

Without actually being attached to the oysters, many animals may live among them.

Crabs, shrimps, isopods, amphipods, snails, limpets, chitons, nudibranches, sea urchins, sea cucumbers, starfish, and small fish have all been found in Alaskan oyster trays. Entering the trays as larvae, these organisms can grow too large to get out through the mesh. Generally this type of fouling is at worst harmless and sometimes even beneficial to the oysters. However, flatworms have been found to eat oyster flesh. Snails, crabs, and sea urchins will eat small oysters. The starfish is considered the worst predator. In one incident starfish trapped in a stack of trays ate 300 oysters.

PREVENTION AND CONTROL

Preventing fouling is one of the keys to successful oyster farming. If fouling organisms have to be removed manually throughout oyster growth, the labor cost can be higher than the value of the final product. For this reason equipment should be selected carefully for easy cleaning and access. See Appendix C for equipment suppliers.

There are several ways to reduce fouling. By putting trays in an area with tidal action, larvae that settle best in still water are discouraged. There may be areas in the bay where fouling organisms are less prevalent, so a farmer should experiment with several locations at a new site before settling on a place for the trays or lines.

Deep suspension of oysters discourages seaweed attachment. It also deters barnacles and mussels entering during their normal spring setting. This is a temporary measure and not an option for a grower using fixed surface trays.

One way to remove fouling is exposure to air. Oysters are by nature an intertidal species, able to handle being out of the water easily. Most fouling organisms are not as resistent. Allowing a surface raft to "dry out" on a sunny, windy day is best for killing fouling organisms.

Empty oyster trays and other gear can be cleaned without scrubbing by the following method. Remove them completely from the water for a week or more. Then place the equipment on the beach at about the half tide level. Each time the gear gets covered with water the dead fouling organisms will be eaten off by animals such as zooplanktons, shrimps and hermit crabs.

Encouraging results have been achieved on some local farms allowing available predatory species to feed on the fouling. Small herbivores such as snails, sea cucumbers and limpets will eat algae as it grows on floats, logs and mesh. Small sea urchins (less than 1 inch in diameter) will devour most types of fouling as will small to medium-sized crabs (less than 4 inches across the back). They also move the oysters about as they work, preventing clumping. Urchins and crabs sometimes appear on their own in the trays but can also be imported from nearby beaches. Be sure to remove them before they get big enough to eat the maturing oysters. This type of "biological control" shows great promise and should be emphasized in anti-fouling planning.

There are other methods not yet tried in Alaska. Exposure to freezing air temperatures in winter should kill most fouling organisms. Another effective method involves dipping trays into 60°C water for two minutes. Dipping into freshwater or brine is also effective. A mesh of copper-nickel alloy has been found to prevent biofouling (see Woods Hole Engr. Assc. at chapter end).

Biological control is a good fouling control strategy but it is sometimes difficult to find the right predator. Fouling organisms such as sponges do have specific predators among local fish, mollusk and arthropod species. Finding the species that will live in trays and not eat oysters will demand extensive research. Many Alaskan invertebrate species have not been studied to establish such things as reproductive timing or predator species.

No method will control all types of fouling. For some types, manual scrubbing will be the only answer, particularly before the oysters are sold. For small operations, a combination wire brush/scraper can be used. Larger farms may wish to invest in a washer that sprays a jet of high pressure water through a nozzle. Different sprayer aperatures are necessary to clean the live oysters and the empty trays. If used incorrectly, the gas-powered washers can wash the meat right out of the shell. Machines with rotating brushes have also been developed.

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CONTACTS

John Huguerin (anti-fouling mesh)
Woods Hole Engineering Associates
P.O. Box 133
Woods Hole, MA 02543
(617) 548-9668

Syndel Laboratories, Ltd. (manufacturers of
8879 Selkirk St. environmentally safe
Vancouver, British Columbia V6P 4S6 anti-fouling agent)
(604) 266-7131

ENVIRONMENTAL SANITATION AND SHELLFISH POISONING

by Kit Ballentine and Michael Ostasz
Alaska Department of Environmental Conservation
Pouch O
Juneau, Alaska 99801

The pristine waters of southeast Alaska are considered to be isolated from industrial and domestic waste discharges. Consequently they provide a myriad of potential growing sites free from the developmental constraints common to many other areas. Alaskan waters, however, are periodically subjected to natural dinoflagellate plankton blooms that may result in the concentration of toxins or poison within the body tissues of bivalve shellfish (clams, oysters, mussels). Human consumption of bivalve shellfish containing significant levels of toxin may result in paralytic shellfish poisoning (PSP), which, if severe enough, can be lethal.

The earliest recorded PSP episode in Alaska dates back to 1748, when four of Captain George Vancouver's men consumed mussels, resulting in three intoxications and one death. Shortly thereafter, Baranof lost nearly 100 crewman after they ate a meal of mussels harvested in the Peril Straights near Sitka. To this time, PSP intoxication continues to occur sporadically throughout southeastern Alaska.

The inability to predict blooms and the potency of the neurotoxins involved dictate that stringent measures be observed to assure that only bivalve shellfish with acceptable toxin levels are marketed. The neurotoxins (poisons directly affecting the nervous system) associated with PSP are metabolic byproducts of the marine dinoflagellates Gonyaulax catanella and Gonyaulax acatanella, that will periodically inhabit the surface layer of marine waters. Under adverse environmental conditions the organisms may change form and become dormant cysts which settle to the bottom sediments. There, the cysts will await more favorable growth conditions. PSP toxin production does not result from industrial or domestic sewage discharge into marine waters.

Recent research indicates that at least twelve unique forms of the PSP toxin exist. One of the more widely known toxin forms is saxitoxin, the principal toxin element associated with butter clams. Purified saxitoxin is 1,000 times more potent than cyanide and 50 times more potent than strychnine. The toxicity of this neurotoxin has long been recognized by the military and has been considered for use in biological warfare weapons and suicide vials.

The presence of PSP toxins cannot be detected by any simple method because the toxins do not alter the appearance, smell, or taste of contaminated shellfish. The toxin is not significantly affected by heat, so steaming, cooking or frying shellfish will slightly reduce but not destroy the toxins present. Freezing has no effect on toxin levels.

PSP toxins create neurological and muscular symptoms by blocking sodium permeability of nerve and muscle cell membranes thus suppressing electrical activity necessary for cells (and the body) to operate. Human illness is characterized by mild to severe symptoms occurring within a few minutes to several hours after eating toxic shellfish. Most commonly, nausea, vomiting, and numbness and tingling around the lips and tongue will develop. Numbness and tingling may progress to hands and feet. In severe cases, dryness

and tightness of the throat, generalized muscle weakness, slurred speech, lack of coordination, sense of euphoria, blurred vision, dizziness, and difficulty in breathing may develop. If sufficiently toxic shellfish have been eaten and medical treatment is not rendered, death results from respiratory failure. Victims who recover suffer no after-effects.

PSP toxin-producing dinoflagellates (a part of the plankton community) are not uniformly distributed in marine waters because of tides, currents, temperature, winds and chemical factors that tend to concentrate organisms in relatively restricted areas. Gonyaulax blooms (rapid multiplication of organisms) can cause concentrations to rise from 20,000 organisms/quart of seawater to 200,000 organisms/quart with no visible color change in the water. However, a significant rise in toxicity occurs. Environmental factors such as water temperature, salinity, sunlight, nutrient concentration, and stability of the water column stimulate growth, but the particular combination of factors resulting in a bloom is only poorly known. Consequently, all beaches are at risk and no simple test can determine the safety of a harvest area. Monitoring programs are essential to protect public health from the possible rapid proliferation of dinoflagellates and, in the process, to promote the development of the shellfish industry.

Research indicates a cycle may exist in which the upwelling of dinoflagellate cysts from bottom sediments may result in a bloom. The cycle theory is as follows: upwelling is caused by warm rains resulting in a warmer, less dense brackish water layer at the surface of protected coastal sea water. Subsequent winds drive these waters offshore, resulting in deep, cold and nutrient-rich water moving along the bottom shoreward, and rising to the surface. Wind and waves mix waters near the shore. If a warm dry period follows, stratification (layering) of the waters can produce a warm, nutrient-rich surface layer ideal for the multiplication of dinoflagellate cysts now present in this layer.

Although bivalve shellfish such as clams, oysters, geoducks, and cockles are not physically affected by Gonyaulax, toxins are stored within the shellfish tissues after the bivalve feeds on plankton. Explosive growth of the dinoflagellate results in increased toxin levels in shellfish. Rock scallops and snails have also been associated with PSP. Bivalves feed by filtering water through a siphon. Dinoflagellates, concentrated in mucus secreted over the gill network, enter the bivalve mouth and digestive tract, concentrating toxin in various body parts.

Areas of toxicity vary by species. The digestive processes of bivalves do not detoxify poisons. However the bivalve will eventually purge the toxin through normal elimination of waste. The actual time for this depuration varies with individual species.

The only recognized method for calculating toxin concentration in shellfish is the mouse bioassay. Shellfish to be tested are shucked, homogenized in a blender, acidified with hydrochloric acid and boiled for five minutes. A portion of the resulting liquid from the homogenized shellfish is injected interperitoneally into a mouse of specific weight and species. The animal is then observed.

A standard assay requires six mice. Since death time must be adjusted to fall within 5 to 7 minutes, several sets of tests may be required before proper dilution is established. Toxin levels are calculated based on death times. The established maximum acceptable toxin level is 80 micrograms/100 grams of meat. The stand contains a safety margin designed to protect the highest risk consumers: the very young and the very old.

Human response to PSP toxin varies considerably and seems to be affected by a number of factors. Among these are sex, tolerance to toxin, alcohol consumption, and how much other food was consumed along with the toxic shellfish. Because of this variety, one cannot assign a specific toxin concentration at which illness and death will occur for everyone. Therefore, the 80 mg standard is applied to protect the broadest range of consumers. Appendix D gives more detail on PSP testing.

Oyster farm development and sale of farmed oysters is regulated by the Alaska Fish Inspection Regulations. Article II of these regulations, dealing particularly with bivalve shellfish, adopts the National Shellfish Sanitation Program standard for sanitation, harvesting, handling, shucking, and shipping shellfish. Here are some highlights of these regulations which directly affect oyster farmers and shellstock shippers (see Appendix E for regulations and Appendix F for National Shellfish Sanitation Program). They must:

1. Adopt the National Shellfish Sanitation Program.

2. Acquire annual permits for processing, packing, re-packing, selling, selling or processing shellstock for sale.

3. Application requirements include description of growing site, plat plan showing structure and holding methods, explanation of marketing method including size of individual sales, and sample or facsimile of product label.

4. Must have sanitary and biological survey of growing site prior to site approval.

5. Written approval is required to re-lay oysters from one area to another. (Sale of re-laid oysters must be obtained in writing before marketing.)

6. Adhere to regulations on harvesting and handling of shellfish for sale including restrictions on harvest vessels, condition of shellstock and shellstock packaging.

7. Meet requirements for shellstock tag and recordkeeping.

Contact with other regulatory agencies such as the Corps of Engineers and Department of Natural Resources is also recommended.

Oyster farm development falls into two phases: site certification and development, and marketing.

Site certification involves field review of each proposed site by the Department of Environmental Conservation (DEC). This review identifies actual or potential sources of point discharge into growing waters, development of

adjacent properties or waters, check for biological factors such as heavy PSP contamination of local bivalve species, and site access.

The point discharge evaluation should detect places where sewage or other sources of disease-producing organisms can be ingested by shellfish. If these shellfish are then consumed raw, these diseases can be passed along.

Specific laboratory tests may also be conducted. These evaluate pollution by sewage, oil, heavy metals, and pesticides. Standard measurements of oceanographic factors such as pH, salinity, temperature, and water clarity will be made.

The growing waters are tested for total bacteria and for fecal coliform bacteria counts. Coliform bacteria are standard indicators of water pollution. The standards for growing waters are:

TOTAL BACTERIA: Median of 70 MPN/100 ml, not to exceed 230 MPN/100 ml in 10 percent samples, or

FECAL COLIFORM: Median of 14 MPN/100 ml, not to exceed 430 MPN in 10 percent samples

MPN = Most probable number

Fresh waters that enter the growing area are similarly tested for bacteria, pollution, and for other contaminants as deemed necessary by the DEC inspector.

Microbiological standardss exist for market products as well. Oysters may be obtained for microbiological analysis at the time of the field survey. Product microbiological standards are:

FECAL COLIFORM: 100 MPN/100 g of sample, and

TOTAL PLATE COUNT: 100,000 MPN/g of sample.

Shellfish exceeding either or both of these levels are unsuitable for human consumption.

Evaluation of the PSP history of the farm area is critical to site development. A PSP history is constructed through review of literature and files, as well as by sampling local shellfish. Documented high and recurrent PSP toxin levels in a specific area means there is a high probability of PSP contamination in oysters planted in this area. Likewise, a lack of documented PSP episodes could support selection of a site. However, a lack of authenticated PSP episodes does not assure that PSP will never infect oysters grown at the site. Therefore, periodic site testing of oysters for PSP and area-specific PSP level data bases or histories must be established for each growing area.

Dinoflagellate blooms can develop rapidly and are for the most part unpredictable. Product being held for market pending PSP test results must be stored in an approved facility. Location of the holding facility is also a part of the site review. A dry storage facility must protect oysters from contamination while waiting for test results. The holding facility must prevent oysters from contamination by a variety of sources, including salt water.

required. Preliminary data development testing results are provided in Table 1, 2 and 3 and Figure 1 of Appendix D.

Data development results support Canadian test results performed on tray and string cultured oysters. PSP monitoring in British Columbia led officials to state that continually submerged oysters, such as tray cultured or string oysters, tend to pick up toxin more rapidly than wild stock.

Efforts continue to obtain a sufficient PSP data base to support interstate shipment certification and possible alternative sales methods. The significant public health risk associated with paralytic shellfish poisoning and consumption of raw product require a cautious, conservative approach to rearing and marketing. Development and success of the industry depends upon producers' cooperation in programs to assure product quality and safety.

DEC CONTACTS

Michael Ostasz
Environmental Sanitation
ADEC, Seafood and Animal Industries
P.O. Box 10-4240
Anchorage, AK 99510
(907) 272-1561

Ken Elliott
Environmental Sanitarian
ADEC, Seafood and Animal Industries
P.O. Box 2420
Juneau, AK 99803
(907) 789-3151

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HARVESTING OYSTERS

by John Church
P.O. Box 1528
Wrangell, Alaska 99929

Oyster harvesting is labor-intensive. A farmer who normally works alone may want to gather a crew. They could be paid shares as on a commercial fishing boat to avoid some of the paperwork associated with employees. Oysters are graded by hand according to size and weight, although grading machines do exist. Fouled oysters may need some scrubbing at this time also. Different buyers will want different sizes, but the small "gourmet" oysters served in fine restaurants are the most likely product for the Alaskan grower. A major advantage of these small oysters is their relatively short growth time. Large "soup" oysters and shucked oysters in jars can be produced more cheaply in other states and in the Orient.

After grading, the oysters should be bagged (large wire or nylon mesh bags are good) and placed on a protected beach to "harden". Hardening is simply accustoming the oysters to being out of the water after spending most of their life submerged. As the bags are moved high up the beach they spend more time dry and the remaining fouling tends to disappear.

When kept completely out of the water, temperature is important in quality preservation. Oysters will remain alive 8 days at 11°C (52°F) but quality deteriorates after 5.5 days. Storage at 2 to 3°C (36°F) will maintain high quality for 13 days. At 0°C (32°F) oysters have remained alive for more than 17 days (Boyd, Wilson and Hall 1980).

When enough oysters have reached marketable size, the state Department of Environmental Conservation must be notified that a sale is near. After processing the sample oysters for toxin, they will release lot the for sale. (See Appendix D for further details.)

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Riley, J.G. and D.A. Smyth. 1979. Mechanization of cultivated European oyster processing. Maine Sea Grant Tech. Rep. #53. Paper 79-5037. Univ. of Maine, Orono. 20 pp.

SUPPLIERS

Domtar Packaging
Attn: Peter M. Cook
3300 Vikings Way
Richmond, British Columbia V6V 1N6
(604) 273-7321

King Plastics, Ltd.
849 Elm St.
Orange, CA 92668

SHUCKING OYSTERS

To remove the shell in order to eat the oyster raw, insert a knife and sever the adductor muscle so the shell will no longer be held shut. An oyster out of the water with its shell open is dead and should not be eaten because of the danger of bacteriological infection.

A right-handed person holds the oyster in a cloth in the left hand, with the flat side uppermost and the hinge towards the opener. A short-bladed oyster knife is inserted between the two halves of the shell, close to the hinge, and twisted to break the hinge and lever the oyster open. The knife is then used to sever the adductor muscle at its point of attachment to first the flat half of the shell and then the cupped half. The meat is then removed (Stroud 1980). Oysters grown in trays tend to have thin shells with lots of sharp fluted edges. To shuck these shells a sharp, thin knife is driven into the center of the upper valve an inch from the bill end, and the oyster opened from there (Quayle 1971).

All fresh oysters should be cooled to less than 7°C (45° F) within two hours after shucking. As in any operation involving food, cleanliness is important. Tables and utensils should be made of smooth, nonporous, and easy to clean materials. Do not use wood because it supports bacterial growth.

Shucked oysters are graded by size as follows:

GRADE	NUMBER PER GALLON (3.8 liters)
Extra Large or Counts	160 or fewer
Large or Extra Selects	161 to 210
Medium or Selects	211 to 300
Small or Standards	301 to 500
Very Small	Over 500

(Gisslen 1983)

According to FDA regulations the number of oysters per gallon, by size, are as follows for Pacific oysters:

SIZE	NUMBER PER GALLON
Large	64
Medium	64-96
Small	96-144
X-small	144-240
*Yearling	240-300
*Petite	300-400
*Cocktail	400-600

*Industry standards

Due to the high labor costs commonly encountered in Alaska, the oyster farmer will likely find that shucking oysters for commercial purposes is uneconomical, but will surely shuck or steam oysters open for personal consumption.

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RESEARCH

The prospective oyster farmer must have a basic understanding of the ecosystem in which the oysters will grow. It is important to predict the food supply available to the oyster, not to mention the measurement of other environmental parameters. Conditions that may lead to increases in PSP toxin levels should be observed, as well as fouling organisms. The better the farmer understands the farm environment, the better the crop will be.

Parameters that would normally be measured in a study of basic productivity of a bay are pH, oxygen, alkalinity, nitrate, nitrite, phosphorous, calcium, dissolved and total organic and inorganic carbon, and plankton levels. Some of these parameters are easy to measure in most bays, while others need specialized techniques and equipment that would not be practical for most oyster farmers.

This section suggests a simple research program that will provide some insight into environmental conditions while not requiring too much equipment. It is a standard program, so data will be compatible with other research programs underway in the state.

Parameters measured in this standard program would include: temperature, depth of light extinction, weather conditions, phytoplankton levels measured by settled volume, phytoplankton dry weight, and species identification. Temperature is one of the most important variables. It affects phytoplankton and oyster growth and often controls stability of the water column and timing of plankton blooms. The depth of light extinction gives an estimate of how much particulate matter is in the water and also provides an indication of the levels where phytoplankton will be found. Weather conditions, with particular regard to the local wind and wave climate, are valuable observations providing further indications of growing conditions and water stability.

METHODS FOR PLANKTON WATCH

Temperature measurements should be made at 0.5 m and 1 m, continuing in 1 m intervals with depth, until a stable profile is found. The thermometer should be calibrated with crushed ice and water to 0°C. Weather conditions should be simultaneously noted and include air temperature, wind direction, barometric pressure, wind speed, degree of overcast, and inches of rain. The weather code for recording degree of overcast is numerical, with 01 indicating clear, 02 partly cloudy (less than one-half of the sky cloudy), 03 partly cloudy (greater than one-half of the sky cloudy), 04 total overcast, and 05 precipitation. The time of the day should be kept constant at midday plus or minus two hours, preferably at mid-tide. These techniques are recommended for a "plankton watch" being conducted by federal and state agencies for salmon hatcheries, and are compatible with the data base now being developed for southeastern Alaskan waters (Hauser 1981).

Depth of light extinction is measured with a Secci disk:

> The disk consists of a circular plate (20 cm diameter), painted black in two opposite quarters and white in the other two. To determine Secci disk transparency, lower the disk into the water in the shade until it disappears and record the depth. Lower the

> disk a few ft and then slowly raise it until it reappears, and record this depth. The average of the two readings is the Secci disk transparency. Make measurements at midday. (Nielsen and Johnson, Fisheries Techniques).

Water samples should be taken via a pump from 0.5 m depth and 5 m depth (or a depth chosen from the temperature and Secchi disk measurements as being likely for phytoplankton concentration). These measurements will be used to produce an average value for the plankton biomass in the photosynthetic zone and to obtain an indication of possible layering of the phytoplankton. It has been shown that:

> In bright daylight illumination at sea surface seems often to be at or above saturation level for most of the phytoplankton, and measurements of photosynthesis in these conditions show that maximum productivity occurs some distance below surface, usually somewhere between 5 and 20 m depending upon light intensity and falls off sharply above this level (Tait and DeSanto 1972, p. 127).

This has great importance for the oyster farmer in the placement of trays.

The water should be pumped through a series of successive mesh cups with the finest mesh being 10 microns. The purpose of successive cups is to prevent clogging of the finer meshes by large debris. Cells larger than 200 microns are not preferred by oysters. A first filtration through coarse screen may necessary to remove debris. A source for this mesh is cited at the end of this section. The volume pumped must be kept standard. The mesh (all filters between 200 and 10 microns) will be rinsed with pre-filtered water into a measuring cylinder and allowed to settle for 15 minutes. The settled volume will then equal the height of the plankton times the cylinder area filled with plankton. The plankton may then be dried and a dry weight taken. This is a rough measurement and has no control for particles in the sample which have no nutritive value to the oyster. Thus, if a microscope is available, the sample should be examined to determine its composition.

PARALYTIC SHELLFISH POISONING STUDIES

Recent research on PSP causes has clarified some of the differences between the Alaskan problem and that of more southern waters. The dinoflagellate that produces the toxin has a resting form (cyst) which also contains toxin. Sediments capable of giving rise to the dinoflagellate are widespread along the Alaskan coast (Hall 1982). When storms disturb the sediments, the cysts may be suspended in the water column where oysters can feed upon them. Cyst abundance varies widely and has been measured as high as 2,000 mouse units per meter squared of bottom (Hall 1982). Benthic cyst abundance is fairly stable and in the future may be used as an indicator of toxin levels. Cyst concentrations would be surveyed only one or two times a year, rather than bimonthly as in the oyster sample program now underway, to provide adequate warning of increased PSP contamination risk (Hall 1982).

Cyst studies are made by incubating sediments with nutritive medium and isolating the mobile cells that appear in two to seven days. Growth of these cells at low temperatures and at phosphate concentrations similar to those of

Alaskan waters produces cells with higher toxicity. In other words, Alaskan strains of toxic dinoflagellates appear to be more virulent than those from more southern states. There are also regional differences within Alaska (Hall 1982). These findings may be culture effects rather than true in situ differences, but the documented fatalities in Alaska show that PSP is a serious problem.

When conditions are right, the cyst develops into a mobile, vegetative stage, generally spheroidal although some strains are elongate. It is 20 to 50 microns in diameter, and has an equatorial and a longitudinal groove. There are two flagella and the plates lack obvious decoration. The cells tend to form chains involving two to more than 30 cells. Chains with recently divided cells have a characteristic "Z" appearance. The cells are photosynthetic and are green, brown, or copper-colored. Taxonomic assignment requires phase-contrast microscopy. However, examination of Alaskan samples has not found any other cells of similar structure that are not toxic (Hall 1982). The appearance of cells of this description in plankton samples would suggest it is time for a PSP test.

The marked development of a thermocline or stratified warm surface layer may be required for blooms. In Japan, the high density zone of the dinoflagellate was associated with surface water in the range of 8° to 12°C (46° to 54°F). The stability of the water from spring to summer seemed to be a necessary condition for propagation of plankton cells (Nishihama 1982).

In Puget Sound, reduced turbulance and increased water temperature was found to give rise to a dinoflagellate bloom in mid-June when temperatures were greater than 14°C. There are differences in toxicity with depth or tide height due to this thermal layering (Nishitani and Chew 1983).

The dinoflagellate populations may also reside offshore in deeper waters, undergoing diel (or daily up-and-down) vertical migration. During recent years PSP has seemed to spread and get worse. High PSP levels have prevented shellfish harvesting for as much as ten months each year in certain parts of Japan. On the positive side, there is a parasite that seems to be important in controlling blooms and perhaps in the future may be cultured for that purpose (Nishitani and Chew 1983).

Certain bays appear to function as "breeding bays", with the cells blooming in protected waters with the right conditions and dispersing and raising havoc in adjacent waters. Thus, oyster farmers want to make sure they have not selected such a site for their farms.

MEASUREMENTS OF OYSTER GROWTH

Sample oysters may be marked with a conspicuous painted insignia and length and weight measured. After the growing season has ended, measurements should be repeated. The oysters should then be sacrificed and a wet and dry weight taken of the meat.

CONDITIONING INDEX FOR DETERMINING MARKETABILITY

Oyster growers use the following formula for determining the marketability of cultured oysters:

$$\frac{\text{Dry weight of oyster meat (grams)}}{\text{Volume of space between shell valves (ml)}} \times 100 = \text{INDEX OF CONDITION}$$

Procedure:

1. Sample a minimum of 10 oysters for each test.
2. Clean the shells with a brush (a toothbrush is fine).
3. Scrape barnacles, mussels, etc. off the shells.
4. Place the whole sample in a beaker with enough water to cover them and measure the water displacement of the oysters.
5. Shuck the oysters, placing the meats on a weighed foil container and save the shells.
6. Place the meat in a drying oven (about 90°C). If a drying oven is not available, sunlight or any heat source may be used. The goal is to evaporate the water content and achieve a constant weight.
7. Measure the water displacement of the empty shells (as in step 4).
8. Subtract the displacement obtained in step 7 from that obtained in step 4, and that number is the volume of the space between the shell valves.
9. Dry the meat until a constant weight is attained (take the weight measurement 30 to 60 minutes after removing sample from oven).
10. Subtract the foil weight from the total dry weight to get the dry meat weight.

Approximately 50 or more is an acceptable condition index, however the desired market index of condition varies with species and size of the harvested oysters. Caution must be observed with reproducing oysters for southern oyster growers, as oysters full of sperm can still have a high condition index (Biggs 1981).

An equation may also be calculated for estimating dry weight from wet weight. The number of oysters marked will depend on the time available for measurement. The greater the variation found the greater the number of measurements should be taken in order to get significant values. Some oysters may be kept through the winter if sufficient marked oysters are available.

OBSERVATIONS OF FOULING SETS

When checking trays or lines, careful observations should be made of new encrustations or other forms of settlement. It may take some time to become familiar with the appearance of the new settler as opposed to the adult form. Rough estimations of the quantity setting may be correlated with the other environmental parameters measured and comparisons made in future years. Be sure to keep written notes with as much detail as possible in order to maintain accuracy. Experience will enable the farmer to take effective evasive action in the future.

SUPPLIERS

East-Side Net Shop (mesh)
14207 100th NE
Bothell, WA 98011

Ohaus Scale Corporation
29 hanover Road
Forham Park, NJ 07932

American Optical (microscopes)
Scientific Instrument Division
Box 123
Buffalo, NY 14240

UWR (all scientific supplies)
355 Treck Drive
Seattle, WA 98188

Love Controls Corporation (thermometers)
1475 South Whelling Road
Whelling, IL 60090

REFERENCES

Environmental Monitoring and Support Laboratory. 1974. Methods for chemical analysis of water and wastes. Report number EPA-62516-74-003a. Washington, D.C.: Environmental Protection Agency.

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LOOKING FORWARD IN OYSTER CULTURE

Changes and innovations will re-shape the oyster farming industry in Alaska as it grows. Mechanization of cleaning and harvesting alone can make a significant difference, increasing production without causing increases in labor costs.

Environment-controlled rearing systems, especially for young spat, can provide optimum start conditions. These systems control many water conditions. oyster food might be cultured rather than relying on available food in the water. Algal culture takes some practice, but the resulting increased availability of food in the winter months and more consistent availability year-round can further assure success in oyster growing. These systems are expensive but give you an extra measure of control you don't have with water at natural sites.

These systems may also be combined, so you can produce oysters along with other farmable sea crops. Algae, mussels, clams, scallops, and herring roe-on-kelp grow well with oysters, as will spot shrimp and some crab species held in associated live tanks. The mollusk species mentioned are also subject to PSP contamination, particularly mussels. These would also have to be monitored for PSP.

Seaweeds are the most likely crop to be first incorporated into an oyster farm. Their culture is simpler than animal culture. The Washington State Department of Natural Resources has published a market survey and analysis for products of red algae Porphyra. It suggests that moderate-sized seaweed culture can be profitable (contact Tom Mumford).

Several Alaskan oyster farmers have received preliminary permits to start an oyster hatchery. This is a key to growth in the industry, alleviating the problems of spat supply, import certification and mortality during transport. The hatchery would work to develop oysters better able to survive in Alaskan waters. Associated genetic research may also solve other problems, such as slow growth in Alaskan water temperatures.

Research could also help avoid some fouling organisms by better predicting their sets. PSP research might develop new ways of toxin testing that are less time-consuming, more accurate, and less expensive. A bioassay using houseflies is two months away from general lab testing, and a binding exchange method, one year. (Ragelis, personal communication, April 24, 1984.)

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Ragelis, Edward P. Research scientist and project manager, Food and Drug Administration, Washington, DC 20240.

CONTACTS

N.I. Calvin and R.J. Ellis Auke Bay Fisheries Laboratory National Marine Fisheries Service Box 155 Auke Bay, Alaska 99821	rope culture of kelp
Canadian Kelp Resources, Ltd. Bonfield, B.C. V0R 1B0 CANADA (604) 728-329	seaweed culture
James E. Heming SRA Box 37-D Anchorage, AK 99506 (907) 279-0673 or 349-7060	mussel culture (recipient of state development grant)
Tom Mumford Marine Land Management Division Dept. of Natural Resources Olympia, WA 98504 (206) 753-3703	mussel culture
John Olson Pacific Northwest Nori Growers Route 1, Box 94-A Burton, Washington 98103	seaweed culture
Brian Paust Marine Advisory Program P.O. Box 1329 Petersburg, AK 99833	herring-roe-on-kelp and other forms of mixed culture
Dr. Michael Stekoll University of Alaska School of Fisheries 11120 Glacier Highway Juneau, AK 99801	herring-roe-on-kelp

APPENDIX A
SEED SOURCES

SKE, Inc.
Rt. 2, Box 752
Quilcene, WA 98376

Bay Center Mariculture, Inc.
P.O. Box 356
Bay Center, WA 98527

International Shellfish Enterprises, Inc.
P.O. Box 201
Moss Landing, CA 95039

Lummi Tribal Enterprises
P.O. Box 77
Marietta, WA 98268

Western Oyster Co.
Jerry Yamishita
P.O. Box 568
Wauna, WA 98395

Lee Weigardt
Ocean Park, WA 98640
(206) 665-4111 or 665-4172

Pacific Mariculture*
Box 336
Moss Landing, CA 95039
(408) 633-3548

Pigeon Pt. Shellfish Hatchery*
Box 4512
Arcata, CA 95521
(415) 781-0220

Coast Oyster Co.*
Wayne Morris
South Bend, WA 98586
(206) 875-5565

Innovative Aquaculture Products, Ltd.*
Skerry Bay
Lasqueti Is., British Columbia
V0R 2J0
Parksville Mobile Operator N49-7564 Channel YR

*Note: Starred companies have previously sold their products to Alaskan farmers. The other U.S. companies listed were contacted prior to manual production, but none have responded expressing interest in developing an Alaskan market.

Whiskey Creek Oyster Farm (eyed larvae only)
6785 Whiskey Creek Rd.
Tillamook, OR 97141

Rick Engle
Port Townsend, WA 98368
(206) 765-3759 or 385-3788

Baynes Sound Oyster Co.
J. Tarnowski
Box 127
Union Bay, B.C.
V0R 3B0
CANADA
(604) 335-2111

Diamond Oyster Seed Co.
K. Lawrence
Comox, B.C.
CANADA

Wes Perry (Seed on clutch)
Pacific Oyster Co., Ltd.
#301-15041 Prospect Ave.
White Rock, B.C.
V4B 2B5
CANADA
(604) 536-2371

Norm Gibbons
Redonda Sea Farms, Ltd.
Refuge Cove, B.C.
V0P 1P0
CANADA
Campbell River operator: N690368 Channel 1YK

APPENDIX B
PERMIT FORMS

FISH TRANSPORT PERMIT: EXPLANATIONS
ALASKA DEPARTMENT OF FISH AND GAME
FRED DIVISION

These procedures are to implement Chapter 41 of Section 5 of the Alaska Administrative Code, governing the transportation, possession, and release of live fish and their reproductive products.

Permit applications must be made and submitted to the appropriate Regional Office of the Fisheries Rehabilitation, Enhancement and Development (FRED) Division of the Alaska Department of Fish and Game (ADF&G) by the person or organization requesting to transport, possess, export from the State, or release into the water of the State any live fish or eggs.

Region I - Southeastern Region
230 South Franklin Street, Room 301
Juneau, Alaska 99801

Region II - Central, Westward and Arctic-Yukon/
Kuskokwim Region
333 Raspberry Road
Anchorage, Alaska 99502

A separate form must be completed for each species, stock, and release location.

Prior to the taking of any fish and/or eggs, the ADF&G, Division of Commercial Fisheries, area biologist must be notified.

The attached form must be completed in its entirety. Please note the following instructions for completion:

1. Effective Period: The length of time that an FTP is good for, i.e. number of years necessary to complete the project.

2. Transport Date(s): Should include the date of the egg and/or fish take and all applicable transport dates.

3. Maximal Number Allowed: Numbers of fish and/or eggs to be taken and transported.

4. Incubation and Rearing Location(s): Identification of hatchery, Scientific-Educational facility, or Central Incubation facility, if applicable.

5. Purpose and benefits: The projected benefits of this project, and the purpose for undertaking it.

6. Evaluation: Methods employed to evaluate the success or failure of this project.

7. Native stocks present: Refers to stocks naturally present at both origin and release sites. Include the anticipated effects of the take and/or release on these stocks.

8. History of known transports of this stock: All known transports of this stock, either by your organization or others.

9. Disease history: Completion listing of disease incidence testing, as conducted by the Pathology Section, FRED, ADF&G, or other qualified fish pathologists. The following information should be included: date of testing, age of fish, and the results of the test. Note the following example:

2/6/81	Adult	0/60	(0%)	BKD

The permit is issued by the Commissioner of ADF&G or his authorized designee. The Fish Transport Permit authorizes only that operation specified in the permit. The person or organization using the permit must be in compliance with all conditions of the permit.

Chapter 41. Transportation, Possession, and Release of Live Fish

Article 1. Scope of Regulations

5 AAC 41.001. APPLICATION OF THIS CHAPTER. The provisions of this chapter govern the transportation, possession, or release of live fish transplanted for or cultivated for human consumption or sport fishing purposes, or as part of an aquaculture program for scientific, educational or propagative purposes. Unless specifically provided, the provisions of this chapter do not apply to the transportation, possession, or release of fish taken for commercial, sport, or subsistence purposes.

Authority: AS 16.05.251(a)(4),(8),(10)

Article 2. Permit System Established.

5 AAC 41.005. PERMIT REQUIRED. (a) No person may transport, possess, export from the state, or release into the waters of the state, any live fish unless the person holds a fish transport permit issued by the commissioner or his authorized designee, and the person is in compliance with all conditions of the permit and the provisions of this chapter. A fish transport permit will be issued for a fixed term subject to the provisions of (c) of this section.

(b) A fish transport permit authorizes only that operation specified in the permit. Any changes of species, brood stock, or location requires a new permit. Any other changes requires an amendment to the permit.

(c) The commissioner shall suspend the permit, or particular provisions of the permit including amendments, if he finds:

(1) on the basis of new information or changed circumstances, that the permitted activity will adversely affect the continued health and perpetuation of native, wild, or hatchery stocks of fish; or

(2) the permittee has failed to comply with permit terms or the provisions of this chapter.

(d) Notwithstanding the expiration, termination or suspension of a fish transport permit, each permittee is responsible for the obligations arising under the terms and conditions of the permit, and under the provisions of this chapter.

Authority: AS 16.05.251(a)(4),(8),(10),(12)

5 AAC 41.010. UNIFORM APPLICATION PROCEDURES. (a) Each application for a fish transport permit shall submit the following information to the department:

(1) identification of each species and location of the stock to be transported, possessed, or released;

(2) the destination of the transported fish and the release site;

(3) the number of fish and their life history stage or age;

(4) a descriptive history of previous transport, if any;

(5) a statement on the health or condition of the fish, including a disease history of the stock, a disease history of the hatchery or rearing facilities through which they may have passed, and any previous disease treatments or vaccinations, or if the disease history is incomplete or unavailable a brood stock inspection and certification pursuant to 5 AAC 41.020.

(6) isolation measures planned to control disease during transport, including a description of containers, water source, depuration measures, and plans for disinfection;

(7) a description of proposed egg take methods;

(8) the source of water for rearing and proposed effluent discharge location;

(9) identification and status of native stocks in the area of taking, retention and release site, including a statement of espected interactions with other stocks in these areas;

(10) the method of transport or release and the expected date of transport or release;

(11) the purpose and expected benefits of the transport or release; and

(12) evaluation plans.

(b) A completed application must be submitted to the department regional office in the region in which the proposed transport or release will occur.

(c) If the commissioner or his authorized designee determines that an application is incomplete and that further information is necessary, the department will return the application to the applicant with a description of the deficient information.

(d) The commissioner or his authorized designee will approve, condition, or deny a permit within 30 days after a completed application containing all of the applicable information in (a) of this section has been received in the appropriate regional office.

5 AAC 41.020. INSPECTION FOR DISEASE OF BROOD STOCK. If the disease history of the brood stock is unavailable or incomplete as required by 5 AAC 41.010(a)(5), an inspection of the brood stock to detect fish disease must be scheduled by the applicant and conducted by the fish pathology section of the department, or by a person designed by the fish pathology section. The applicant must submit samples of the brood stock as directed by the fish pathology section for the purpose of inspection. The applicant will receive a certification from the fish pathology section upon successful completion of the inspection.

Authority: AS 16.05.251(a)(4),(8),(10)
AS 16.05.868

5 AAC 41.030. PERMIT ISSUANCE OR DENIAL. (a) The commissioner or his authorized designee will issue a fish transport permit if it is the department's determination that the proposed transport, possession or release of fish will not adversely affect the continued health and perpetuation of native, wild, or hatchery stocks of fish; or

(b) The commissioner or his authorized designee will issue a fish transport permit with terms and conditions attached if it is the department's determination that the terms and conditions are necessary to protect the continued health and perpetuation of native, wild, or hatchery stocks of fish.

(c) The commissioner or his authorized designee will deny an application for permit, or a request for amendment of a permit, if the applicant's proposed plans, methods, or specificiations are not adequate, on the basis of fish disease, genetics competition, predation, or other biological considerations, to assure the continued health and perpetuation of native, wild, or hatchery stocks of fish. Written notice of denial shall be given to the applicant, including the reasons of denial.

Authority: AS 16.05.251(a)(4),(8),(10)

5 AAC 41.040. AMENDMENTS TO THE PERMIT. (a) A permittee may request amendment of a fish transport permit by submitting, in writing to the department regional office where the permit was issued, an amended plan and a statement explaining why the amendment is necessary.

(b) The commissioner or his authorized designee will issue an amendment to the permit upon a determination made pursuant to Sec. 30(a) or (b) of this chapter. The commissioner or his authorized designee will approve, condition or deny a request for amendment withing 30 days after receipt of the request in the appropriate regional office.

(c) The commissioner or his authorized designee may alter or amend permit conditions if additional information or unforeseen changes allow relaxation, or changed circumstances affect the adequacy of permit terms and conditions.

(d) Amendments approved by the commissioner or his authorized designee become effective when received by the permittee, or at a later date specified in the amendment. Unless otherwise specified, amendments remain valid for the duration of the permit.

Authority: AS 16.05.251(4),(8),(10)

5 AAC 41.050. PERMIT CONDITIONS. The commissioner or his authorized designee may prescribe conditions on a permit to control the occurrence of fish disease, genetic change, or control other disturbances of biological origin affecting native, wild, or hatchery stocks of fish. These conditions may include designation of brood stock and release locations, methods of transport or release, quarantine and depuration requirements and procedures, disease inspections, disposal of water and effluents, timing of transportation and release, reporting requirements, and other measures necessary to achieve the purposes of 5 AAC 41.

Authority: AS 16.05.251(a)(4),(8),(10)

5 AAC 41.060. RETENTION OF PERMIT FOR INSPECTION. (a) After issuance a copy of the permit including any amendments must be retained by the permittee, and be made available upon request for inspection by a representative of the department, or a law enforcement officer of the Department of Public Safety.

(b) For the purposes of inspecting and monitoring compliance with the terms of the permit or the requirements of this chapter for the continued health and perpetuation of native, wild, or hatchery stocks of fish, each permittee shall give authorized representatives of the department, and law enforcement officers of the Department of Public Safety, free and unobstructed access at all times to permit sites. Each permittee shall give such assistance and furnish information the representative or law enforcement officer may reasonable require for monitoring and inspection.

Authority: AS 16.05.251(a)(4),(8),(10)

FISH TRANSPORT PERMIT

Permit No. _____

Applicant/Organization: _____ Date: _____

Project Leader: _____ Telephone No. _____

Effective Period: _____ Species: _____

Transport Date(s): _____

Stock Origin: _____

Maximal Number Allowed: _____

Incubation & Rearing Location(s): _____

Release Location: _____

Purpose and Benefits: _____

_____

_____

Evaluation Plans: _____

_____

_____

Is release site landlocked? _____

_____

_____

Native stocks present, their status, and effects of the proposed action on them:

_____

_____

_____

_____

Permit No. _____

History of previous transports of this stock: _____

_____

_____

Disease history of stock to be transported: _____

_____

_____

Description of proposed egg take methods: _____

_____

_____

Isolation measures planned to control disease during transport, including description of container, water source, and method and plan for transport:

_____

_____

_____

_____

_____

Source of water for rearing and proposed effluent discharge location: _____

_____

_____

Permit No. _____

REGIONAL REVIEW	AGREE	DISAGREE	DATE
FRED (Review Coordinator):	_____	_____	_____
Incomplete:		_____	_____
FRED TECHNICAL REVIEW			
Principal Pathologist	_____	_____	_____
Incomplete:		_____	_____
Principal Geneticist	_____	_____	_____
REGIONAL REVIEW			
Commercial Fish	_____	_____	_____
Sport Fish	_____	_____	_____
HEADQUARTERS REVIEW			
Principal Biologist	_____	_____	_____
Principal Culturist	_____	_____	_____
FRED Chief of Technology and Development	_____	_____	_____
FRED Director	_____	_____	_____
APPROVAL:			
Commissioner:	_____		_____
DISAPPROVAL:			
Commissioner	_____		_____

COMMENT PAGE
(Please include signature)

Permit No._____

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

(33 CFR 325)

OMB APPROVAL NO. 0702-0036
Expires 30 June 1986

The Department of the Army permit program is authorized by Section 10 of the River and Harbor Act of 1899, Section 404 of the Clean Water Act and Section 103 of the Marine, Protection, Research and Sanctuaries Act. These laws require permits authorizing activities in or affecting navigable waters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Information provided on this form will be used in evaluating the application for a permit. Information in this application is made a matter of public record through issuance of a public notice. Disclosure of the information requested is voluntary; however, the data requested are necessary in order to communicate with the applicant and to evaluate the permit application. If necessary information is not provided, the permit application cannot be processed nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application *(see sample drawings and instructions)* and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

1. APPLICATION NUMBER *(To be assigned by Corps)*

2. NAME AND ADDRESS OF APPLICANT

Telephone no. during business hours

A/C ( ) _____ *(Residence)*
A/C ( ) _____ *(Office)*

3. NAME, ADDRESS, AND TITLE OF AUTHORIZED AGENT

Telephone no. during business hours

A/C ( ) _____ *(Residence)*
A/C ( ) _____ *(Office)*

Statement of Authorization: I hereby designate and authorize _____ to act in my behalf as my agent in the processing of this permit application and to furnish, upon request, supplemental information in support of the application.

SIGNATURE OF APPLICANT | DATE

4. DETAILED DESCRIPTION OF PROPOSED ACTIVITY

4a. ACTIVITY

4b. PURPOSE

4c. DISCHARGE OF DREDGED OR FILL MATERIAL

ENG FORM 4345, Apr 83 EDITION OF 1 OCT 77 IS OBSOLETE (Proponent: DAEN-CWO-N)

5. NAMES AND ADDRESSES OF ADJOINING PROPERTY OWNERS, LESSEES, ETC., WHOSE PROPERTY ALSO ADJOINS THE WATERWAY

6. WATERBODY AND LOCATION ON WATERBODY WHERE ACTIVITY EXISTS OR IS PROPOSED

7. LOCATION ON LAND WHERE ACTIVITY EXISTS OR IS PROPOSED

ADDRESS.

STREET, ROAD, ROUTE OR OTHER DESCRIPTIVE LOCATION

COUNTY STATE ZIP CODE

LOCAL GOVERNING BODY WITH JURISDICTION OVER SITE

8. Is any portion of the activity for which authorization is sought now complete? ☐ YES ☐ NO
If answer is "Yes" give reasons, month and year the activity was completed. Indicate the existing work on the drawings.

9. List all approvals or certifications and denials received from other federal, interstate, state or local agencies for any structures, construction, discharges or other activities described in this application.

ISSUING AGENCY	TYPE APPROVAL	IDENTIFICATION NO.	DATE OF APPLICATION	DATE OF APPROVAL	DATE OF DENIAL

10. Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities or I am acting as the duly authorized agent of the applicant.

SIGNATURE OF APPLICANT DATE SIGNATURE OF AGENT DATE

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in Block 3 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

Do not send a permit processing fee with this application. The appropriate fee will be assessed when a permit is issued.

APPENDIX C
EQUIPMENT SUPPLIERS

Newport Pacific Oyster Co. P.O. Box 1028 Newport, OR 97365	net, cages
E and B Marine Supply, Inc. 90 Gladys Ct. P.O. Box 747 Edison, NJ	boat supplies
Murray Pacific P.O. Box 3656 Seattle, WA 98124 (206) 763-9300	line, log staples, hardware
Trans World Pacific Corporation 2133 4th St. at Allston Way Berkeley, CA 94710 (415) 548-4434 or (800) 227-1570	plastic net, wire cloth
Webb Camp Sea Farm 2103 Blarney Place S.E. Bellevue, WA 98107	lantern nets
Rob Saunders Canadian Benthic Ltd. c/o Bamfield Marine Station Bamfield, B.C. V0R 1BO CANADA (604) 728-3274	general
Consolidated Net and Twine Co., Inc. 1549 N.W. 49th Seattle, WA 98107 (206) 784-5100	net, line
MI-T-M Corp. Peosta, IA 52068 (319) 556-7484 or (800) 553-9053	pressure washer
Northwest Plastics, Ltd. 224 Cayer St. Coquitlam, B.C. V3K 5B1 CANADA (604) 525-8331	floats
Wolff Marine Supply, Ltd. 780 Cordova St. E. Vancouver, British Columbia V6A 1M3 (604) 256-8137	shucking knives, etc.

Watson Gloves, Ltd. 127 E. 2nd Vancouver, B.C. V8T 1B4 CANADA (604) 874-1105	gloves
Northwest Plastic 1118 East 3rd St. N. Vancouver, B.C. V7J 1B8 CANADA (604) 980-5423	plastic floats
Scott Plastics, Ltd. 21 Erie St. Victoria, B.C. CANADA	links, shackles, snaps
PACS, Inc. 19707 64th Ave. W, Suite 108 Lynnwood, WA 98036 (206) 385-3803	oyster stacks
Memphis Net and Twine Co., Inc. P.O. Box 8331 Memphis, TN 38108 (901) 458-2656	net, line, and misc. supplies

APPENDIX D
PSP TESTING AND ALASKA DATA

LOT SAMPLING PROCEDURES FOR PARALYTIC SHELLFISH POISONING IN OYSTERS

The lot sampling procedures below will be used for a lot-by-lot approval of oysters cultured in approved growing areas for paralytic shellfish poison (PSP) content.

Frequency of Sampling: Every lot will be sampled and analyzed prior to release for human consumption.

Point of Sample Collection: Shellstock storage facilities.

Sample Size: Six (6) sample units of 100 grams of shucked oysters each.

Number of Sample Units to be Submitted for Analysis: Twelve (12) sample units of 100 grams of shucked oysters each; six (6) samples for initial analysis each and six (6) standby samples.

INTERPRETATION OF AND REACTION TO PSP ANALYSIS RESULTS

Step 1: Analysis of six (6) initial samples.

Results - Toxicity detected but all samples (60 micrograms per 100 grams; analyze six (6) standby samples (for total of twelve (12) samples). (See Step 2).

Results - No toxicity detected; accept lot.

Results - Toxicity detected and any individual sample is greater than or equal to 60 micrograms per 100 grams but less than or equal to 80 micrograms per 100 grams; analyze six (6) standby samples and collect and analyze six (6) additional samples (for a total of eighteen (18) samples). (See Step 3).

Results - Any individual sample greater than or equal to 80 micrograms per 100 grams; reject lot. NOTE; Disposition may be to relay, condemn or dye for use as bait.

Step 2: Analysis of six (6) standby samples (for a total of twelve (12) samples).

Results - All samples 60 micrograms per 100 grams; accept lot.

Results - Any individual sample greater than or equal to 60 micrograms per 100 grams but less than 80 micrograms per 100 grams, collect and analyze six (6) additional samples (for a total of eighteen (18) samples). (See Step 3).

Results - Any individual sample greater than or equal to 80 micrograms per 100 grams, reject lot. NOTE: Disposition may be to relay, condemn, or dye for use as bait.

Step 3: Collection and analysis of six (6) additional samples (for total of eighteen (18) samples).

Results - All samples less than 80 micrograms per 100 grams; accept lot.

Results - Any individual sample greater than or equal to 80 micrograms per 100 grams; reject lot. NOTE: Disposition may be to relay, condemn or dye for use as bait.

Table 1. Some preliminary PSP testing data from the Alaska Shellfish Grower's Association monitoring program, 1982-1983

FARM LOCATION	DATE OF HARVEST	SPECIES	TEST RESULTS (in micrograms)
Clarence Strait (b)	06-23-82	Oysters	37.71
Etolin Island (g)	06-28-82	Oysters	42.47
Metlakatla (h)	06-30-82	Oysters	39
Metlakatla (i)	06-30-82	Oysters	40
Clarence Strait (b)	07-13-82	Oysters	51.62
Metlakatla (a)	11-01-82	Oysters (12')*	40
Metlakatla (a)	11-01-82	Oysters (6')*	40
Clarence Strait (b)	04-22-83	Oysters	32.44
Zimovia Straits (e)	04-24-83	Oysters	31.5
Metlakatla (a)	05-02-83	Oysters	48.24
Zimovia Straits (e)	05-08-93	Oysters	31.5
Metlakatla (a)	05-19-83	Oysters	53.7
Clarence Strait (b)	05-17-83	Oysters	545.76
Zimovia Straits (e)	05-22-83	Oysters	327.6
Clarence Strait (b)	05-30-83	Oysters	408.56
Clarence Strait (f)	05-31-83	Oysters	34.74
Metlakatla (a)	05-31-83	Oysters	31.5
Zimovia Straits	06-09-83	Oysters	31.5
Clarence Strait (b)	06-11-83	Oysters	31.5
Metlakatla (a)	06-12-83	Oysters	33.08
Metlakatla (a)	06-25-83	Oysters	31.5
Clarence Strait (b)	06-27-83	Oysters	31.5
Clarence Strait (b)	06-27-83	Oysters	42.23
Zimovia Straits (e)	06-28-83	Oysters	31.5
Metlakatla (a)	07-09-83	Oysters	32.33
Clarence Strait (b)	07-16-83	Oysters	41.04
Metlakatla (a)	07-23-83	Oysters	65.38
Zimovia Straits (e)	07-24-83	Oysters	31.05
Metlakatla (a)	08-06-83	Oysters	ND
Zimovia Straits (e)	08-07-83	Oysters	31.5**
Clarence Strait (b)	08-07-83	Oysters	45.5
Metlakatla (a)	08-20-83	Oysters	ND
Zimovia Straits (e)	08-21-83	Oysters	31.5
Zimovia Straits (e)	08-28-83	Oysters	31.5
Clarence Strait	08-29-83	Oysters	ND
Metlakatla (a)	09-04-83	Oysters	ND
Zimovia Straits	09-10-83	Oysters	31.5
Metlakatla	09-23-83	Oysters	31.5
Clarence Strait	09-24-83	Oysters	35.28
Zimovia Straits	09-25-83	Oysters	31.5
Metlakatla	10-01-83	Oysters	36
Zimovia Straits	10-05-83	Oysters	31.5
Zimovia Straits	10-05-83	Oysters	31.5
Zimovia Straits	10-05-83	Oysters	31.5
Zimovia Straits	10-05-83	Oysters	31.5
Zimovia Straits	10-05-83	Oysters	31.5
Zimovia Straits	10-05-83	Oysters	31.5
Clarence Strait	10-05-83	Oysters	39.24
Clarence Strait	10-05-83	Oysters	37.98
Clarence Strait	10-05-83	Oysters	36
Clarence Strait	10-05-83	Oysters	37.07
Clarence Strait	10-05-83	Oysters	33.73
Clarence Strait	10-05-83	Oysters	39.34
Metlakatla	10-16-83	Oysters	31.5
Zimovia Straits	10-24-83	Oysters	31.5
Zimovia Straits	10-24-83	Oysters	31.5
Zimovia Straits	10-24-83	Oysters	31.5
Zimovia Straits	10-24-83	Oysters	31.5
Zimovia Straits	10-24-83	Oysters	31.5
Zimovia Straits	10-24-83	Oysters	31.5
Clarence Strait (b)	10-28-83	Oysters	31.5
Metlakatla (a)	10-31-83	Oysters	31.5
Clarence Strait (b)	11-14-83	Oysters	31.5
Metlakatla (a)	11-14-83	Oysters	NT
Metlakatla (a)	11-28-83	Oysters	NT
NO RESULTS			
Metlakatla (a)	12-16-83	Oysters	
Metlakatla (a)	12-26-83	Oysters	
Metlakatla (a)	01-09-84	Oysters	
Kasaan (c)	01-11-84	Oysters	

* length of rope culture
** results from 12 samples

Table 2. PSP test results in selected British Columbian tray and string cultured oysters

Date	Method	Toxin Level (micrograms/100g)
09-26-80	Tray	270
11-25-80	Tray	1600
11-25-80	Tray	1800
12-09-80	Tray	480
12-30-80	Tray	80
09-22-81	Tray	1000
06-10-82	Tray	430
07-02-82	Tray	32
10-02-82	String	750
08-25-83	Tray	190

(all in same location)

Review of Metric Weight Units

decigram	=	1/10 gram	
centigram	=	1/100 gram	
milligram	=	1/1000 gram	= mg.
microgram	=	1/1,000,000 gram	= ug.

Table 3. Some preliminary PSP testing data from the Alaska Shellfish Grower's Association monitoring Program, 1983-1984

FARM LOCATION	DATE OF HARVEST	SPECIES	TEST RESULTS
Kasaan	01-11-84	Oysters	< 31.5
	01-11-84	Butter clams	< 31.5
	01-11-84	Blue mussels	< 31.5
	01-11-84	Brown mussels	89.2
	03-04-84	Brown mussels	< 31.5
	03-04-84	Butter clams	42.2
	03-04-84	Oysters	< 31.5
	03-04-84	Blue mussels	< 31.5
	03-18-84	Oysters	< 31.5
	03-18-84	Butter clams	124.92
	03-18-84	Blue mussels	< 31.5
	03-18-84	Blue mussels	< 31.5
	04-01-84	Butter clams	65.0
	04-01-84	Brown mussels	< 31.5
	04-01-84	Blue mussels	< 31.5
	04-01-84	Oysters	< 28.0
Etolin Island	07-24-83	Mussels	< 31.5
	07-24-83	Oysters	< 31.5
	08-21-83	Oysters	< 31.5
	08-28-83	Oysters	< 31.5
	08-28-83	Oysters	< 31.5
	09-10-83	Oysters	< 31.5
	09-10-83	Mussels	< 31.5
	09-25-83	Mussels	< 31.5
	10-05-83	Oysters	< 31.5
	10-05-83	Oysters	< 31.5
	10-05-83	Oysters	< 31.5
	10-05-83	Oysters	< 31.5
	10-05-83	Oysters	< 31.5
	10-24-83	Oysters	< 31.5
	10-24-83	Oysters	< 31.5

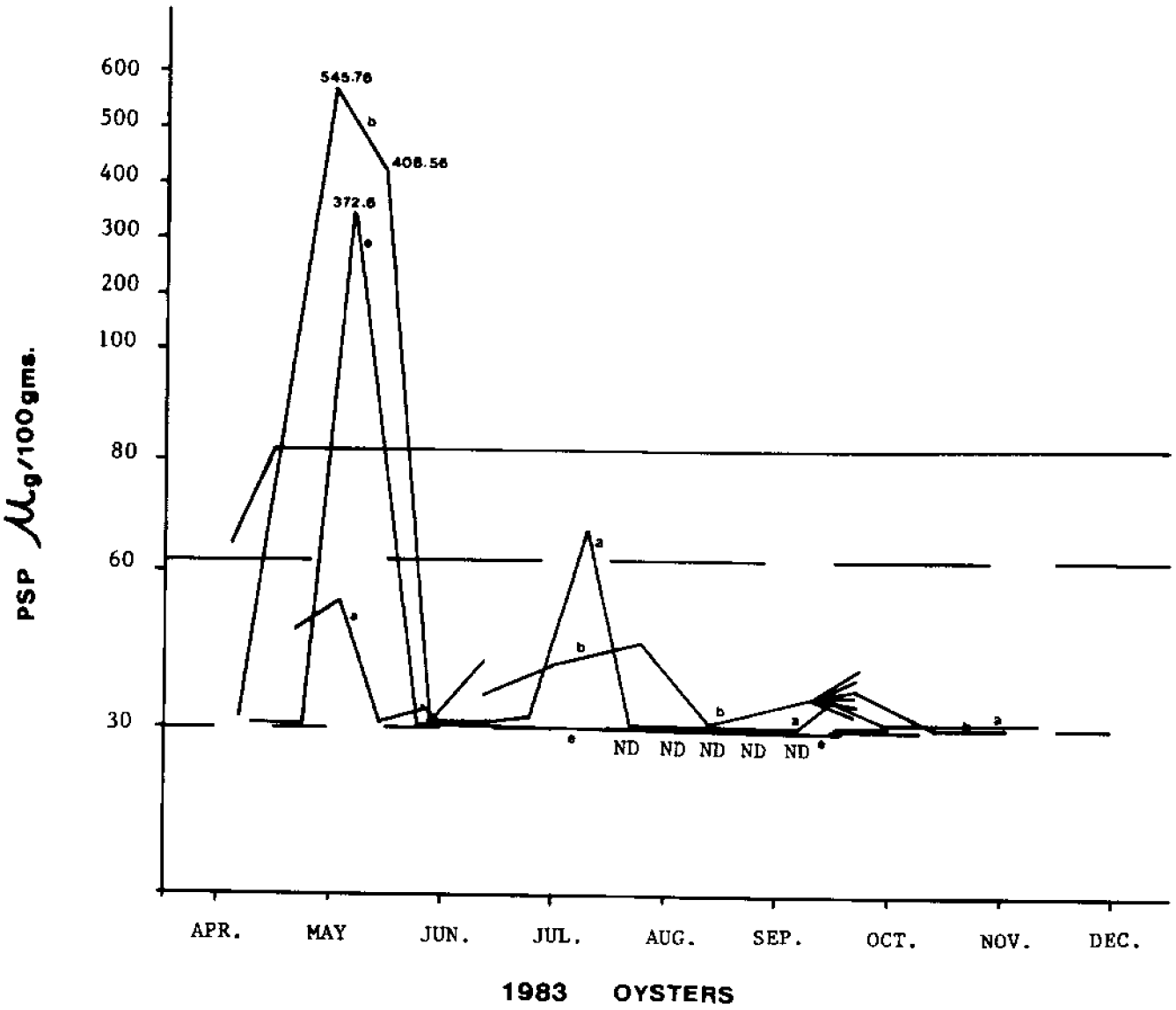

Figure 1. Preliminary testing data from the Alaska Shellfish Grower's Association monitoring program, 1983. Small letters indicate sites. (See Table 1, parenthetical letters indicate sites).

APPENDIX E
SANITATION REGULATIONS

ALASKA ADMINISTRATIVE CODE: SCOPE OF ACTIVITIES

Shellstock Shipper (Grower)

18 AAC 34.170	Sanitation Standards
18 AAC 34.180	Permit and Inspection Requirements
18 AAC 34.200	Harvesting and Handling
18 AAC 34.220	Preparing for Market
18 AAC 34.280	Applicable Standards
18 AAC 34.290	Water Supply
18 AAC 34.300	Waste Disposal
18 AAC 34.310	Plumbing
18 AAC 34.320	Storage and Handling of Fishery Products and Ice
18 AAC 34.900	Waiver of Requirements
18 AAC 34.910	Definitions

Harvester (Bait and/or Human Consumption)

18 AAC 34.170	Sanitation Standards
18 AAC 34.180	Permit and Inspection Requirements
18 AAC 34.200	Harvesting and Handling
18 AAC 34.220	Preparing for Market
18 AAC 34.900	Waiver of Requirements
18 AAC 34.910	Definitions

Shucker Packer

18 AAC 34.170	Sanitation Standards
18 AAC 34.180	Permit and Inspection Requirements
18 AAC 34.220	Preparing for Market
18 AAC 34.280	Applicable Standards
18 AAC 34.290	Water Supply
18 AAC 34.300	Waste Disposal
18 AAC 34.310	Plumbing
18 AAC 34.320	Storage and Handling of Fishery Product and Ice
18 AAC 34.900	Waiver of Requirements
18 AAC 34.910	Definitions

ARTICLE 2. SHELLFISH PROCESSING

Section
170. Sanitation standards
180. Permit and inspection requirements
200. Growing areas
210. Harvesting and handling
220. Preparing for market
240. Processing of razor clams in restaurants
250. Eligibility for permit to process razor clams
260. Processing standards for razor clams in restaurants
270. Sale of razor clams by restaurants

18 AAC 34.170. SANITATION STANDARDS. The National Shellfish Sanitation Program Manual of Operations, Parts I and II, 1965 Revision, Public Health Service Publication No. 33, published by the United States Department of Health and Human Services, is adopted by reference as a regulation of the department and must be complied with in the sanitation, harvesting, handling, shucking, and shipping of fresh or frozen shellfish. These standards are in addition to the requirements contained in 18 AAC 34.010 -- 18 AAC 34.160. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.035
AS 03.05.040

Editor's Note: Copies of the National Shellfish Sanitation Program Manual of Operations, Parts I and II, 1965 Revision, Public Health Service Publication No. 33, are available from the United States Department of Health and Human Services, Food and Drug Administration, Bureau of Foods, Shellfish Sanitation Branch, 200 C Street, S.W., Washington, D.C. 20204.

18 AAC 34.180. PERMIT AND INSPECTION REQUIREMENTS. (a) A person operating a facility used for processing, packing, or repacking shellfish, and a person selling or possessing shellstock for sale, must have a permit issued by the department. Permits will be numbered and renewed annually, and may be suspended or revoked for violation of 18 AAC 34.010 -- 18 AAC 34.270.

(b) Shellfish permit applications must contain, if applicable,

(1) a description of the location where shellfish will be raised;

(2) a sketch drawn to scale showing the location of any structures;

(3) a listing of potential hazards to which the shellfish may be exposed at that location; and

(4) a description of the measures planned to avoid the listed hazards.

(c) The operator, superintendent, manager, or agent of a shellfish facility in Alaska shall allow the commissioner or a designated representative access for inspection to facilities regulated by 18 AAC 34.170 -- 18 AAC 34.270. A person may not obstruct the commissioner or designated representative during an inspection. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.040
AS 03.05.050

18 AAC 34.200. GROWING AREAS. (a) Shellfish growing areas in Alaska are closed to commercial shellfish harvesting for human consumption marketing unless approved by the commissioner. Bait shellfish harvesting is permitted from shellfish growing areas if harvesting and handling comply with 18 AAC 34.210.

(b) The department will examine a shellfish growing area in Alaska by a sanitary and biological survey before approving the area under (a) of this section. Before approval the area must have been

(1) examined by sanitary survey, and verified by laboratory findings in appropriate cases, which indicates that pathogenic microorganisms, radionuclides, pesticide chemicals, harmful industrial wastes, and sewage wastes do not reach the approved area in dangerous concentration and do not pollute the shellfish in the approved areas; and

(2) sampled by the taking of shellfish from the area to ensure that paralytic shellfish poison content is less than 80 micrograms per 100 grams of the whole raw shellfish meat tested in the approved area.

(c) The commissioner will give public notice of the approval under (a) of this section of a shellfish growing area. The notice will be published in at least three newspapers of general circulation, one of which serves the area nearest the approved area. The notice will describe the boundaries of the approved area by one or both of the following:

(1) longitude and latitude to the nearest degree, minute, and second as shown on the latest edition of the appropriate Coast and Geodetic Survey chart;

(2) fixed objects or landmarks as described in the United States Coast Pilot No. 8 (Pacific Coast of Alaska-Dixon Entrance to Cape Spencer) 12th edition, and United States Coast Pilot No. 9 (Pacific Coast of Alaska-Cape Spencer to Beaufort Sea) 8th Edition.

(d) Because of differing levels of paralytic shellfish poisoning in various species of shellfish, the commissioner will, in his discretion, approve a shellfish growing area under (a) of this section for the harvesting of selected species of shellfish.

(e) The commissioner will, in his discretion, prescribe specific processing techniques for shellfish harvested from a shellfish growing area approved under (a) of this section to ensure that the species harvested are safe for human consumption.

(f) If a shellfish growing area approved under (a) of this section, upon reinspection, fails to meet a requirement of (b) of this section, or is otherwise hazardous to public health, emergency revocation of the approval will be made by the department with appropriate notice as described in (c) of this section.

(g) Shellfish may be relaid from one growing area to another only with written permission from the department. Shellfish from a prohibited area may be relaid to an approved area only under department supervision. The department will notify other interested agencies of permission for relaying.

(h) If shellfish from a prohibited area are relaid in an approved area, no shellfish may be harvested for human consumption marketing in the approved area until the same bacterial and chemical levels of the original resident shellfish have been reached. Shellfish relaid in approved growing areas from other approved growing areas may be taken for marketing purposes only with written permission from the department.

(i) Procedures to be used in the bacteriological examination of shellfish and shellfish waters are those established by the American Public Health Association, Inc., publication, Recommended Procedures for the Examination of Sea Water and Shellfish, 4th Edition, 1970. Procedures to be used for paralytic shellfish poisoning determination are those published in the Official Methods of Analysis of the Association of Official Analytical Chemists, 13th Edition, 1980. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.040

Editor's Note: Copies of the United States Coast Pilot No. 8 and United States Coast Pilot No. 9 may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402. Copies of Recommended Procedures for the Examination of Sea Water and Shellfish, 4th Edition, 1970, are available from the American Public Health Association, Inc., 1015 18th Street, N.W., Washington, D.C. 20036. Copies of Official Methods of Analysis, 13th Edition, 1980, are available from the Association of Official Analytical Chemists, 1111 N. 19th Street, Suite 210, Arlington, Virginia 22209.

18 AAC 34.210. HARVESTING AND HANDLING. (a) Vessels, including buying vessels, used for tonging, dredging, or transporting shellfish must be designed, constructed, operated, and maintained to prevent contamination of the shellfish.

(b) During the harvesting season for human consumption marketing, no body excretions may be discharged or dumped overboard from a vessel used in harvesting shellfish while it is in approved or conditionally approved areas from which shellfish are being dredged, tonged, or otherwise gathered. The vessel must be equipped with a United States Coast Guard approved marine sanitation device.

(c) Only live, unbroken shellfish from approved harvest areas may be sold or purchased for human consumption processing.

(d) Bait shellstock must be identified with an approved dye before being transferred from the beach or for a commercial purpose. A permit is required from the department to harvest bait shellstock for commercial purposes.

(e) Shellstock or shucked shellfish intended for human consumption may not be transferred, shipped in the same vehicle, or stored with bait shellfish. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.040

18 AAC 34.220. PREPARING FOR MARKET. (a) Shellstock in dry storage must be protected from contamination.

(b) Shellfish may be processed for human consumption only in facilities constructed and operated in accordance with 18 AAC 34.010 -- 18 AAC 34.270. However, with written approval from the department, the freezing of previously shucked and packed shellfish may take place in a separate facility which meets sanitary requirements.

(c) In processing facilities the shucking and packing processes must be done in separate rooms. A delivery window must be installed in the partition between the two rooms through which the shucked stock is passed to the packing room.

(d) Shellfish processing facility construction, equipment and utensils, cleanliness, personnel, and operations must comply with 18 AAC 34.010 -- 18 AAC 34.270. The management of a shellfish processing facility shall designate a person who is responsible for compliance with 18 AAC 34.010 -- 18 AAC 34.270.

(e) Shucking room equipment and operation must conform with the following:

(1) the tops of shucking benches and the sides above the bench top to a height of at least two feet must,

when the benches are used for storage, be of smooth concrete, noncorrodible metal, or other nonabsorbent material, free from cracks or crevices, and so constructed that drainage is rapid and complete;

(2) shucking blocks must be removable unless they are an integral part of the bench and must be of solid one-piece construction;

(3) stands or stalls must be of finished material and impervious to water;

(4) boxes, shelves, hooks, or nails may not be placed above the benches;

(5) floor shucking is prohibited;

(6) shucking pails or colanders must be of a noncorrodible, smooth, impervious material and must be constructed to eliminate grooves, seams, and cracks where foreign particles, dirt, and slime might collect;

(7) seams and joints must be well filled with solder and dressed;

(8) the nesting of pails and similar containers is prohibited after they have been washed and sterilized;

(9) knives must be of noncorrodible, smooth, impervious material and must be constructed to eliminate grooves, joints, and cracks where food particles and dirt might collect;

(10) the handles of opening knives and the breaking blocks must be made without cracks or crevices which would retain food particles, dirt, and slime;

(11) persons who handle shucked shellfish shall wear an apron or coat of washable or waterproof material which must be kept reasonably clean;

(12) finger cots, if worn, must be of clean, washable or waterproof material;

(13) shields for protecting the palm of the hand must be of clean, washable or waterproof material, preferably rubber;

(14) shucking pails must be rinsed with running potable water before each filling. Returning shucked shellfish to the shucker after delivery to the packing room is prohibited;

(15) utensils used in shucking, including pails, knives, hammers, and shucking blocks which come in contact with shucked shellfish, must be thoroughly cleaned within three hours of the end of each day's operation (or sooner as considered necessary by the inspector), treated with a bactericidal solution, and stored where they are protected from contamination;

(16) the bactericidal requirements of this subsection are satisfied if utensils and equipment are

(A) exposed for at least 15 minutes to a temperature of at least 170°F, or for at least five minutes to a temperature of at least 200°F, in a steam cabinet with an indicating thermometer in the coldest zone;

(B) immersed in hot water at a temperature of at least 170°F for at least one-half minute;

(C) exposed to hot air at a temperature of at least 180°F for at least 20 minutes in a properly designed oven or hot-air cabinet with an indicating thermometer in the coldest zone; or

(D) immersed in or exposed to a flow of chlorine solution containing not less than 50 parts per million free chlorine, for a period of at least one minute;

(17) The following table represents amounts of chlorine compounds which will satisfy 18 AAC 34.220(15) and (16):

Amounts of Chlorine Compounds Required
to Give Approximately 100 Parts Per Million
Chlorine by Readily Available Measuring Devices

Volume of Water--Gallons	Dry Chlorine Compounds Available Chlorine			Liquid Hypochlorite Solutions Available Chlorine	
	15%	25%	70%	15%	5%
20	5-1/2 tbs.	3-1/2 tbs.	1-1/2 tbs.	3 cups	10 tbs.
40	11 tbs.	6-1/2 tbs.	2-1/2 tbs.	3 pts.	1-1/4 cups
60	1 cup	10 tbs.	3-1/2 tbs.	4-3/4 pts.	2 cups
80	1-2/5 cups	13-1/2 tbs.	4-1/2 tbs.	6-1/2 pts.	2-1/2 cups
100	1-4/5 cups	1 cup	6 tbs.	4 qts.	3 cups
150	2-3/4 cups	1-1/2 cups	9 tbs.	6 qts.	4-3/4 cups
200	3-3/5 cups	2 cups	12 tbs.	2 gal.	3 pts.

Note: Dry Measure: 1 tablespoon (tbs.) -- approximately 0.3 oz.
1 cup (1/2 pint) -- approximately 5 oz.

Liquid Measure: 1 tbs. -- approximately 15 ml.
1 cup (1/2 pint) -- approximately 16 tbs.

(18) equipment used in shucking, including pails, knives, breaking blocks, and finger cots must be stored in a steam cabinet or other suitable place after cleaning and bactericidal treatment;

(19) shucked shells must be promptly removed from the shucking room and disposed of to prevent product contamination and so that no nuisance is created; and

(20) miscellaneous equipment, including unused or abandoned equipment, not needed to carry out the shucking process, may not be in the operating area; the shucking and packing areas, when in operation, must be restricted to the handling of shellfish to prevent accumulation of material and articles which would hinder cleaning or cause contamination of the shellfish.

(f) The inspector will approve the use of a type of bactericide or bactericidal treatment other than that described in (e)(16) of this section only if the inspector is satisfied that it is effective for use with shellfish sanitation. The use of formaldehyde or other preservatives is prohibited where the preservatives will contact shellfish meats.

(g) Packing and shipping rooms and equipment in packing and shipping rooms must conform with the following:

(1) packing equipment, including skimmers, tanks, tubs, measures, colanders, and paddles must be of a noncorrodible, smooth, impervious material and constructed to eliminate grooves, seams, and cracks where foreign material and slime might collect;

(2) seams and joints in equipment must be well filled with solder and dressed to a smooth finish;

(3) a stand or shelf must be under chutes from skimmers or blowers to support a measure or can;

(4) the surface of skimmers, blowers, tubs, tanks, and other utensils with which shucked shellfish come in contact must be free of paint and rust;

(5) the air pipes in the blower must be removable or located to aid cleaning;

(6) the portion of the air pipes below the tank liquid level must be of smooth, noncorrodible, impervious material;

(7) there must be a sterilization connection of adequate size to the air line of the blower above the tank liquid level by which steam or hot water may be forced through the line;

(8) perforations in the skimmers, colanders, and blower trays must be smooth to aid cleaning;

(9) skimmers, ladles, and colanders made of wire mesh are prohibited;

(10) blowers with narrow and deep compartments along their sides or at the corner, separated from the main part of the blower by a perforated plate, may not be used;

(11) pipes in blowers must be supported at a sufficient distance above the bottom of the tank to allow easy passage of a brush between the pipes and tank bottom;

(12) air pump intakes must be protected against contamination;

(13) shallow tanks and tubs must be elevated to raise the top rim at least two feet above the floor;

(14) tables and shelves must be of materials that can be readily cleaned;

(15) the United States Department of Health and Human Services Public Health Service publication, Shellfish Industry Equipment Construction Guide, Public Health Publication No. 943, April 1963, is adopted by reference and its recommendations established as standards for compliance with requirements of equipment construction in this subsection;

(16) shucked shellfish must be packed and shipped in approved single-service containers of clean, impervious materials positively sealed, or in containers so sealed that tampering can be detected;

(17) single-service containers may not be reused;

(18) the state abbreviation, the packer's permit number, and the earliest date of shucking must be impressed, embossed, lithographed, or otherwise permanently recorded on the container or on the cover if the cover becomes an integral part of the container during the sealing process; if a code system is used to indicate this information, the code must be filed with the department; the earliest date of shucking and the destination of each shipment must be made part of the packer's record;

(19) the refrigeration unit used to keep shucked shellfish at the holding temperatures required by (h) of this section must have adequate storage capacity for shucked stock received or packed during each day, must be insulated with an impervious lining, must have a floor which is graded to drain quickly, and must have a thermometer at the warmest point in the refrigerator;

(20) ice used in cooling water for processing of shucked stock or for cooling shucked stock during processing must be from a source approved by the department and must be stored and handled in a clean way;

(21) ice may not be allowed to contact shucked stock after processing is completed;

(22) facilities must be provided for bactericidal treatment of packaging equipment such as skimmers, tanks, tubs, measures, colanders, and paddles which come in contact with shucked shellfish;

(23) a person working in a packing room shall wear a clean outer garment protected with a clean waterproof or washable apron or coat;

(24) when manual handling of shucked shellfish which have received their final washing is necessary, persons handling the shucked shellfish shall wear clean rubber gloves or shall wash and sanitize their hands;

(25) the floors, walls, and, if necessary, the ceiling of the packing room must be cleaned at the end of each day's operation and flushed with water from a source approved by the department;

(26) windows and skylights must be kept clean;

(27) refrigerators or iceboxes must be washed out once a week or more often if necessary;

(28) packing equipment, including skimmers, tanks, tubs, measures, colanders, and paddles which come in contact with the shucked shellfish must be thoroughly scoured until clean, then sterilized, at the end of each day's operation;

(29) air pipes in blowers must be removed daily at the end of packing operations and their interior and exterior surfaces thoroughly cleaned;

(30) cleaning and sterilizing operations must be done within three hours of the end of each day's operation, and equipment must be stored where it will be protected from contamination;

(31) large equipment which cannot be protectively stored must be cleaned as necessary and at the end of each day's operation and must be subjected to bactericidal treatment immediately before use; and

(32) in the packing rooms, equipment with which shucked shellfish come in contact must, after thorough bactericidal treatment, be stored to protect it from contamination.

(h) Shucked shellfish must be cooled to 45°F or less within two hours after the shellfish are shucked, packed in dated and sealed containers, and, unless quick frozen, must be kept at an internal temperature of 34°-39°F until delivered to the consumer. Frozen shucked shellfish must be kept frozen until delivered to the consumer.

(i) Repacking of stock must be done in accordance with the requirements for packing facilities. Stock may be repacked only if it is received in approved shipping containers. Container must show the earliest date of shucking of stock packed in the containers, as well as the identity of the supplier where the stock was shucked. The information required by this subsection must be made a part of the repacker's record.

(j) The handling of shellstock must conform to the following:

(1) the washing of shellstock, when necessary, must be done with water from a source approved by the department;

(2) after tub washing or blowing, the washed shellfish may not be returned to the skimmer used for handling the freshly shucked stock;

(3) shellstock must be packed and shipped in clean containers under conditions which prevent spoilage or contamination;

(4) storage facilities must comply with 18 AAC 34.010 -- 18 AAC 34.270; and

(5) shellstock must be identified by a tag or label securely fastened to each shipping container and bearing the permit number, name, and address of the shipper; the name and address of the consignee; and the kind and amount of shellstock in the container.

(k) Complete and accurate records must be kept by shellfish packers and shippers to permit the department to readily trace shellfish on the market to the point of origin.

(l) The bacteriological standard for fresh and frozen shucked shellfish at the wholesale market level is a fecal coliform density of not more than 100 MPN per 100 grams and a 35°C aerobic total plate count of not more than 100,000 MPN per gram. Shellfish exceeding either or both of these levels are unsuitable for human consumption. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.035
AS 03.05.040
AS 03.05.050

Editor's Note: Copies of the Shellfish Industry Equipment Construction Guide are available from the United States Department of Health and Human Services, Food and Drug Administration, Bureau of Foods, Shellfish Sanitation Branch, 200 C Street, S.W., Washington, D.C. 20204.

18 AAC 34.240. PROCESSING OF RAZOR CLAMS IN RESTAURANTS. A restaurant must have a permit to process razor clams. The permit must be kept on the premises and made available for inspection by the commissioner or a designated representative. (Eff. 6/24/79, Register 70; am 9/1/83, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.040

18 AAC 34.250. ELIGIBILITY FOR PERMIT TO PROCESS RAZOR CLAMS. To qualify for a permit to process razor clams, a restaurant must comply with this chapter and 18 AAC 31. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)

18 AAC 34.260. PROCESSING STANDARDS FOR RAZOR CLAMS IN RESTAURANTS. (a) Only live, unbroken razor clams from approved growing areas may be processed in a restaurant. They must be received and held in an area protected from dirt, filth, and other contamination. The shellstock must be rinsed at the digging site of sand and foreign debris. Only water from a source approved by the department may be used on the shellstock.

(b) Razor clams must be processed by shucking from the shell, removing the dark portion of the siphon tip, guts, and mantle, and rinsing the cleaned meat free of debris with approved potable water. Waste must be removed promptly from the restaurant.

(c) Shucking and gutting may be done only when the restaurant is closed to food preparation and service.

(d) Processing and food-contact utensils and equipment must be cleaned, rinsed, and sanitized before use in processing razor clams. Utensils and equipment must be protectively stored against contamination.

(e) Only food-grade utensils and equipment may be used for processing razor clams and for holding the shucked meat until cooking.

(f) Utensils and equipment must be thoroughly cleaned, rinsed, and sanitized after razor clam processing and before food preparation and service. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)

18 AAC 34.270. SALE OF RAZOR CLAMS BY RESTAURANTS. Razor clams processed in an approved restaurant must be served only in the establishment. (Eff. 6/24/79, Register 70; am 9/1/82, Register 83)

Authority: AS 03.05.010(c)
AS 03.05.020(a)(1)
AS 03.05.040

PART 161—FISH AND SHELLFISH

Subpart A—General Provisions

Sec.

Subpart B—Requirements for Specific Standardized Fish and Shellfish

AUTHORITY: Secs. 401, 701, 52 Stat. 1046 as amended, 1055-1056 as amended (21 U.S.C. 341, 371) unless otherwise noted.

SOURCE: 42 FR 14464, Mar. 15, 1977, unless otherwise noted.

Subpart A—General Provisions

§ 161.30 Declaration of quantity of contents on labels for canned oysters.

(a) For many years packers of canned oysters in the Gulf area of the United States have labeled their output with a declaration of the drained weight of oysters in the containers. Packers in other areas have marketed canned oysters with a declaration of the total weight of the contents of the container. Investigation reveals that under present-day practice consumers generally do not discard the liquid packing medium, but use it as a part of the food. Section 403(e)(2) of the Federal Food, Drug, and Cosmetic Act and the regulations thereunder require food in package form to bear an accurate label statement of the quantity of food in the container.

(b) It is concluded that compliance with the label declaration of quantity

of contents requirement will be met by an accurate declaration of the total weight of the contents of the can. The requirements of § 161.145(c), establishing a standard of fill of container for canned oysters and specifying the statement of substandard fill for those canned oysters failing to meet that standard remain unaffected by this interpretation.

(Sec. 403, 52 Stat. 1047, as amended; 21 U.S.C. 343)

Subpart B—Requirements for Specific Standardized Fish and Shellfish

§ 161.130 Oysters.

(a) Oysters, raw oysters, shucked oysters, are the class of foods each of which is obtained by shucking shell oysters and preparing them in accordance with the procedure prescribed in paragraph (b) of this section. The name of each such food is the name specified in the applicable definition and standard of identity prescribed in §§ 161.131 to 161.140, inclusive.

(b) If water, or salt water containing less than 0.75 percent salt, is used in any vessel into which the oysters are shucked the combined volume of oysters and liquid when such oysters are emptied from such vessel is not less than four times the volume of such water or salt water. Any liquid accumulated with the oysters is removed. The oysters are washed, by blowing or otherwise, in water or salt water, or both. The total time that the oysters are in contact with water or salt water after leaving the shucker, including the time of washing, rinsing, and any other contact with water or salt water is not more than 30 minutes. In computing the time of contact with water or salt water, the length of time that oysters are in contact with water or salt water that is agitated by blowing or otherwise, shall be calculated at twice its actual length. Any period of time that oysters are in contact with salt water containing not less than 0.75 percent salt before contact with oysters, shall not be included in computing the time that the oysters are in contact with water or salt water. Before packing into the containers for shipment or other delivery for consumption the oysters are thoroughly drained and are packed without any added substance.

(c) For the purposes of this section:

(1) "Shell oysters" means live oysters of any of the species, *Ostrea virginica*, *Ostrea gigas*, *Ostrea luridu*, in the shell, which, after removal from their beds, have not been floated or otherwise held under conditions which result in the addition of water.

(2) "Thoroughly drained" means one of the following:

(i) The oysters are drained on a strainer or skimmer which has an area of not less than 300 square inches per gallon of oysters, drained, and has perforations of at least ¼ of an inch in diameter and not more than 1¼ inches apart, or perforations of equivalent areas and distribution. The oysters are distributed evenly over the draining surface of the skimmer and drained for not less than 5 minutes; or

(ii) The oysters are drained by any method other than that prescribed by paragraph (c)(2)(i) of this section whereby liquid from the oysters is removed so that when the oysters are tested within 15 minutes after packing by draining a representative gallon of oysters on a skimmer of the dimensions and in the manner described in paragraph (c)(2)(i) of this section for 2 minutes, not more than 5 percent of liquid by weight is removed by such draining.

§ 161.131 Extra large oysters.

Extra large oysters, oysters counts (or plants), extra large raw oysters, raw oysters counts (or plants), extra large shucked oysters, shucked oysters counts (or plants), are of the species *Ostrea virginica* and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains not more than 160 oysters and a quart of the smallest oysters selected therefrom contains not more than 44 oysters.

§ 161.132 Large oysters.

Large oysters, oysters extra selects, large raw oysters, raw oysters extra selects, large shucked oysters, shucked oysters extra selects, are of the species

Ostrea virginica and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 160 oysters but not more than 210 oysters; a quart of the smallest oysters selected therefrom contains not more than 58 oysters, and a quart of the largest oysters selected therefrom contains more than 36 oysters.

§ 161.133 Medium oysters.

Medium oysters, oysters selected, medium raw oysters, raw oysters selects, medium shucked oysters, shucked oysters selects, are of the species *Ostrea virginica* and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 210 oysters, but not more than 300 oysters; a quart of the smallest oysters selected therefrom contains not more than 83 oysters, and a quart of the largest oysters selected therefrom contains more than 46 oysters.

§ 161.134 Small oysters.

Small oysters, oysters standards, small raw oysters, raw oysters standards, small shucked oysters, shucked oysters standards, are of the species *Ostrea virginica* and conform to the definition and standards of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 300 oysters but not more than 500 oysters; a quart of the smallest oysters selected therefrom contains not more than 138 oysters and a quart of the largest oysters selected therefrom contains more than 68 oysters.

§ 161.135 Very small oysters.

Very small oysters, very small raw oysters, very small shucked oysters are of the species *Ostrea virginica* and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 500 oysters, and a quart of the largest oysters selected therefrom contains more than 112 oysters.

§ 161.136 Olympia oysters.

Olympia oysters, raw Olympia oysters, shucked Olympia oysters, are of the species *Ostrea lurida* and conform to the definition and standard of identity prescribed for oysters in § 161.130.

§ 161.137 Large Pacific oysters.

Large Pacific oysters, large raw Pacific oysters, large shucked Pacific oysters, are of the species *Ostrea gigas* and conform to the definitions and standards of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains not more than 64 oysters, and the largest oyster in the container is not more than twice the weight of the smallest oyster therein.

§ 161.138 Medium Pacific oysters.

Medium Pacific oysters, medium raw Pacific oysters, medium shucked Pacific oysters, are of the species *Ostrea gigas* and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 64 oysters and not more than 96 oysters, and the largest oyster in the container is not more than twice the weight of the smallest oyster therein.

§ 161.139 Small Pacific oysters.

Small Pacific oysters, small raw Pacific oysters, small shucked Pacific oysters, are of the species *Ostrea gigas* and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 96 oysters and not more than 144 oysters, and the largest oyster in the container is not more than twice the weight of the smallest oyster therein.

§ 161.140 Extra small Pacific oysters.

Extra small Pacific oysters, extra small raw Pacific oysters, extra small shucked Pacific oysters, are of the species *Ostrea gigas* and conform to the definition and standard of identity prescribed for oysters by § 161.130 and are of such size that 1 gallon contains more than 144 oysters, and the largest oyster in the container is not more than twice the weight of the smallest oyster therein.

§ 161.145 Canned oysters.

(a) *Identity.* (1) Canned oysters is the food prepared from one or any mixture of two or all of the forms of oysters specified in paragraph (a)(2) of this section, and a packing medium of water, or the watery liquid draining from oysters before or during processing, or a mixture of such liquid and water. The food may be seasoned with salt. It is sealed in containers and so processed by heat as to prevent spoilage.

(2) The forms of oysters referred to in paragraph (a)(1) of this section are prepared from oysters which have been removed from their shells and washed and which may be steamed while in the shell or steamed or blanched or both after removal therefrom, and are as follows:

(i) Whole oysters with such broken pieces of oysters as normally occur in removing oysters from their shells, washing, and packing.

(ii) Pieces of oysters obtained by segregating pieces of oysters broken in shucking, washing, or packing whole oysters.

(iii) Cut oysters obtained by cutting whole oysters.

(3)(i) When the form of oysters specified in paragraph (a)(2)(i) of this section is used, the name of the food is "Oysters" or "Cove oysters", if of the species *Ostrea virginica;* "Oysters" or "Pacific oysters", if of the species *Ostrea gigas;* "Oysters" or "Olympia oysters", if of the species *Ostrea lurida.*

(ii) When the form of oysters specified in paragraph (a)(2)(ii) of this section is used, the name of the food is "Pieces of ————", the blank being filled in with the name "Oysters" or "Cove oysters", if of the species *Ostrea virginica;* "Oysters" or "Pacific oysters", if of the species *Ostrea gigas;* "Oysters" or "Olympia oysters", if of the species *Ostrea lurida.*

(iii) When the form of oysters specified in paragraph (a)(2)(iii) of this section is used, the name of the food is "Cut ——", the blank being filled in with the name "Oysters" or "Cove oysters", if of the species *Ostrea virginica;* "Oysters" or "Pacific oysters", if of the species *Ostrea gigas;* "Oysters" or "Olympia oysters", if of the species *Ostrea lurida.*

(iv) In case a mixture of two or all such forms of oysters is used, the name is a combination of the names specified in this paragraph (a)(3) of the forms of oysters used, arranged in order of their predominance by weight.

(b) [Reserved]

(c) *Fill of container.* (1) The standard of fill of container for canned oysters is a fill such that the drained weight of oysters taken from each container is not less than 59 percent of the water capacity of the container.

(2) Water capacity of containers is determined by the general method provided in § 130.12(a) of this chapter.

(3) Drained weight is determined by the following method: Keep the unopened canned oyster container at a temperature of not less than 68° or more than 95° Fahrenheit for at least 12 hours immediately preceding the determination. After opening, tilt the container so as to distribute its contents evenly over the meshes of a circular sieve which has been previously weighed. The diameter of the sieve is 8 inches if the quantity of the contents of the container is less than 3 pounds, and 12 inches if such quantity is 3 pounds or more. The bottom of the sieve is woven-wire cloth which complies with the specifications for such cloth set forth under "2380 Micron (No. 8)," in Table I of "Standard Specifications for Sieves," published March 1, 1940, in L. C. 584 of the United States Department of Commerce, National Bureau of Standards. Without shifting the material on the sieve, so incline the sieve as to facilitate drainage. Two minutes from the time drainage begins, weigh the sieve and the drained oysters. The weight so found, less the weight of the sieve, shall be considered to be the drained weight of the oysters.

(4) If canned oysters fall below the standard of fill of container prescribed in paragraph (a) of this section, the label shall bear the general statement of substandard fill specified in § 130.14(b) of this chapter in the manner and form therein specified, followed by the statement, "A can of this size should contain ——— oz. of

oysters. This can contains only ——— oz.", the blanks being filled in with the applicable figures.

§ 161.170 Canned Pacific salmon.

(a) *Identity.* (1) Canned Pacific salmon is the food prepared from one of the species of fish enumerated in paragraph (a)(2) of this section, prepared in one of the forms of pack specified in paragraph (a)(3) of this section, and to which may be added one or more of the optional ingredients specified in paragraph (a)(4) of this section. The food is packed in hermetically sealed containers and so processed by heat as to prevent spoilage and soften bones. The food is labeled in accordance with paragraph (a)(5) of this section.

(2)(i) The species of fish which may be used in this food are:

Oncorhynchus tshawytscha	Chinook, king, spring
Oncorhynchus nerka	Blueback, red, sockeye
Oncorhynchus kisutch	Coho, Cohoe, medium red, silver
Oncorhynchus gorbuscha	Pink
Oncorhynchus keta	Chum, keta
Oncorhynchus masou	Masou, cherry

(ii) For the purpose of paragraph (a)(5)(i) of this section, the common or usual name or names of each species of fish enumerated in paragraph (a)(2)(i) of this section is (are) the name(s) immediately following the scientific name of each species.

(3) The optional forms of canned Pacific salmon are processed from fish prepared by removing the head, gills, and tail, and the viscera, blood, fins, and damaged or discolored flesh to the greatest extent practicable in accordance with good manufacturing practice; and then washing. Canned Pacific salmon is prepared in one of the following forms of pack:

(i) "Regular" consists of sections or steaks which are cut transversely from the fish and filled vertically into the can. In preparation, segments of skin or large backbone may be removed. The sections or steaks are so packed that the cut surfaces approximately parallel the ends of the container. A small portion of salmon may be added if necessary to complete the fill of the container.

(ii) "Skinless and backbone removed" consists of the regular form of canned salmon set forth in paragraph (a)(3)(i) of this section from which the skin and vertebrae have been removed in accordance with good manufacturing practices.

(iii) "Minced salmon" consists of salmon which has been minced or ground.

(iv) "Salmon tips or tidbits" consists of small pieces of salmon.

(v) "No salt added" consists of canned salmon to which no salt has been added.

(4) One or more of the following optional ingredients may be added to the food:

(i) Salt.

(ii) Edible salmon oil comparable in color, viscosity, and flavor to the oil which would occur naturally in the species of salmon canned.

(5)(i) The name of the food is "salmon" together with the common or usual name or names of the species. At least one species name shall be printed in letters of the same style of type and not less in height than those used for the word "salmon".

(ii) (*a*) Whenever the form of pack is that described in paragraph (a)(3) (ii), (iii), or (iv) of this section, the word or words describing the form of pack shall immediately precede or follow the name of the food without intervening written, printed, or graphic matter in the manner prescribed in § 101.3(e) of this chapter; for example, "red salmon" as the name of the food followed by "skinless and backbone removed".

(*b*) Whenever the form of pack is that described in paragraph (a)(3)(v) of this section and words describing the form of pack are declared on the label, the label shall also bear the statements required by § 105.69 of this chapter.

(iii) The name of each of the ingredients used shall be declared on the label as required by the applicable sections of Part 101 of this chapter.

(b) [Reserved]

(c) *Fill of container.* (1) The standard of fill of container for canned salmon is a fill including all the contents of the container and is not less than the minimum net weight speci-

BIVALVE SHELLFISH PRODUCT LABEL

Information required on product tag (which must be securely fastened to each shipping container:

AK #
Shipper's name
Shipper's address
Name of consignee
Address of consignee
Kind and amount of shellstock being shipped
Product handling statement may be desired such as
"Keep Refrigerated"

EXAMPLE

AK 9000SS
Happy as a Clam Seafood Company
Anywhere, Alaska
John Q. Public
Idontknow, Alaska
Oysters (Crassostrea gigas) 2 dozen

KEEP REFRIGERATED

Tags must be waterproof and label contents must be applied to insure the permanency of label information.

SHELLFISH
FRESH OR FROZEN CLAMS, MUSSELS AND OYSTERS

Public Health Significance:

1. Possess ability to filter and concentrate pathogenic microorganisms and toxic substances many times than what is in the water. Can and will filter 210-300 gallon/day.

2. Estuary habitat is almost universally subject to pollution.

3. Shellfish are packed whole and alive and are often consumed raw or lightly and partially cooked.

4. Entire animal is usually eaten.

5. Shucking process can possibly introduce deleterious material into the final product.

Quality of Oysters and pH

Liquor pH	State of Product
5.6 - 6.1	Passing from fresh to stale
5.3 - 4.9	Passing from stale to sour
below 5.0	advanced decomposition

Note: If this parameter is used, it is of extreme caution that you are knowledgeable of its limitations. The change in pH is the resultant of the conversion of glycogen to lactic acid. Main importance here is to know what the indigenous pH is of a fresh oyster. West Coast oysters, when fresh, will usually show a pH at 6.1 - 6.2.

Use of Interstate Certified Shellfish Shippers List

Dealers are listed alphabetically under their respective state. If you cannot find a certain dealer listed, then proceed to the late listing section in the back of the publication. If this is of no avail, refer back to the alphabetical listing to see when the state's certificates expire. This may be the case of a non-renewal. Refer any or all questions if the "approved" status cannot be ascertained.

Tags/Labels/Identification

All product is to have the proper identification to address its source. Refer to 18 AAC 34.220 (j)(5), (g)(18), and (i) for specifics in the code book. This documentation will provide approved source status information.

Standards for Shellfish (Shucked and Shellstock)

APC ⟩ 100,000 MPN/g
and
Fecal Coliform ⟩ 100/100 grams

Inspection Notes

1. Live shellfish will have shells tightly closed or respond to touch to close quickly.
2. Exterior of shell should be free of excessive dirt and slime.
3. Live shellfish will sink if placed in water.
4. Color of shellfish meats vary with region of harvest.
5. Tapping shells together should sound like hard pebbles if they're alive.
6. No offensive or off odors should be present.
7. Pink coloration in oysters reveals a yeast contamination - proceed to check for decomposition.

Some Diseases and Shellfish

Typhoid fever, hepatitis A, vibrio, campylobacter, paratyphoid, polio, paralytic shellfish poision (PSP), viral gastroenteritis, and bacillus cereus.

Quality Control Hints for the Retailer/Restaurant Facility

Shucked Product

1. Use on a rotational schedule.
2. Submerse containers in ice while currently in a walk-in box. Shucked oysters will freeze at 29° F.
3. Freeze for later use upon arrival to facility - not after prolonged storage.
4. Best storage temperatures are 34°-39° F for quality or lower.

Shellstock

1. Store at temperatures 34-39° F or lower.
2. Prolonoged storage will eventually cause death by dessication of liquor.

STATE OF ALASKA

Department of Environmental Conservation

SEAFOOD PROCESSORS PERMIT APPLICATION

Annual completion of this form will satisfy the application requirements of the Alaska Department of Environmental Conservation (ADEC) for authorization to operate a seafood processing facility. Submittal of a complete application will enable ADEC to determine which, if any, approvals and permits are necessary for a specific operation. A seafood processing permit is required for:

All fish or fishery product processors, shrimp, crab and bivalve shellfish processors, growers, harvesters, packers or repackers of bivalve shellfish.

In addition, the following permits may be required depending on the specific type and method of operation:

Plan Review and Approval of Sewage or Sewage Treatment Works
Wastewater Disposal Permit
Plan Review and Approval of Public Water Systems
Food Service Permit
Air Quality Control Permit to Operate
Solid Waste Management Permit
NPDES Permit

In most cases, these permits and approvals can be issued on the basis of information provided in a complete application. The Department will contact an applicant if additional information is needed. UP TO 60 DAYS MAY BE REQUIRED TO PROCESS THIS APPLICATION. THEREFORE, IT IS SUGGESTED THAT THE APPLICATION BE SUBMITTED AT LEAST THREE MONTHS BEFORE AN OPERATION'S ANTICIPATED START-UP DATE. The permits which ADEC will issue authorize the work described in this application. Changes in your operation will require another application to describe the changed operation and may result in amended permits.

INSTRUCTIONS

1. **Type or print responses in ink. If a question does not apply to your operation, indicate this with "N/A". If space provided on the form is inadequate for your written response, please use an additional sheet of paper. All blanks on the application must be filled in to be considered complete. An incomplete application will be returned to the applicant.**

2. **Applicants for new or recently modified operations must furnish the following plans and specifications for their plant or facility.**

   a. **PLOT PLAN** (for land based operations only)
   Submit a drawing of reasonable scale (1"=8 feet or larger) showing the entire premises and the location of all buildings, roadways, alleys, dock areas, streams, catch basins, water wells, reservoirs, storage tanks, septic systems, and solid waste storage areas. Indicate the character and surfacing of all traffic areas and drainage features of the premises. Show the North point of the compass.

   b. **VESSEL PLAN** (for vessel based operations only)
   Submit complete and accurate drawings of a reasonable scale (1"=4 feet or larger) showing overall dimensions of the vessel.

   c. FLOOR (OR DECK) PLANS Submit floor (or deck) plans for each floor and all buildings or for all areas of the vessel. Essential information required on plans includes: location of walls (bulkheads), partitions, doorways, posts, windows (port holes); floor drainage openings and gutters; principal pieces of equipment; hot and cold water outlets, water hose connections, and facilities for cleaning and sanitizing utensils and equipment; handwash facilities, employee work positions; storage or holds (dry, cold, chemical, etc.), shelves and racks; conveyors, chutes, ramps, stairways, and ventilation fans; lockers, benches, lavatories, urinals, and toilets. Additional information to be included on the drawings are the name, use, temperature, and ceiling height of each room, and number of employees to use each welfare and toilet room. Floor (or deck) pitch to drains and/or gutters should be indicated by grade lines and/or arrows.

   d. **PLUMBING PLAN** Submit plumbing plans or incorporate them into the floor plan if the information can be shown clearly by using color coded lines. For each plumbing system (potable water system - both domestic and processing system if separate; seawater system for processing and equipment washing; non-potable water system; and domestic and processing waste systems) show the following:
   Intakes, lines, flow volumes, treatment equipment, location and size of holding or storage tanks, outlets and backflow protectors, drains, gutters, grinders, screens, outfalls, and diffusers.

   e. **MISCELLANEOUS PLANS AND SPECIFICATIONS** Submit the following information either by incorporating it into the floor or deck plans or by submitting additional pages:
   A finishing schedule which identifies composition (for example gypsum board, concrete, marlite) and type of finish (for example, specifications for paint, epoxy, fiberglass) to be used on wall, floor, partition, and ceiling surfaces; manufacturer's specifications or complete description of **principle pieces of equipment** (dimensions, materials, horsepower); location, type and size of all **lighting fixtures**, as well as shielding to protect against breakage and falling glass; location and type of **ventilation and insulation** utilized to control excessive steam, vapors, fumes, and condensation; methods and means used for **control of insects and rodents** (for example, screen doors, air curtains, traps and baits, types of application of pesticides); type, size, and location of **solid waste containers**, as well as method and frequency of waste disposal.

   f. **NARRATIVE DESCRIPTION OF PROCESSING OPERATION** Submit a narrative description of the processing operation describing concisely the steps involved in the movement and processing of the product from receipt or raw materials to departure of finished product from the premises. A flow chart is useful in the review process.

   g. **LABELING INFORMATION:** Product labels must contain the following: Company name and address, product name, net weight, date of packing, AK number, ingredients statement (if indicated), and product holding statement.

3. Submit this completed application, as well as requests for assistance in completing the application, to:
   Seafood Permit Coordinator, Division of Environmental Health, Department of Environmental Conservation
   437 "E" Street, Suite 200, Anchorage, Alaska 99501, Telephone (907) 274-2533

4. Submit a copy of this application to:
   Chief of Water Permits, Environmental Protection Agency, Region X
   1200 6th Avenue, Seattle, Washington 98101

STATE OF ALASKA

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SEAFOOD PROCESSORS PERMIT APPLICATION

Incomplete Applications will NOT be accepted. Insert N/A if not applicable.

A. 1. GENERAL INFORMATION

Company Name	Plant/Vessel Name

Home Office Mailing Address	Telephone

Plant Mailing Address	Telephone (Radio Telephone)

Previous Facility Name	Date of Purchase

2. Principals/Owners

President/Owner	Plant Manager/Superintendent

Vice-President/Partner	Quality Controller

Secretary/Treasurer	Plant/Vessel Owner (If different from company named above)

3. Location (Stationary facilities including seasonally moored vessels)

Latitude and Longitude of Location/Receiving Waters

Layman's Description of Location

4. Vessel Information

USCG Vessel Registration Number or Documentation Number	Length of Vessel

5. Permits/Authorizations Previously Issued (Indicate as appropriate)

Permit to Operate a Seafood Processing Plant - AK Number: _____ ☐ New ☐ Unknown

Sewage Plan Reviewed and Approved - Date: _____ ☐ USCG Approved System

☐ Engineer's Plans Attached

Public Drinking Water Supply Approval - Number: _____ ☐ Engineer's Plans Attached

Waste Water Disposal Permit - Number: _____ ☐ No Discharge ☐ Engineer's Plans Attached

Air Quality Control Permit - Number: _____ ☐ Specifications of Source

Solid Waste Management Permit - Number: _____ ☐ Specifications of Site

EPA Permit - Number: _____ ☐ Applied For

Food Service Permit Number: _____ ☐ New ☐ Plans Attached (see item 8)

CONTINUED ON FOLLOWING PAGE

B. 6. PRODUCTION (Check those operations to be performed)

Processor (18 AAC 34.010) Catcher/Processor (18 AAC 34.010) Air Export (18 AAC 34.010) Harvester (18 AAC 34.180) (Bivalve Shellfish) _____

B. 7. TYPE OF PROCESS (Insert appropriate number in process column)

1 Canning 4 Freezing 6 Cooking 8 Packing/Re-packing Bivalve Shellfish Other fishery products

2 Shucking (Bivalve Shellfish) 5 Retail Sales 7 Other (Specify) _____

3 Curing (Specify Method) _____

Product	Process	Max. Production Capability Raw Product ton/lb per day	Anticipated Finished Product tons/cases per year	Maximum Storage Capability	For Floating Processing in More than 1 location indicate Areas (see attached map)	Mark Months of Anticipated Processing: Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

B. 8. Product Packaging Information

a Can/Package Codes (Attach Can Code Sheet)	Canned Sizes	Number of Lines
b Frozen/Fresh Product	Package Sizes	Attach actual or proposed product label for each product
c Other	Package Type and Sizes	Attach actual or proposed product label for each product

C. 9. FOOD SERVICE

Is Food Service Provided?	Number of Individuals Served Per Day
YES NO	

If you do not have a food service permit attach to this application a drawing or plans of the proposed operation and identify equipment and location of wash basins, sinks, ranges, refrigerators, work tables, etc. Include a narrative description of planned operations.

I certify that I am familiar with 18 AAC 31, Food Service Regulations of the Department of Environmental Conservation, and that the above described establishment will be operated and maintained in accordance with this chapter.

D. 10. FUEL/AIR QUALITY

Fuel Storage Capacity (Gallons)	Type of Fuel Utilized (for example, No. 2 Diesel)	Rate of Electrical Generating Equipment (KW)

E. 11. WATER Fresh Water Source (Check Appropriate Box)

☐ Municipal Supplier - Name _____ ☐ Surface Water - Location or I.D. # _____

☐ Ground Water - Location or I.D. # _____ ☐ Other (Describe): _____

Maximum Number of Employees Served By Drinking Water System	Estimated FRESH WATER used during Processing Gallons Per Day	Estimated SEAWATER used during Processing Gallons Per Day

Fresh Water Storage Capacity (Gallons)	Maximum Production of Fresh Water (Gallons/Minute)

Has In-plant/Vessel Water Supply System Been Evaluated For Possible Cross-connections?

NO YES By _____ Date _____

Identify and Describe Type of In-Plant Treatment Process for SEAWATER	Identify and Describe Type of In-Plant Treatment Process for FRESH WATER

CONTINUED ON FOLLOWING PAGE

F. 12. WASTE DISPOSAL 1

Check method for disposal of sewage (toilet, shower, kitchen and bathroom sink waste)

- ☐ Septic System (Describe) _____
- ☐ Package Treatment Plant (Type) _____
- ☐ Lagoon (Describe) _____
- Municipal System (Name) _____
- ☐ USCG Approved System (Type) _____
- ☐ Holding Tank (Size) _____ Distance From Shore When Discharging _____
- ☐ Depth of Discharge (if Applicable) _____
- ☐ Other (Describe) _____

Check method(s) for disposal of process waste (gurry, fish heads and entrails, carcasses, shells, etc.)

- ☐ No Treatment (Describe) _____
- ☐ Grinder (Type) _____ To what size is waste ground _____
- Depth of Discharge Below Mean Lower Low Water _____
- ☐ Screen Waste ☐ Reduction Plant ☐ Barge to Approved Dumping Site
- ☐ No Processing Waste Discharge ☐ Other (Describe) _____

Check method of disposal of domestic solid waste (kitchen wastes, cardboard, damaged cans)

- ☐ Incinerator — Rated Capacity, lbs./hr. _____
  Describe Construction _____
- ☐ Municipal Solid Waste Facility (Name and Location) _____
- ☐ Private Solid Waste Facility (Name and Location) _____
- ☐ Other (Describe) _____

G. 13. ICE AND REFRIGERATION

Identify method(s) used to maintain or reduce temperature of product upon receipt at facility: _____

If ice, ice production capabilities (tons/24 hours) _____ Source of ice _____

Storage capacity for ice (tons or cubic feet) _____

Method of storage _____

H. 14. SUBMITTALS

Check Additional Information being submitted:

- ☐ Facility Plans and Specifications (Part 2 a-e of Instructions)
- ☐ Narrative Description of the Processing Operation (Part 2f of Instructions)
- ☐ Can/Package Code Sheet (Part 2g and Section B of Application)
- ☐ Copy of this Application has been submitted to the Environmental Protection Agency (Part 4 of instructions)

I. 15. SIGNATURE

I certify that the information contained herein is true and correct to the best of my knowledge.

Signature of Responsible Official Principal/Owner (see item #2)	Date

Printed or Typed Name	Title

Mail completed application and any supporting documents to: Seafood Permit Coordinator, Division of Environmental Health
Department of Environmental Conservation
437 "E" Street, Suite 200, Anchorage, Alaska 99501
Telephone (907) 274-2533 for further information or assistance.

DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF ENVIRONMENTAL CONSERVATION

Name of firm:
Address:
State certification No.:

Ticket	Quantity Purchased or Harvested (indicate oysters, clams, or mussels)	Date of Harvest	Date of Purchase	State Area Designation From Which Harvested	Name and Address or State Permit or License No. of Harvester	Quantity Sold-Indicate Oysters, Clams, or Mussels	Date Sold	State Permit or License No., or Name and Address of Purchaser

APPENDIX F
SANITATION AND EQUIPMENT REQUIREMENTS

SHELLFISH INDUSTRY EQUIPMENT CONSTRUCTION GUIDES

Compiled and Edited by Roy Lunsford

(Developed for use with the Public Health Service-States-Industry Cooperative Program for the Certification of Shellfish Shippers. Adopted by the 1961 National Shellfish Workshop. Public Health Service Publication No. 943. First printed April 1962. Reprinted July 1963.)

Since 1925 the Public Health Service, the States, and the shellfish industry have cooperated in a program designed to maintain a high level of sanitation in the growing, harvesting, and processing of oysters, clams, and mussels to be marketed as a fresh or frozen product. The basic sanitary standards used in the program are fully described in PHS Publication No. 33, Manual of Reccommended Practice for Sanitary Control of the Shellfish Industry, Parts I and II. General construction and cleanability standards for equipment used by the shellfish industry are an integral part of these basic standards.

The need for more specific construction guides for equipment used by the shellfish industry was reviewed at the 1958 Shellfish Sanitation Workshop * and the Public Health Service was requested to initiate development of such guides. In accord with the request, the Public Health Service developed initial drafts of equipment contruction guides. Agencies and organizations which received these initial drafts and thus contributed to development of the completed construction guides included: Interested State agencies, Oyster Institute of North America, Bureau of Commercial Fisheries, Food and Drug Administration, Canandian Department of National Health and Welfare, and two equipment manufacturing companies. The completed construction guides were reviewed and adopted by the 1961 National Shellfish Sanitation Workshop.

It is the purpose of this guide to describe construction and fabrication procedures which will insure that blower tanks, skimmers, returnable shipping containers, and shellfish shucking buckets and pans will meet the construction standard of the Cooperative Program and also the functional needs of industry. However the development of new methods of equipment construction or fabrication is also encouraged. Therefore, shellfish equipment specifications heretofore or hereafter developed which so differ in design material, fabrication, or otherwise as not to conform with the following standards, but which in the the fabricator's opinion are equivalent to or better may be submitted for consideration. Correspondence relative to such standards should be directed to Shellfish Sanitation Program, Division of Environmental Engineering and Food Protection, Public Health Service, Washington 25, D.C.

SCOPE

This guide covers the sanitary construction aspects of (1) shellfish blower tanks, including the sanitary piping for air, water and drain lines, (2) the stand-supported skimmer, including the supporting stand, (3) returnable shipping containers, (4) shellfish shucking buckets, and (5) shellfish shucking pans.

* Proceedings, 1958 Shellfish Sanitation Workshop, U.S. Public Health Service, Washington 25, D.C.

DEFINITIONS

(1) Shellfish--All edible species of oysters, clams, or mussels. Shellfish products which contain and material other than the meats and/or shell liquor of oysters, clams, or mussels will be regarded as a "processed food" and will not be included in the Cooperative Program. (For the purpose of this guide, the term does not include crabs, shrimps, or lobsters.)

(2) Shucked Shellfish--Shellfish, or parts thereof, which have been removed from their shells.

(3) Product--Shucked shellfish which are either held, shipped, washed, and/or drained in this equipment.

(4) Product Contact Surface--All surfaces that are exposed to the product, or surfaces from which liquid may drain, drop, or be drawn into the product.

(5) Non-Product Contact Surface--All other surfaces not included in (4) above.

(6) Blower--A tank-like device for the immersion washing of shucked shellfish. Air may be introduced at the bottom of the tank to produce agitation.

(7) Drain gate and chute--The tank opening through which the washed shellfish are discharged.

(8) Drain valve--The valve through which the wash water is released to the floor or waste line.

(9) Skimmers--The stand-supported, perforated tray in which shucked shellfish are spray washed and/or drained.

(10) Skimmer Paddle--The utensil used as the gate on the skimmer exit chute and/or one used to scrape the product through the exit chute.

(11) Returnable Shipping Container--Multiple use containers for holding or shipped of shucked shellfish.

(12) Shellfish Shucking Bucket--Containers for temporarily holding shucked shellfish during the shucking process.

(13) Shellfish Shucking Pan--Containers for temporarily holding shucked shellfish during the shucking process.

(14) Welds--Permanent seams and joints.

BLOWER TANK

A. Material

(1) All product-contact surfaces shall be of A.I.S.I. (American Iron and Steel Institute) Type No. 302 stainless steel or equally corrosion-resistant

metal that is non-toxic and nonabsorbent except that:

(a) Plastic material may be used for the blower tank drain gate and drain valve. These materials shall be relatively inert, resistant to scratching, scoring and distortion by the temperature, chemicals and methods to which they are normally subjected in operation, or by cleaning and bactericidal treatment. They shall be non-toxic, fat resistant, relatively nonabsorbent, relatively insoluble, and shall not release component chemicals or impart a flavor to the product.*

(b) Rubber and rubber-like materials may be used for blower tank paddles or gate, drain gate, and drain valve. These materials shall be relatively inert, resistant to scratching, scoring and distortion by the temperature, chemicals and methods to which they are normally subjected in operation, or by cleaning and bactericidal treatment. They shall be non-toxic, fat resistant, relatively nonabsorbent, relatively insoluble, and shall not release component chemicals or impart a flavor to the product.*

(2) All nonproduct contact surfaces shall of of inherently corrosion-resistant material, shall be rendered corrosion-resistant, or shall be painted. Surfaces to be painted shall be effectively prepared for painting; and the paint used shall adhere, be relatively nonabsorbent, and shall provide a smooth, cleanable, and durable surface. Parts having both product and non-product contact shall not be painted.

B. Fabrication

(1) All product-contact surfaces shall be at least as smooth as No. 4 mill finish on stainless steel sheets.

(2) All seams in product-contact surfaces shall be welded with the welds ground smooth and polished to not less than a No. 4 finish. All outside seams shall be smooth and waterproof. All weld areas and deposited weld material shall be substantially as corrosion-resistant as the parent metal.

(3) All appurtenances, including drain gates and chutes having product-contact surfaces, shall be easily removable for cleaning, or shall be readily cleanable in place.

(4) All product-contact surfaces shall be easily accessible, visible, and readily cleanable, either when in an assembled position or when removed.

(5) All internal angles of 135 degrees or less on the product-contact surfaces shall hace minimum radii of 1/4 inch, except that minimum radii for fillets or welds on product contact surfaces may be smaller for essential functional reasons. In no case shall radii be less than 1/8 inch.

(6) All sanitary pipe fittings shall conform to "3-A Sanitary Fittings Used on Milk and Milk Products Equipment" and supplements thereto. Sanitary standards describing the construction of values, fittings, and pumps may be

*Plastic, rubber and rubber-like material used for equipment may be subject to the Food Additives Amendment to the Federal Food, Drug, and Cosmetic Act. The acceptability of such materials under the Food Additives Amendment shall be obtained from equipment manufacturers.

obtained from the International Association of Milk and Food Sanitarians, Inc., Box 347, Shelbyville, Indiana.

(7) Non-product contact surfaces shall have a smooth finish, be free of pockets and crevices, and readily cleanable.

(8) Legs shall be of sufficient length to provide at last 12 inches clearance between the lowest fixed point of the tank and the floor, shall be smooth with rounded ends, and shall have no exposed threads. If legs are of hollow tube stock, they shall be effectively sealed.

(9) All threads on product-contact shall comply with specifications contained in the 3-A Sanitary Standards for Fittings (See (6)).

(10) External and internal section of the air pipe shall be easily cleanable to a point at least two inches above the tank overflow level.

(11) The false bottom shall be so constructed as to be rigid and, in any event, of at least 16 gage stainless steel or equivalent material.

(12) Perforations or slots in the false bottom shall not be less than 3/16 inch in the minimum diameter and the end radius of the perforations shall not be less than 3/32 inch. After perforation, the flat surface of the sheet from which the perforating punch or drill emerges on the down stroke shall be polished to the equivalent of not less than a No. 4 mill finish.

(13) Air lines shall be of easily cleanable construction to a point two inches above tank overflow.

(14) Wire mesh shall not be used.

(15) The blower tank shall be constructed so that it will not buckle or sag and so that is will be self draining. Product contact surfaces shall be constructed of not less than 16 U.S. Standard gage stainless steel or equivalent material.

(16) Maximum dimension of the tank from the point of overflow to the drain valve flange shall not exceed 40 inches.

(17) Drain valves and flange shall comply with the 3-A Sanitary Standards for Fittings used on Milk and Milk Products Equipment. The flange shall be welded to the body of the blower tank.

(18) There shall be no exposed screw, bolt, or rivet heads on product-contact surfaces.

SKIMMERS

A. Material

(1) All product-contact surfaces shall be of A.I.S.I. (American Iron and Steel Institute) Type No. 302 stainless steel or equally corrosion -resistant metal that is non-toxic and nonabsorbent except that:

(a) Suitable plastic material or rubber and rubber-like material may be used for the skimmer paddle or gate. These materials shall be relatively

inert, resistant to scratching, scoring and distortion by the temperature, chemicals and methods to which they are normally subjected in operation, or by cleaning and bactericidal treatment. They shall be non-toxic, fat resistant, relatively nonabsorbent, relatively insoluble, and shall not release component chemicals or impart a flavor to the product.*

(2) All nonproduct contact surfaces shall of of inherently corrosion-resistant material, shall be rendered corrosion-resistant, and except for the funnel drain, shall be painted. Surfaces to be painted shall be effectively prepared for painting; and the paint used shall adhere, be relatively nonabsorbent, and shall provide a smooth, cleanable, and durable surface. Parts having both product and non-product contact shall not be painted.

B. Fabrication

(1) All product-contact surfaces shall be at least as smooth as No. 4 mill finish on stainless steel sheets.

(2) All seams in product-contact surfaces shall be welded with the welds ground smooth and polished to not less than a No. 4 finish. All outside seams shall be smooth and waterproof. All weld areas and deposited weld material shall be substantially as corrosion-resistant as the parent metal.

(3) All appurtenances having product-contact surfaces, shall be easily removable for cleaning, or shall be readily cleanable in place.

(4) All product-contact surfaces shall be easily accessible, visible, and readily cleanable, either when in an assembled position or when removed. The skimmer shall be demountable from the supporting stand for cleaning.

(5) All internal angles of 135 degrees or less on the product-contact surfaces shall have minimum radii of 1/4 inch, except that minimum radii for fillets or welds on product contact surfaces may be smaller for essential functional reasons.

(6) The skimmer shall be constructed so that it will not buckle or sag when in use, so that both the perforated area and drainage funnel are self-draining, and so as to provide plane surfaces free from depressions, indentations, or bulges which prevent draining when the pitch is not greater than 1 inch in 50 inches. (Corners and rims of perforated skimmers should be adequately reinforced to precent damage from handling during cleaning and bactericidal treatment.)

(7) The product contact surfaces shall be constructed of not less than 16 U.S. standard gage stainless steel or equivalent material. The perforations or slots in the strainer shall be at least 1/4 inch in diameter (dimension A, Figure 1)* and not more than 1-1/4 inches apart (dimension B, Figure 1)* The strainer area shall have no perforations within 1/2 inch of the edge (dimension C, Figure 1)*. After perforations, the flat surface of the sheet from which the perforating punch or drill emerges on the down stroke shall be polished to the equivalent of not less than a No. 4 mill finish. No bracing for the skimmer shall block any perforations unless the brace is made of corrosion-resistant material and fabricated in a manner suitable for a product-contact surface, and unless it can be readily removed for cleaning.

SKIMMER DESIGN DETAIL

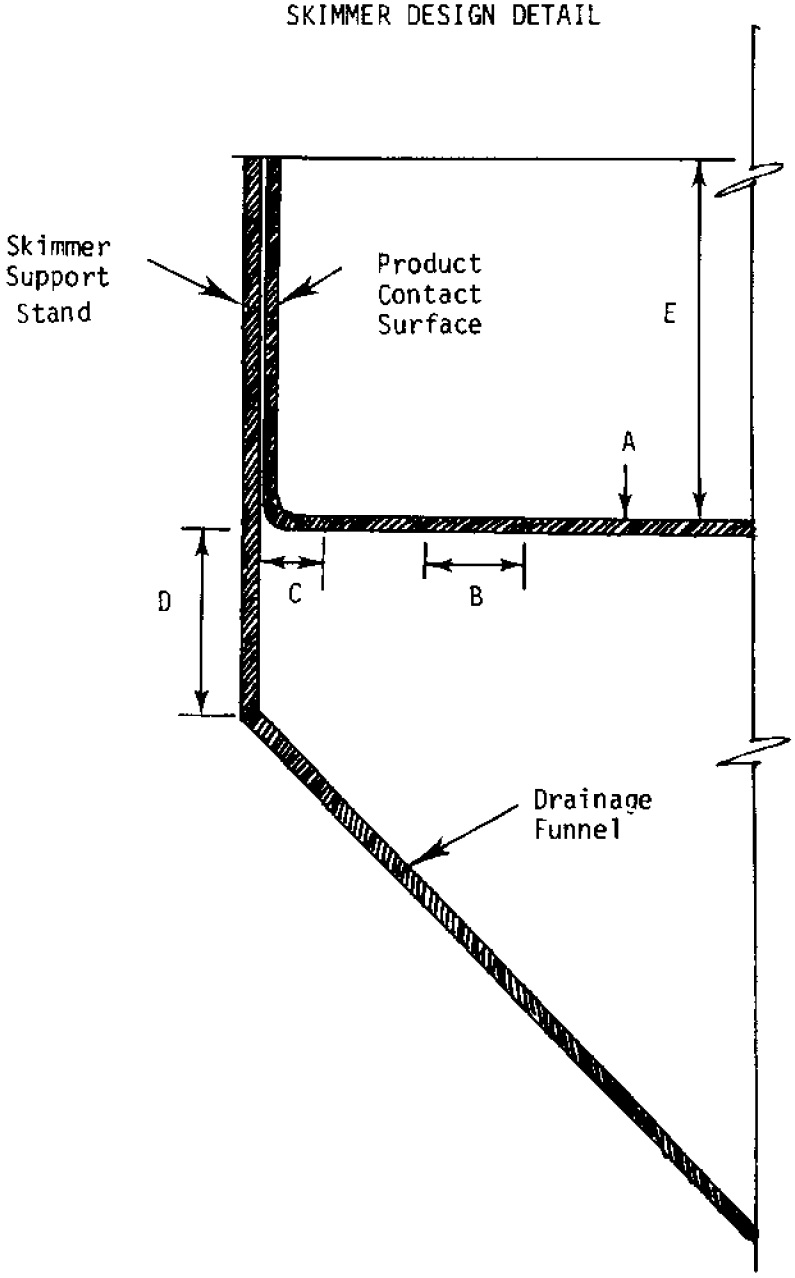

Figure 1.

A minimum of 3-1/2 inches shall be provided between the strainer and the top of the skimmer (dimension E, Figure 1).*

(8) Legs shall be smooth with rounded ends and have no exposed threads. If legs are of hollow tube stock they shall be effectively sealed.

(9) A minimum vertical clearance of 2 inches shall be provided between the perforated skimmer area and the draining funnel. (Dimension D, Figure 1)*

(10) There shall be no threads on product contact surfaces except as provided for in the 3-A Sanitary Standards for Fittings.

(11) The funnel drain shall have a discharge opening of a size sufficient to discharge the drainage without pooling above, and be not less than equivalent to a diameter of 4 inches. The funnel drain shall terminate in a free discharge, a distance of at least 6 inches above the floor or the drain connection if located at a higher elevation than the floor.

(12) Frames, frame legs, and supporting edge of the skimmer shall have:

(a) Structural parts not in contact with the product, and parts constructed with a smooth finish so as to be readily cleanable.

(b) Self draining exterior surfaces.

(c) A minimum of 6 inches of space between the lowest part of the frame and the floor to provide ready access for cleaning the legs and feet and those parts not readily removable.

(13) The frame shall provide continuous support for the outside edge of the skimmer strainer.

(14) The receiving-container shelf under the skimmer chute, where provided as an integral part of the skimmer support frame, shall be constructed of nonabsorbent, corrosion-resistant material and be located so that the receiving-container rim will be at least 2 feet above the floor.

(15) All seams in the funnel drain area shall be smooth and waterproof, and substantially as corrosion-resistant as the parent metal.

(16) There shall be no exposed blots, screws, or rivets in the product-contact surfaces.

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* Skimmer size: The Food and Drug Administrations definition and standard of identity for raw oysters states in part: "The oysters are drained on a strainer or skimmer which has an area of at least 300 square inches per gallon of oysters drained, and has perforations of at least 1/4 of an inch in diameter and not more than 1-1/4 inches apart, or perforations of equivalent areas and distributions. (Definitions and Standards under the Federal Food, Drug and Cosmetic Act, Title 21, Part 36, Federal Register, August 27, 1946.)

RETURNABLE SHIPPING CONTAINERS

A. Material

(1) All metallic product-contact surfaces shall be of A.I.S.A. type No. 302 stainless steel or Aluminium Association type No. 5052-0 alloy, or equally corrosion-resistant metal that is non-toxic. If constructed of stainless steel, the containers shall not be constructed of less than 20 gage material. If constructed of aluminium alloy, the material shall not have a thickness less than 0.004 inches.

(2) All nonproduct-contact surfaces shall be or corrosion-resistant material, and shall provide a smooth, cleanable, and durable surface.

B. Fabrication

(1) All product-contact surfaces shall be at least as smooth as a number 4 mill finish on stainless steel, or equivalent surface finish on aluminum.

(2) All internal angles of 135 degrees or less on product-contact surfaces shall have minimum radii of 1/4 inch.

(3) There shall be no seams, crevices, or other openings within the food-contact surfaces.

(4) The container rim shall be rolled so as to permit easy and complete cleaning. The bead shall either be an open type with an external radii of not less than 3/16 inch or a sealed closed type.

(5) The container lid shall be so constructed as to afford easy and complete cleaning, shall be reasonably tight-fitting, and a lip shall extend at least one inch down the outside of the container. Provisions shall be made for sealing the container so that any tampering will be evident.

(6) Handles shall be provided on 5-gallon or larger containers. The handles shall be considered as a nonproduct-contact surface.

SHUCKING BUCKETS AND PANS

A. Material

(1) All metallic product-contact surfaces shall be of A.I.S.A. type No. 302 stainless steel or Aluminium Association type No. 5052-0 alloy, or equally corrosion-resistant metal that is non-toxic. If constructed of stainless steel, the containers shall not be constructed of less than 20 gage material. If constructed of aluminium alloy, the material shall not have a thickness less than 0.004 inches.

(2) All nonproduct-contact surfaces shall be or corrosion-resistant material, and shall provide a smooth, cleanable, and durable surface.

B. Fabrication

(1) All product-contact surfaces shall be at least as smooth as a number 4 mill finish on stainless steel, or equivalent surface finish on aluminum.

(2) All internal angles of 135 degrees or less on product-contact surfaces shall have minimum radii of 1/4 inch.

(3) The shellfish shucking bucket shall not exceed a nine-pint capacity except for the soft clam (Mya arenaria) shucking pan which shall not exceed a four-pint capacity.

(4) There shall be no seams, crevices, or other openings within the food-contact surfaces except that two holes 180 degrees apart shall be permitted in the side of each bucket near the top to accommodate a removable ball-type handle.

(5) The container rim shall be so constructed as to afford maximum strength and protection against damage, and shall be so rolled as to permit easy and complete cleaning. The bead shall be open type with an external radii of not less than 3/16 inch, or a sealed closed type.

(6) The bail, if provided, shall be considered as contact surface and subject to material specifications as outline in paragraph A of this standard. The bail shall not be less than 3/16 inch in diameter; it shall be so constructed that it will be held into place by spring tension. The bail shall be so constructed that it can easily be removed from the shucking bucket for cleaning purposes.

National Shellfish Sanitation Program

Manual of Operations

Part I

Sanitation of Shellfish Growing Areas

1965 Revision

Edited by

Leroy S. Houser, Sanitarian Director

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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LIST OF PREVIOUS EDITIONS OF MANUAL OF OPERATIONS FOR NATIONAL SHELLFISH SANITATION PROGRAM—NOW SUPERSEDED

1925. Supplement No. 53 to Public Health Reports November 6, 1925 "Report of Committee on Sanitary Control of the Shellfish Industry in the United States".

1937. U.S. Public Health Service Minimum Requirements for Approval of State Shellfish Control Measures and Certification for Shippers in Interstate Commerce (Revised October 1937).

1946. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry Recommended by the U.S. Public Health Service (Public Health Bulletin No. 295).

1957. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry (Part II: Sanitation of the Harvesting and Processing of Shellfish). Printed as Part II of Public Health Service Publication No. 33.

1959. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry (Part I: Sanitation of Shellfish Growing Areas). Printed as Part I of Public Health Service Publication No. 33.

1962. Cooperative Program for the Certification of Interstate Shellfish Shippers, Part II, Sanitation of the Harvesting and Processing of Shellfish. (Printed as Part II of Public Health Service Publication No. 33.)

1962. Cooperative Program for the Certification of Interstate Shellfish Shippers, Part I, Sanitation of Shellfish Growing Areas. (Printed as Part I of Public Health Service Publication No. 33.)

Contents

FOREWORD

A Declaration of Principles

The National Shellfish Sanitation Program is an unusual teaming of State and Federal resources to preserve and manage a natural resource for a beneficial use. Although the current program is of comparatively recent origin, its development can be traced back through several centuries of American history. When the European colonists arrived they found almost unimagined natural wealth. Forests, rich agricultural land, minerals, and space itself, were present in quantities and a variety previously unknown. To these settlers one of the most valuable and readily useable of these natural resources was the food resources of the sea, particularly the estuaries. It is not surprising that shellfish were foremost among their staple food items.

The value of these renewable natural resources to the early settlers was reflected in colonial legislation designed to encourage their wise use. In 1658—over 300 years ago—the Dutch council of New Amsterdam passed an ordinance regulating the taking of oysters from the East River. Other early legislation, including that of New York (1715), New Jersey (1730), and Rhode Island (1734), was designed to regulate harvesting, presumably as conservative measures to guarantee a continuing supply.

The public health problems which were associated with shellfish in the United States in the first two decades of the present century brought a new dimension to natural resource utilization; i.e., shellfish could not be used for food unless of acceptable sanitary quality. This concept was clearly recognized in the Public Health Service sponsored conference of 1925 in which the concepts of the present cooperative program were first outlined and the administrative foundation put down. All parties seemed to recognize, and accept as fact, the premises that: (1) shellfish represented a valuable natural food resource; (2) the cultivation, harvesting, and marketing of this food resource were valuable components in the financial bases of many coastal communities; (3) a State and Federal program was necessary to permit the safe use of this resource; and (4) the transmission of disease by shellfish was preventable and therefore not to be tolerated. It is significant that the founders of this program did not take the parochial stand that the only completely safe way to prevent disease transmission by shellfish was to prohibit its use. Instead, they held that this beneficial use of the estuaries was in the best public interest, and that sanitary controls should be developed and maintained which would allow safe use. These concepts were recognized in the program which evolved following the report of the "Committee on Sanitary Control of the Shellfish Industry in the United States" in 1925.

In 1954 the Surgeon General of the U.S. Public Health Service called a second national conference to discuss shellfish sanitation problems. Specifically, the 1954 conference addressed itself to the questions of the practicality and need for this tripartite program. There was general agreement that, despite the profusion of technical problems, the basic concepts were sound and that it was in the public interest to maintain the program. Thus, the presence of an irrevocable bond between the application of sanitary controls in the shellfish industry and the continuing beneficial use of a renewable natural resource was again confirmed.

Despite this long established relationship the national program has tended to neglect the second of these biphasic goals—use of a valuable natural resource—and to concentrate on the negative policy of closure of areas of unsuitable sanitary quality. Little effort has been made by the program to develop a compensatory ele-

ment which would encourage corrective action by State or Federal agencies. Similarly, the program has not taken a position on the use of conservation law even when it was known that this would increase the program's consumer protection confidence factor.

In recognition of past history of the shellfish industry in the United States and of the relationship of the National Shellfish Sanitation Program to the effective use of this natural resource, the 1964 Shellfish Sanitation Workshop endorses the following principles:

1. Shellfish are a renewable, manageable natural resource of significant economical value to many coastal communities, and which should be managed as carefully as are other natural resources such as forests, water, and agricultural lands.
2. Shellfish culture and harvesting represents a beneficial use of water in the estuaries. This use should be recognized by State and Federal agencies in planning and carrying out pollution prevention and abatement programs and in comprehensive planning for the use of these areas.
3. The goals of the National Shellfish Sanitation Program are: (1) the continued safe use of this natural resource and (2) active encouragement of water quality programs which will preserve all possible coastal areas for this beneficial use.

It is the conviction of the 1964 National Shellfish Sanitation Workshop that survival of the shellfish industry is in the best public interest; that by application of the above principles on a State-by-State basis shellfish can continue to be used safely as food and to make a valuable contribution to the economic structure of the Nation both in the immediate present and in the foreseeable future.

Introduction

In 1925 State and local health authorities and representatives of the shellfish industry requested the Public Health Service to exercise supervision over the sanitary quality of shellfish shipped in interstate commerce. In accordance with this request, a cooperative control procedure was developed. In carrying out this cooperative control, the States, the shellfish industry, and the Public Health Service, each accept responsibility for certain procedures as follows.

1. Procedures To Be Followed by the State.—Each shellfish-shipping State adopts adequate laws and regulations for sanitary control of the shellfish industry, makes sanitary and bacteriological surveys of growing areas, delineates and patrols restricted areas, inspects shellfish plants, and conducts such additional inspections, laboratory investigations, and control measures as may be necessary to insure that the shellfish reaching the consumer have been grown, harvested, and processed in a sanitary manner. The State annually issues numbered certificates to shellfish dealers who comply with the agreed-upon sanitary standards, and forwards copies of the interstate certificates to the Public Health Service.

2. Procedures To Be Followed by the Public Health Service.—The Public Health Service makes an annual review of each State's control program including the inspection of a representative number of shellfish-processing plants. On the basis of the information thus obtained, the Public Health Service either endorses or withholds endorsement of the respective State control programs. For the information of health authorities and others concerned, the Public Health Service publishes a semimonthly list of all valid interstate shellfish-shipper certificates issued by the State shellfish-control authorities.

3. Procedures To Be Followed by the Industry.—The shellfish industry cooperates by obtaining shellfish from safe sources, by providing plants which meet the agreed-upon sanitary standards, by maintaining sanitary plant conditions, by placing the proper certificate number on each package of shellfish, and by keeping and making available to the control authorities records which show the origin and disposition of all shellfish.

The fundamental components of this National Shellfish Sanitation Program were first described in a *Supplement to Public Health Reports*, "Report of Committee on Sanitary Control of the Shellfish Industry in the United States" (1925). This guide for sanitary control of the shellfish industry was revised and reissued in 1937 and again in 1946. It was separated into two parts by publication of Part II, Sanitation of the Harvesting and Processing of Shellfish in 1957 and by publication in 1959, of Part I, Sanitation of Shellfish Growing Areas. The need for a specialized program of this nature was reaffirmed at the National Conference on Shellfish Sanitation held in Washington, D.C., in 1954 (*1*) and at the Shellfish Sanitation Workshop held in 1956 (*2*), 1958 (*3*), 1961 (*67*) and 1964 (*68*).

This edition of the shellfish sanitation manual has been prepared in cooperation with the State shellfish control authorities in all coastal States, food control authorities in the inland States, interested Federal agencies, Canadian Federal departments, the Oyster Institute of North America, the Pacific Coast Oyster Growers Association, and the Oyster Growers and Dealers Association of North America.

Since the growing and processing of shellfish are two distinct phases of operation in the shellfish industry, the manual has been prepared in two parts: I: Sanitation of Shellfish-Growing Areas; and II: Sanitation of the Harvesting and Processing of Shellfish. This, Part I of the manual, is intended as a guide for the preparation of State shellfish sanitation laws and regulations, and for sanitary control of the growing, relaying, and purification of shellfish. It is in-

tended that States participating in the National Shellfish Sanitation program for the certification of interstate shellfish shippers will be guided by this manual in exercising sanitary supervision over shellfish growing, relaying, and purification, and in the issuing of certificates to shellfish shippers.

The manual will also be used by the Public Health Service in evaluating State shellfish sanitation programs to determine if the programs qualify for endorsement. Part III of the manual, "Public Health Service Appraisal of State Shellfish Sanitation Programs", sets forth appraisal procedures in evaluating State shellfish sanitation programs and is based on the requirements contained in parts I and II.

The provisions of this manual were accepted at the Shellfish Sanitation Workshop held in Washington, November 17–19, 1964, and unless otherwise stated become effective 60 days after publication (*68*).

EUGENE T. JENSEN,
Chief, Shellfish Sanitation Branch, Division of Environmental Engineering and Food Protection, Public Health Service.

Definitions

And/or.—Where this term is used, *and* shall apply where possible; otherwise, *or* shall apply.

Area, growing.—An area in which market shellfish are grown.

Coliform group.—The coliform group includes all of the aerobic and facultative anaerobic, Gram-negative, non-spore-forming bacilli which ferment lactose with gas formation within 48 hours at 35° C. Bacteria of this group which will produce gas from E. C. medium within 24 hours at 44.5° C. in a water bath will be referred to as fecal coliforms.

Controlled purification.—The process of removing contamination from whole live shellfish acquired while growing in polluted areas.

National shellfish sanitation program.—The cooperative State-PHS-Industry program for the certification of interstate shellfish shippers as described in Public Health Service Publication Number 33, *National Shellfish Sanitation Program Manual of Operations*, Parts I and II.

Depletion.—The removal of all market-size shellfish from an area.

Most probable number (abbreviated MPN).—The MPN is a statistical estimate of the number of bacteria per unit volume, and is determined from the number of positive results in a series of fermentation tubes. A complete discussion of MPN determinations and computations, including MPN tables, can be found in the American Public Health Association publication "Standard Methods for the Examination of Water and Waste Water" (*4*) (*5*).

Population equivalent (coliform).—A quantity of sewage containing approximately 160×10^9 coliform group bacteria. This is approximately equal to the per capita per day contribution of coliforms as determined in a metropolitan sewerage system (*6*) (*7*) (*8*).

Sanitary survey.—The sanitary survey is the evaluation of all factors having a bearing on the sanitary quality of a shellfish growing area including sources of pollution, the effects of wind, tides, and currents in the distribution and dilution of the polluting materials, and the bacteriological quality of the water.

Shellfish.—All edible species of oysters, clams, or mussels, either shucked or in the shell, fresh or frozen.

Shellfish, market.—Shellfish which are, may be, or have been harvested and/or prepared for sale for human consumption as a fresh or frozen product.

State shellfish control agency.—The State agency or agencies having legal authority to classify shellfish growing areas and/or to issue permits for the interstate shipment of shellfish in accord with the provisions of this manual.

State shellfish patrol agency.—The State agency having responsibility for the patrol of shellfish growing areas.

Transplanting.—The moving of shellfish from one area to another area.

Section A

GENERAL ADMINISTRATIVE PROCEDURES

1. State Laws and Regulations.— State laws or regulations shall provide an adequate legal basis for sanitary control of all interstate phases of the shellfish industry. This legal authority shall enable one or more departments or agencies of the State to classify all coastal waters for shellfish harvesting on the basis of sanitary quality; effectively regulate the harvesting of shellfish; effectively prosecute persons apprehended harvesting shellfish from restricted, prohibited, or nonapproved areas; regulate and supervise the shipment and storage of shell stock, and the shucking, packing, and repacking of shellfish; make laboratory examinations of shellfish; seize, condemn, or embargo shellfish; and restrict the harvesting of shellfish from particular areas and suspend interstate shipper certificates in public-health emergencies.

Satisfactory compliance.—This item will be satisfied when the State has legal authority to—

a. Classify all actual or potential shellfish growing areas as to their suitability for shellfish harvesting on the basis of sanitary quality as defined in section C of this manual. (It is strongly recommended that a State permit be required for the growing of shellfish, and that such permits be revocable or subject to suspension for just cause. It is also recommended that the State have authority to regulate the discharge of sewage, radioactive, and other toxic wastes from boats in the vicinity of approved shellfish growing areas.)

b. Control the harvesting of shellfish from areas which are contaminated or which contain marine shellfish poisons. To be effective this authority must allow the State to—

(1) Patrol growing areas.

(2) Apprehend persons violating the restrictions.

(3) Effectively prosecute persons apprehended harvesting shellfish from *restricted* or *prohibited* areas. (Penalties for such violations should be sufficient to discourage illegal harvesting.)

c. Regulate and supervise relaying, depletion, wet storage, and controlled purification as described in this manual if these techniques are used.

d. Require that shell stock in storage or in transit from the growing area to the certified shipper be protected against contamination; i.e., every person, firm, or corporation that handles shellfish up to the certified shipper will be subject to sanitary control by an official agency but will not necessarily be required to have a State shellfish permit.

e. Prohibit national program shippers from possessing or selling shellfish from out-of-State sources unless such shellfish have been produced in accord with cooperative program requirements.

f. Regulate the operations of shucker-packers, repackers, shell stock shippers and reshippers in accord with the applicable provisions of part II of this manual.

g. Restrict the harvesting of shellfish from specific areas, and suspend interstate shipper certificates in a public-health emergency. **Administrative procedures required in connection with such emergency actions should not require more than one day to complete.**

h. Prevent the sale, shipment, or possession of shellfish which cannot be identified as having been produced in accord with national program requirements or which are otherwise unfit for human consumption, and to condemn, seize, or embargo such shellfish. This authority need not be specific for shellfish and may be included in other State food laws.

Public-health explanation.—The National Program was developed by the 1925 Conference on Shellfish Pollution to meet the specific public-health need resulting from the 1924–25 typhoid epidemic (*9*).

However, the National Program has gone beyond the original objective of insuring that shellfish shipped interstate would not be the cause of communicable disease. Thus, in the 1940's, paralytic shellfish poison became a matter of public-health concern and steps were taken to protect the public against this hazard. In 1957 it was recognized that shellfish might concentrate certain radionuclides and that a

radiation surveillance activity might become a necessary adjunct to the established procedures.

To accomplish these public-health objectives the State must supervise all phases of the growing, harvesting, transportation, shucking-packing, and repacking of shellfish to be shipped interstate. It is also important that shellfish be properly refrigerated and protected against contamination during interstate shipment. This is not easily accomplished by the State of origin although certified shippers are required to pack shellfish in containers which will protect them against contamination.

If State supervision is to be effective all phases of the activity must be supported by legal authority. This authority may be either a specific law or regulation. The success with which the State is able to regulate the several components of the shellfish industry provides a measure of the adequacy of the statutory authority.

The unique nature of shellfish as a food also makes it necessary that the State shellfish control agency have authority to take immediate emergency action to halt harvesting or processing of shellfish without recourse to lengthy administrative procedures. As examples, a State may find it necessary to close a shellfish growing area within hours of a breakdown in a sewage treatment plant or the unexpected finding of paralytic shellfish poison.

Periodic revisions of State shellfish laws or regulations may be necessary to cope with new public-health hazards and to reflect new knowledge. Examples of changes or developments which have called for revision of State laws include the wide-scale use of pleasure boats with the resulting probability of contamination of shellfish growing areas with fresh fecal material, the conditionally approved area concept resulting from the construction of sewage treatment works, and the apparent ability of shellfish to concentrate certain radionuclides.

Experience has demonstrated that all actual and potential shellfish growing waters of the State must be classified as to their sanitary suitability for shellfish harvesting. Harvesting should be permitted only from those areas which have been found by sanitary survey to meet the sanitary criteria of this manual. Harvesting should accordingly be specifically prohibited from areas which do not meet the criteria, or which have not been surveyed.

2. General Administrative Procedures To Be Used by States.—States shall keep records which will facilitate Public Health Service review of their shellfish sanitation programs and shall assist the Service in making such reviews. States shall not certify shippers for interstate shipment unless the shipper complies substantially with the construction requirements of part II of this manual and maintains a sanitation rating of at least 80 percent during periods of operation. Shippers not meeting these requirements will not be eligible for inclusion on the Public Health Service list of State-certified shellfish shippers. National Program standards shall be applied to all actual and potential growing areas, all shellfish harvesters, and all persons handling shell stock prior to its delivery to the national program certified shipper. When two or more State agencies are involved in the sanitary control of the shellfish industry, a clear statement of responsibility of each agency should be developed.

Satisfactory compliance.—This item will be satisfied when—

a. National Program requirements are applied to all actual and potential shellfish growing areas.

b. National Program requirements are applied to all commercial market shellfish harvesters.

c. National Program requirements are applied to all persons handling the shellfish prior to its delivery to the interstate shipper.

d. Interstate shellfish shipper certificates are issued only to those establishments substantially meeting the construction requirements of part II of this manual and which maintain a plant sanitation rating of at least 80 percent during periods of operations. (The State shellfish control agency shall suspend or revoke certificates if a plant sanitation rating drops below 80 percent or if any individual sanitation item is violated repeatedly.) Ratings will be determined on the basis of compliance withe the apapplicable provisions of part II of this manual as measured by an inspection report comparable to that contained in appendix A of part II.

e. The following records are kept of shellfish sanitation activities as required in sections C,

D, and E, Part I, of this manual and when monthly summaries of State patrol activities are forwarded to the Public Health Service regional office:

(1) Individual growing area files. (Areas may be defined by either geographic or political boundaries.)

(2) Patrol activities, including arrests, prosecutions, and the results of prosecutions.

(3) Plant inspections. Shucker-packers and repackers shall ordinarily be inspected at least monthly. Shell stock shippers and reshippers shall be inspected at a frequency which will afford adequate public-health supervision of their operations. A central inspection-report file should be maintained by the State.

f. The following guidelines are observed by the State in issuing interstate shellfish certificates.

(1) Certificate content. Each certificate should give the following information:

Name. (The usual business name and alternative names that should appear on the interstate shellfish shippers list, hereafter called "list.")

Address. (A business and/or mailing address in the State issuing the certificate. This address indicates where records are kept and where inspection may be arranged.)

Certificate Number. (A number shall be assigned for each business unit. Suffix or prefix letters may not be used to differentiate between two or more plants of a given shipper.)

Classification. (The shipper classification should be indicated by a symbol: i.e., shucker-packer, SP; repacker, RP; shell stock, SS; or reshipper, RS. Only one classification should be used. The single classification will cover all proposed operations which the shipper is qualified to perform.)

Expiration Date. (All certificates in a State should expire on the same date, preferably the last day of a month. This date will be shown on the "list". All certificates will be automatically withdrawn from the "list" on the date of expiration unless new certificates have been received by Public Health Service headquarters office. If the date of expiration coincides with the date of issue for the "list" the certificates expiring on the date of issue will be deleted.)

Certifying Officer. (Each certificate is signed by a responsible State official.)

(2) Certificate changes. A change in an existing, unexpired certificate should be made by issuing a corrected certificate.

(3) Interstate shipment before listing. The shipper should be informed of the probable date his name will appear on the "list" and should be advised against making interstate shipment prior to that date. (If shipments must be made before the appearance of the shipper's name on the "list", the Public Health Service will notify the applicable receiving States if the names and addresses of the expected receivers are indicated in advance by the State when the certificate is forwarded to the Public Health Service.)

(4) State cancellation, revocation, or suspension of interstate shipper certificates. If a State revokes, cancels, or suspends an interstate shellfish shipper certificate, the Public Health Service regional office should be immediately notified, preferably by telephone or telegram, with a following confirmatory letter.

(5) Mailing list for interstate shellfish shipper list. Names of persons, business units, organizations, or agencies, desiring copies of the "list", and requests for information concerning the "list" should be sent to the appropriate Public Health Service regional office. Recipients will be circularized periodically to determine if they still have use for the "list".

g. The appropriate Public Health Service regional office is notified by the State of any revision in growing area classification. The notification shall so describe the area that it may be readily located on Coast and Geodetic Survey charts.

h. State shellfish plant inspectors are provided with the following inspection equipment: standardized inspection forms, thermometer, chlorine test kit, and light meter.

i. Interdepartmental memoranda of understanding have been developed which will define the responsibilities of each State agency in maintaining adequate sanitary control of the shellfish industry in the State.

Public-health explanation. The annual review of each participating State's shellfish sanitation activities is a fundamental Public Health Service responsibility in the National Program. The purpose of this review is to evaluate the adequacy and reliability of each individual State program in accord with the agreed-upon standards. The Service will endorse those State programs meeting the National Program standards and will publish and distribute a list of the names of the State certified shippers. However, if a State program does not meet the standards the program will not be endorsed. Names of nonparticipating States will be omitted from the Public Health Service list of State certified shellfish shippers.

Minimum plant sanitation standards for interstate shellfish shippers are described in part II of this manual. Experience has shown that absolute compliance with these minimum standards is not always attainable, particularly those items which relate to operating procedures. The establishment of the 80-percent plant sanitation score as a prerequisite for listing on the Public Health Service list of State certified shellfish shippers recognizes the fact that perfection is not always obtainable and, at the same time, provides a mechanism for excluding any plant which is not operated in a reasonably sanitary manner.

National program sanitary requirements should be applied to all actual and potential growing areas and all shellfish harvesters to insure that all shellfish available to certified dealers have been produced and harvested under acceptable sanitary conditions. It is also important that the shell stock be protected against contamination during the period between harvesting and delivery to the certified shipper.

3. Intrastate Sale of Market Shellfish.—Sanitary standards for intrastate shellfish shippers should be substantially equivalent to those of the national program.

Public-health explanation.—States may accept lower sanitary standards for shellfish sold intrastate than are required by the National Program. However, it has been found that small intrastate shippers may at times sell their product to interstate shippers if demand exceeds the supply of shellfish available to the latter. Because of the possibility that such substandard shellfish might be shipped interstate, the 1954 National Conference on Shellfish Sanitation recommended that National Program standards be applied to all shellfish production and processing (*1*). The 1958 Shellfish Sanitation Workshop also strongly recommended the use of substantially equivalent standards for intra- and inter-state shellfish shippers (*3*).

Section B

LABORATORY PROCEDURES

1. Bacteriological. — American Public Health Association Recommended Procedures for the Examination of Sea Water and Shellfish shall be followed in the collection and transportation of samples of shellfish and shellfish waters for bacteriological examination and in the laboratory examination of such samples.[1]

Satisfactory compliance.—This item will be satisfied when current American Public Health Association Recommended Procedures for the Examination of Sea Water and Shellfish are followed in the bacteriological examination of shellfish and shellfish waters.

Public-health explanation.—Experience with the bacteriological examination of shellfish and shellfish growing waters has indicated that minor differences in laboratory procedures or techniques will cause wide variations in the results. Variations in results may also be caused by improper handling of the sample during collection or transportation to the laboratory (*10*). The American Public Health Association Recommended Procedures for the Examination of Sea Water and Shellfish, which are revised periodically, offer a reliable way of minimizing these variations (*62*). (National Program required use of a standard procedure for the bacteriological examination of shellfish and shellfish waters should not discourage laboratories from working on new methods of sample handling or analysis.)

2. Toxicological.—A recognized procedure shall be used in the assay for paralytic shellfish poison.

Satisfactory compliance.—This item will be satisfied when current Association of Official Agricultural Chemists official methods are followed in the bioassay for paralytic shellfish poison.

Public-health explanation.—It has been demonstrated that significant variations in bioassay results will be caused by minor changes in procedures. If reliable results are to be obtained it is essential that the test procedures be standardized and that variations due to use of strains of mice be minimized (*11*). The official procedure for the bioassay for paralytic shellfish poison adopted by the Association of Official Agricultural Chemists minimizes these variations (*66*). A method of analysis for ciguatera poison in shellfish has been developed (*12*).

3. Chemical and Physical.—Standard laboratory methods shall be used for all salinity, radionuclide, and other chemical and physical determinations made on shellfish or shellfish waters in conjunction with National Program activities. Results shall be reported in standard units.

Satisfactory compliance.—This item will be satisfied when—

a. Chemical and physical measurements on shellfish and shellfish waters are made in accord with accepted laboratory techniques.

b. Results of all chemical and physical determinations are expressed in standard units. (For example, salinity should be expressed in parts per thousand rather than hydrometer readings.)

Public-health explanation.—Standardized laboratory procedures are most apt to produce results in which the State shellfish control agency can have confidence, and facilitate comparative evaluation of data. The need for adherence to standardized procedures should not discourage laboratories from experimental use of nonstandard methods.

[1] Material which may be useful in interpretation of results of bacteriological examination of shellfish is contained in appendix A.

Section C

GROWING AREA SURVEY AND CLASSIFICATION

1. Sanitary Surveys of Growing Areas.—A sanitary survey shall be made of each growing area prior to its approval by the State as a source of market shellfish or of shellfish to be used in a controlled purification or relaying operation. The sanitary quality of each area shall be reappraised at least biennially and, if necessary, a resurvey made. Ordinarily, resurveys will be much less comprehensive than the original survey since it will only be necessary to bring the original information up to date. Records of all original surveys and resurveys of growing areas shall be maintained by the State shellfish control agency, and shall be made available to Public Health Service review officers upon request.

Satisfactory compliance.—This item will be satisfied when—

a. A sanitary survey has been made of each growing area in the State prior to initial approval of interstate shipments of shellfish from that area. A comprehensive sanitary survey shall include an evaluation of all sources of actual or potential pollution on the estuary and its tributaries, and the distance of such sources from the growing areas; effectiveness and reliability of sewage treatment works; the presence of industrial wastes, pesticides, or radionuclides which would cause a public-health hazard to the consumer of the shellfish; and the effect of wind, stream flow, and tidal currents in distributing polluting materials over the growing area.[2] The thoroughness with which each element must be investigated varies greatly and will be determined by the specific conditions in each growing area.

b. The factors influencing the sanitary quality of each approved shellfish growing area are reappraised at least biennially.[3] A complete resurvey should be made of each growing area in an approved category at least once every ten years; however, data from original surveys can be used when it is clear that such information is still valid.

c. A file which contains all pertinent sanitary survey information, including the dates and results of preceding sanitary surveys is maintained by the State shellfish control agency for each classified shellfish area.

d. The State agency having primary responsibility for this element of the national program develops a system for identification of growing areas.

Public-health explanation.—The positive relationship between sewage pollution of shellfish growing areas and enteric disease has been demonstrated many times (*13*) (*14*) (*15*) (*16*) (*17*) (*18*) (*63*) (*64*) (*65*). However, epidemiological investigations of shellfish-caused disease outbreaks have never established a direct numerical correlation between the bacteriological quality of water and the degree of hazard to health. Investigations made from 1914 to 1925 by the States and the Public Health Service—a period when disease outbreaks attributable to shellfish were more prevalent—indicated that typhoid fever or other enteric disease would not ordinarily be attributed to shellfish harvested from water in which not more than 50 percent of the 1 cc. portions of water examined were positive for coliforms,[4] *provided the areas were not subject to direct contamination with small amounts of fresh sewage which would not ordinarily be revealed by the bacteriological examination.*

Following the oyster-borne typhoid outbreak during the winter of 1924–25 in the United States (*19*) the national shellfish certification program was initiated by the States, the Public Health Service, and the shellfish industry (*9*). Water quality criteria were then stated as:

a. The area is sufficiently removed from major sources of pollution so that the shellfish would not be subjected to fecal contamination in quantities which might be dangerous to the public health.

[2] In making the sanitary survey consideration should be given to the hydrographic and geographic characteristics of the estuary, the bacteriological quality of the growing area water and bottom sediments, and the presence and location of small sources of pollution, including boats, which might contribute fresh sewage to the area.

[3] The purpose of this reappraisal is to determine if there have been changes in stream flow, sewage treatment, populations, or other similar factors which might result in a change in the sanitary quality of the growing area. The amount of field work associated with such a reappraisal will depend upon the area under consideration and the magnitude of the changes which have taken place.

[4] An MPN of approximately 70 per 100 ml.

b. The area is free from pollution by even small quantities of fresh sewage. The report emphasized that bacteriological examination does not, in itself, offer conclusive proof of the sanitary quality of an area.

c. Bacteriological examination does not ordinarily show the presence of the coli-aerogenes group of bacteria in 1 cc. dilutions of growing area water.

The reliability of this three-part standard for evaluating the safety of shellfish-producing areas is evidenced by the fact that no major outbreaks of typhoid fever or other enteric disease have been attributed to shellfish harvested from waters meeting the criteria since they were adopted in the United States in 1925. Similar water quality criteria have been in use in Canada with like results. The available epidemiological and laboratory evidence gives little idea as to the margin of safety, but it is probably considerable as indicated by the virtual absence of reported shellfish caused enteric disease over a comparatively long period of time (*18*) (*20*) (*21*) (*65*) (*69*) from waters meeting this criteria.

The purpose of the sanitary survey is to identify and evaluate those factors influencing the sanitary quality of a growing area and which may include sources of pollution, potential or actual; the volume of dilution water; the effects of currents, winds and tides in disseminating pollution over the growing areas; the bacterial quality of water and bottom sediments; die out of polluting bacteria in the tributaries and the estuary; bottom configuration; and salinity and turbidity of the water. Sources of pollution include municipal sewage discharged into the estuary or inflowing rivers; sewage brought into the estuary by tides or currents; surface runoff from polluted areas; industrial wastes; and discharges from pleasure craft, fishing boats, naval vessels, and merchant shipping.

Bacteriological examination of the growing waters is an important component of the sanitary survey. In many instances the bacteriological and related salinity data will also provide valuable information on the hydrographic characteristics of an area.[5] [6]

[5] Bacteria in an unfavorable environment die out in such a way that following an initial lag period there is a large percentage decline during the first few days. Descriptions of studies on bacteria dieout have been published by Greenberg (*32*) and Pearson (*53*). Dieoff has also been investigated by the Public Health Service Shellfish Sanitation Laboratory at Woods Hole, Mass., and Pensacola, Fla. Application of this principle may be helpful in predicting the quantity of pollution which will reach an area, and in establishing objective effluent quality criteria (*24*).

Ideally, a large number of water samples for bacteriological examination should be collected at each station. However, in most instances this is not practical because of time and budget limitations, and accordingly only a limited number of samples can be collected. Therefore, sampling stations should be chosen which will provide a maximum of data, and which will be respresentative of the bacteriological quality of water in as wide an area as possible. Sample collection should be timed to represent the most unfavorable hydrographic and pollution conditions since shellfish respond rapidly to an increase in the number of bacteria or viruses in their environment (*25*) (*26*) (*70*) (*71*) (*72*) (*78*).

There is no specified minimum number of sampling stations, frequency of sampling, or total number of samples. Sampling results obtained over a period of several years can be used as a block of data provided at least 15 samples have been collected from each of a representative number of stations along the line separating approved from restricted growing areas and there have been no adverse changes in hydrographic or sanitary conditions. Only occasional bacteriological samples are necessary from areas which are shown to be free from pollution.

Experience with the shellfish certification program indicates a tendency to omit or de-emphasize some components of the sanitary survey unless a central State file of all shellfish sanitary surveys, reappraisals, and resurveys is maintained. This is particularly true where responsibility for shellfish sanitation is divided between two or more State agencies. Maintenance of a central State file for all shellfish sanitary survey information will also simplify the endorsement appraisal of State programs by the Public Health Service and will help prevent

[6] In connection with the evaluation of sampling results, it should be noted that the MPN determination is not a precise measure of the concentration of bacteria (*4*). Thus, in repeated sampling from waters having a uniform density of bacteria varying MPN estimates will be obtained. The use of the tolerance factor 3.3 (applicable only to 5 tube decimal dilution MPN's) is one method of recognizing this variation. For example, in a body of water in which the median concentration of coliform bacteria is 70 per 100 ml., 95% of observed MPN's will be between 20 and 230 per 100 ml.; i.e., $70/3.3=21$ and $70\times3.3=230$.

loss of old data which may be useful in evaluating the sanitary quality of an area.

Periodic reappraisals of the sanitary quality of shellfish producing areas are necessary to determine that environmental conditions are such that the original conclusions are still valid. A *resurvey* should be made within 1 year if the *reappraisal* shows a significant detrimental change.

2. Classification of Growing Areas.—All actual and potential growing waters shall be classified as to their public health suitability for the harvesting of market shellfish. Classification criteria are described in sections C–3, C–4, C–5, C–6, and C–7 of this manual. Except in emergency any upward revision of an area classification shall be preceded by a sanitary survey, resurvey, or reappraisal. A written analysis of the data justifying the reclassification shall be made a part of the area file.

Satisfactory compliance.—This item will be satisfied when—

a. All actual and potential growing waters in the State are correctly designated with one of the following classifications on the basis of sanitary survey information: *Approved; conditionally approved; restricted;* or *prohibited.*[7] *

b. Area classifications are revised whenever warranted by survey data.

c. Classifications are not revised upward without at least a file review, and there is a written record of such review in the area file maintained by the State shellfish control agency.

d. All actual and potential growing areas which have not been subjected to sanitary surveys shall be automatically classified as *prohibited.*

Public-health explanation.—The probable presence or absence of pathogenic organisms in shellfish waters is of the greatest importance in deciding how shellfish obtained from an area may be used. All actual and potential growing waters should thus be classified according to the information developed in the sanitary survey. Classification should not be revised upward without careful consideration of available data. Areas should be reclassified whenever warranted by existing data. A written justification for the reclassification simplifies Public Health Service appraisal of State programs.

A hypothetical use of the four recognized area classifications is shown in figure 1. This idealized situation depicts an estuary receiving sewage from two cities, "A" and "B." City "A" has complete sewage treatment including chlorination of effluent. City "B" has no sewage treatment. The estuary has been divided into five areas, designated by roman numerals, on the basis of sanitary survey information:

Approved

Area I. The sanitary survey indicates that sewage from cities "A" and "B" (even with the "A" sewage plant not functioning) would not reach this area in such concentration as to constitute a public-health hazard. The median coliform MPN of the water is less than 70/100 ml. The sanitary quality of the area is independent of sewage treatment at city "A."

Conditionally Approved

Area II. This area is of the same sanitary quality as area I: however, the quality varies with the effectiveness of sewage treatment at city "A." This area would probably be classified *prohibited* if city "A" had not provided sewage treatment.

Restricted

Area III. Sewage from "B" reaches this area, and the median coliform MPN of water is between 70 and 700 per 100 ml. Shellfish may be used only under specified conditions .

Prohibited

Area IV. Direct harvesting from this area is prohibited because of raw sewage from "B." The median coliform MPN of water may exceed 700/100 ml.

Area V. Direct harvesting from this area is prohibited because of possible failure of the sewage treatment plant. Closure is based on need for a safety factor rather than coliform content of water or amount of dilution water.

[7] Closures may also be based on presence of Marine Toxins or other toxic materials.

* States may use other terminology in describing area classifications; provided, that the classification terms used are consistent with the intent and meaning of the words "approved", "conditionally approved", "restricted", or "prohibited".

3. Approved Areas.—Growing areas may be designated as *approved* when: (*a*) the sanitary survey indicates that pathogenic microorganisms, radionuclides, and/or harmful industrial wastes do not reach the area in dangerous concentration, and (*b*) this is verified by laboratory findings whenever the sanitary survey indicates the need. Shellfish may be taken from such areas for direct marketing.

Satisfactory compliance.—This item will be satisfied when the three following criteria are met:

a. The area is not so contaminated with fecal material that consumption of the shellfish might be hazardous, and

b. The area is not so contaminated with radionuclides or industrial wastes that consumption of the shellfish might be hazardous (see section C, item 7, regarding toxins in shellfish growing areas), and

c. The coliform median MPN of the water does not exceed 70 per 100 ml., and not more than 10 percent of the samples ordinarily exceed an MPN of 230 per 100 ml. for a 5-tube decimal dilution test (or 330 per 100 ml., where the 3-tube decimal dilution test is used) in those portions of the area most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. (Note: This concentration might be exceeded if less than 8 million cubic feet of a coliform-free dilution water are available for each population equivalent (*coliform*) of sewage reaching the area). The foregoing limits need not be applied if it can be shown by detailed study that the coliforms are not of direct fecal origin and do not indicate a public health hazard (*19*) (*20*).[8]

Public-health explanation.—A review of epidemiological investigations of disease outbreaks attributable to the consumption of raw shellfish reveals that two general situations prevail[9] insofar as pollution of growing or storage areas are concerned.

(1) Gross sewage contamination of a growing or wet storage area. (A report of a 1940 outbreak of typhoid fever involving 41 persons notes that raw sewage from a city with a population of 30,000 was discharged only a few hundred feet away from clam beds and floats (*27*) (*28*). In 1947 a case of typhoid fever was attributed to clams harvested 200 yards from the outlet of a municipal sewage treatment plant (*29*). In the latter case, the coliform MPN of the harbor water exceeded 12,000 per 100 ml. and the area had been posted as closed to shellfish harvesting.)

(2) Chance contamination of a growing or wet storage area by fresh fecal material which may not be diffused throughout the entire area (*14*) (*16*) (*17*) (*19*) and therefore not readily detectable by ordinary bacteriological procedures. The possibility of chance contamination was noted by Dr. Gurion in his report on a 1902 typhoid outbreak, and who is quoted in Public Health Bulletin No. 86, as "there is a zone of pollution established by the mere fact of the existence of a populated city upon the banks of a stream or tidal estuary which makes the laying down of oysters and clams in these waters a pernicious custom if persisted in, because it renders these articles of food dangerous at times, and always suspicious". The 1956 outbreak of infectious hepatitis in Sweden (691 cases) attributed to oysters which were contaminated in a wet storage area is an example of such contamination (*16*). Similarly in 1939, 87 cases of typhoid were attributed to fecal contamination of a storage area by a typhoid carrier (*14*).

It is well established that shellfish from water having a median coliform MPN not exceeding 70 per 100 ml.[8] *and which is also protected against chance contamination with fecal material*, will not be involved in the spread of disease which can be attributed to initial contamination of the shellfish. This is not surprising since a water MPN of 70/100 ml. is equivalent to a dilution ratio of about 8 million cubic feet of coliform-free water per day for the fecal material from each person contributing sewage to the area. This tremendous volume of water is available in shellfish growing areas through

[8] This MPN value is based on a typical ratio of coliforms to pathogens and would not be applicable to any situation in which an abnormally large number of pathogens might be present. Consideration must also be given to the possible presence of industrial or agricultural wastes in which there is an atypical coliform to pathogen ratio (*30*).

[9] There is a third general consideration in which shellfish may be contaminated through mishandling. This is not related to growing area sanitation and is considered in part II of this manual.

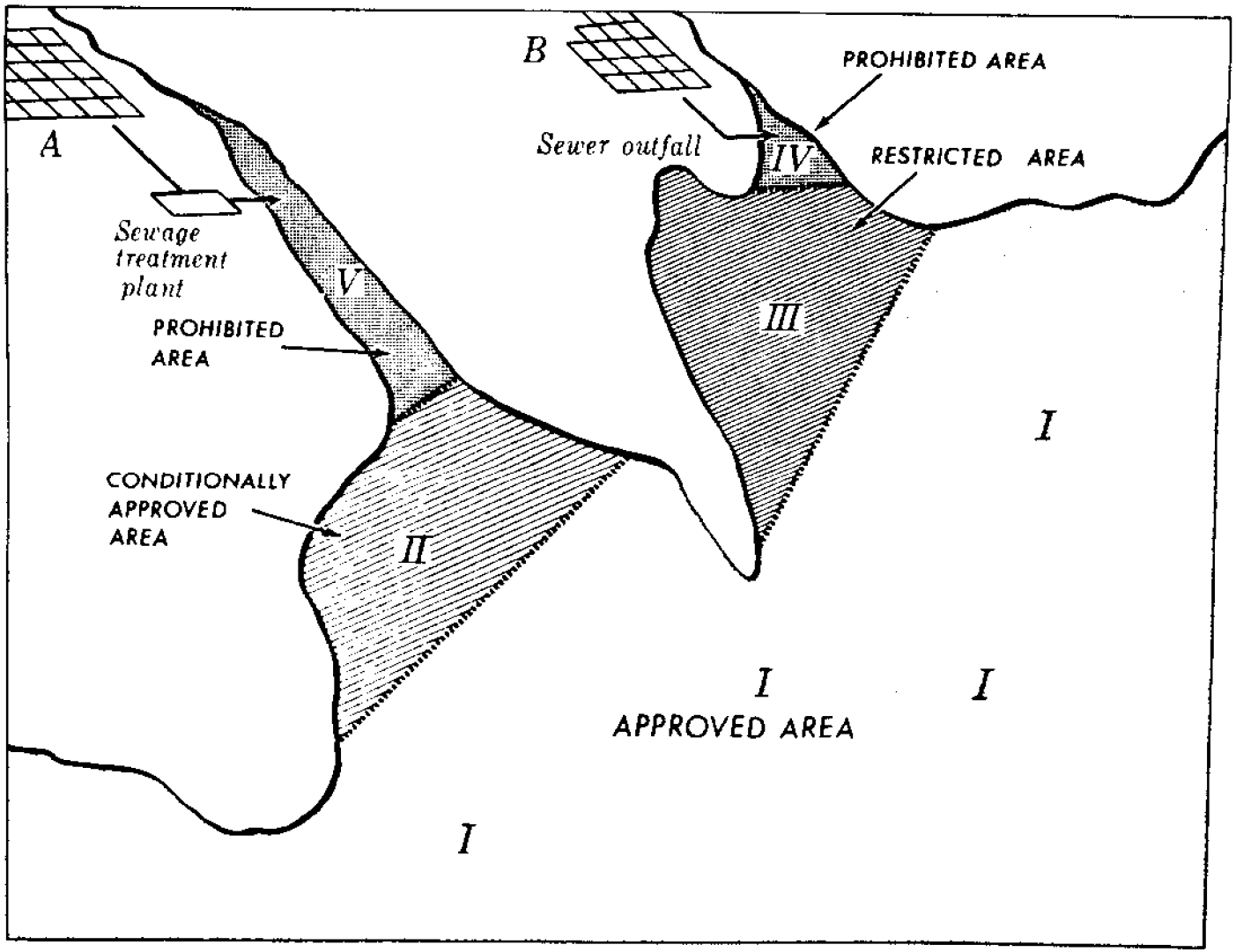
B
PROHIBITED AREA
A
Sewer outfall
IV
RESTRICTED AREA
Sewage
treatment
plant
V
III
PROHIBITED
AREA
I
CONDITIONALLY
APPROVED
AREA
II
I
I
APPROVED AREA
I

FIGURE 1

tidal action which is constantly bringing unpolluted water into the area.[8]

Areas which are approved for direct market harvesting of shellfish which will be eaten raw must necessarily meet one general test; i.e, sewage reaching the growing area must be so treated, diluted, or aged that it will be of negligible public-health significance. This implies an element of time and distance to permit the mixing of the sewage or fecal material with the very large volume of diluting water and for a major portion of the microorganisms to die out. Studies of the natural die-off of microorganisms in an unfavorable marine environment have been summarized by Greenberg (*22*).

The effectiveness of sewage treatment processes must be considered in evaluating the sanitary quality of a growing area since the bacterial and viral content of the effluent will be determined by the degree of treatment which is obtained (*2*) (*73*) (*74*) (*75*). The results of bacteriological sampling must also be correlated with sewage treatment plant operation, and evaluated in terms of the minimum treatment which can be expected with a realization of the possibility of malfunctioning, overloading, or poor operation.

The presence of radionuclides in growing area waters may also have public-health significance since shellfish, along with other marine organisms, have the ability to concentrate such materials (*31*) (*32*) (*33*) (*34*). The degree to which radioisotopes will be concentrated depends upon the species of shellfish and the specific radioisotope. For example, it has been reported that the Eastern oyster has a concentration factor of 17,000 for Zn^{65} whereas the concentration factor in soft tissues for Sr^{90} is approximately unity (*31*) (*33*). The distribution of the radioisotope in the shellfish and the biological half-life are also variable. Sources of radioactive materials include fall-out, industrial wastes, and nuclear reactors. Limiting maximum permissible concentrations of radioactive materials expressed in terms of specific radioisotopes and unidentified mixtures in water and food have been established (*35*) (*36*). The current standard should be consulted in evaluating the public-health significance of detected radioactivity in market shellfish.

See footnote 8 on page 13.

The bacterial quality of active shellfish will ordinarily be directly proportional to the bacterial quality of the water in which they grew; however, considerable variation in individual determinations may be expected. The coliform MPN's of the shellfish usually exceed those of the overlying water because shellfish filter large quantities of water to obtain food, thereby concentrating the suspended bacteria. This relationship will depend upon the shellfish species, water temperature, presence of certain chemicals, and varying capabilities of the individual animals.

4. Conditionally Approved Areas.—The suitability of some areas for harvesting shellfish for direct marketing is dependent upon the attainment of an established performance standard by sewage treatment works discharging effluent, directly or indirectly, to the area. In other cases the sanitary quality of an area may be effected by seasonal population, or sporadic use of a dock or harbor facility. Such areas may be classified as *conditionally approved*.

State shellfish control agencies shall establish *conditionally approved* areas only when satisfied that (a) all necessary measures have been taken to insure that performance standards will be met, and (b) that precautions have been taken to assure that shellfish will not be marketed from the areas subsequent to any failure to meet the performance standards and before the shellfish can purify themselves of polluting microorganisms.

Satisfactory compliance.—This item will be satisfied when—

a. The water quality requirements for an *approved* area are met at all times while the area is approved as a source of shellfish for direct marketing.

b. An operating procedure for *each conditionally approved* area is developed jointly by the State shellfish control agency, local agencies, including those responsible for operation of sewerage systems, and the local shellfish industry. The operating procedure should be based on an evaluation of each of the potential sources of pollution which may affect the area. The procedure should establish performance standards, specify necessary safety devices and measures, and define inspection and check procedures. (These procedures are described in

more detail in the following public-health explanation.)

c. A closed safety zone is established between the *conditionally approved* area and the source of pollution to give the State agency time to stop shellfish harvesting if performance standards are not met.

d. Boundaries of *conditionally approved* areas are so marked as to be readily identified by harvesters.

e. Critical sewerage system units are so designed, constructed, and maintained that the chances of failure to meet the established performance standards due to mechanical failure or overloading are minimized.

f. There is a complete understanding of the purpose of the *conditionally approved* classification by all parties concerned, including the shellfish industry. Successful functioning of the concept is dependent upon the wholehearted cooperation of all interested parties. If such cooperation is not assured the State should not approve the area for direct harvesting of market shellfish.

g. Any failure to meet the performance standards is immediately reported to the State shellfish control agency by telephone or messenger. In some instances States may find it desirable to delegate the authority for closing a *conditionally approved* area to a representative of the agency located in the immediate area.

h. The State immediately closes *conditionally approved* areas to shellfish harvesting following a report that the performance standards have not been met. The area shall remain closed until the performance standards can again be met plus a length of time sufficient for the shellfish to purify themselves so that they will not be a hazard to the public health. (See section D–1, "Relaying," for information on the length of time required for self-purification of shellfish.)

i. The State shellfish control agency makes at least two evaluations during the shellfish harvesting season of each *conditionally approved* area including inspection of each critical unit of the sewerage system to determine the general mechanical condition of the equipment, the accuracy of recording devices, and the accuracy of reporting by the operating agency.

j. It is discovered that failure to meet performance standards have not been reported by the operating agency, or if the performance standards are not met, the area will immediately revert to a *restricted* or *prohibited* classification.

k. All data relating to the operation of a *conditionally approved* area, including operation of sewerage systems, are maintained in a file by the State shellfish control agency.

Public-health explanation.—The *conditionally approved* classification is designed primarily to protect shellfish growing areas in which the water quality might undergo a significant adverse change within a short period of time.[10] The change might result from overloading or mechanical failure of a sewage treatment plant, or bypassing of sewage at a lift station.

Water quality in many growing areas in the more densely populated sections of the country is, to some degree, dependent upon the operation of sewage treatment plants. For example, the boundaries of an approved shellfish area might be determined during a period when a tributary sewage treatment plant is operating at a satisfactory level. If there is some interruption in treatment it follows that there will be some degradation in water quality in the growing area, which may justify a relocation of the boundaries. The degree of relocation would depend upon such items as the distance between the pollution source and the growing area, hydrography, the amount of dilution water, and the amount of pollution.

The concept is also applicable to other situations in which there may be a rapid or seasonal change in water quality. Examples of such situations include—

a. A growing area adjacent to a resort community. During the summer months the community might have a large population which might have an adverse effect on water quality. However, during the winter when there are few people in the community the water quality might improve sufficiently to allow approval of the area. In some States this is known as a seasonal closure.

b. A protected harbor in a sparsely settled area might provide anchorage for a fishing fleet

[10] A natural disaster may also cause many sewage treatment plants to be out of service for an extended period of time. The *conditionally approved* area concept is not ordinarily concerned with such emergency situations.

several months a year. When the fishing fleet is in, the harbor water would be of poor sanitary quality; however, during the remainder of the year the quality of the harbor water might be satisfactory. The area would be approved for shellfish harvesting only when the fishing fleet is not using the harbor.

c. The water quality in an area fluctuates with the discharge of a major river. During periods of high runoff the area is polluted because of decreased flow time in the river. However, during periods of low runoff the area might be of satisfactory quality and thus be approved for shellfish harvesting.

The establishment of *conditionally approved* areas might be considered whenever the potential for sewage contamination is such that the limiting water quality criteria for an *approved* area might be exceeded in less than one week due to a failure of sewage treatment, or other situations as described above.

The first step in determining whether an area should be placed in the *conditionally approved* classification is the evaluation of the potential sources of pollution in terms of their effect on water quality in the area. Potential sources of pollution include the following:

(1) Sewage treatment plants.

(*a*) Bypassing of all or part of sewage because of mechanical or power failure, hydraulic overloading, or treatment overloading.

(*b*) Reduced degree of treatment due to operational difficulties or inadequate plant.

(2) Sewage lift stations.

(*a*) Bypassing during periods of maximum flow due to inadequate capacity.

(*b*) Bypassing because of mechanical or power failure.

(3) Interceptor sewers or underwater outfalls.

(*a*) Exfiltration due to faulty construction.

(*b*) Leakage due to damage.

(4) Other sources of pollution.

(*a*) Sewage from merchant or naval vessels.

(*b*) Sewage from recreation use of area.

The second step in establishment of a *conditionally approved* area is the evaluation of each source of pollution in terms of the water quality standards to be maintained, and the formulation of performance standards for each installation having a significant effect on the sanitary quality of the area. Examples of performance standards might include:

(1) Bacteriological quality of effluent from sewage treatment plants. This might be stated in terms of chlorine residual if the bacteriological quality of the effluent can be positively related to chlorine residual. The following is an example of a performance standard (*37*): "The median coliform MPN, in any one month, shall not exceed 500 per 100 ml., based on not less than 16 composite samples per month, and not more than 10 percent of the samples shall have an MPN in excess of 10,000 per 100 ml. Determinations of the chlorine residual of the effluent should be made hourly and recorded in the permanent plant records."

(2) Total quantity of sewage which can be discharged from any given unit, or from a combination of units, without causing the basic water quality standards to be exceeded.

(3) Amount of shipping in the area and the amount of sewage which can be expected.

Design criteria which may be useful in formulating an opinion on the quantity of sewage which can be discharged into an area without exceeding the desired water quality standards include: Population equivalent (*coliform*) of sewage; predicted survival of coliform in sea water, effectiveness of chlorination, and the total quantity of clean dilution water in an area. Results of many studies on the survival of bacteria in sea water have been summarized in *An Investigation of the Efficacy of Submarine Outfall Disposal of Sewage and Sludge;* Publication No. 14, California State Water Pollution Control Board, 1956.

The mechanical equipment at critical sewage treatment or pumping units should be such that interruptions will be minimized. Wherever possible operations should be automatically recorded on charts. Examples of the requirements which might be imposed, depending upon the importance of the unit in terms of water quality, include:

(1) Ample capacity for storm flows. (Storm water should ordinarily be excluded from the sanitary system.)

(2) Standby equipment to insure that treatment or pumping will not be interrupted because of damage to a single unit or to power failure.

(3) Instrumentation of pumps and equipment to allow the regulatory agency to determine that performance standards have been met. Examples include:

(*a*) Recording scales to indicate rate of chlorine use. Chlorine flow can be integrated with hydraulic flow to establish a ratio.

(*b*) Liquid level recording gages in overflow channels of sewage treatment plants and wet wells of lift stations to indicate when overflow takes place. Charts should be dated and initialed by the operator. Gages should be calibrated so that discharge can be estimated.

(*c*) Automatic devices to warn of failure or malfunctioning at self-operated pumping stations or treatment plants.

(4) The effect of storm sewage can be calculated by multiplying the total estimated flow by the observed coliform content. The result can be expressed in terms of population equivalents (*coliform*).

Design and operation of equipment should be such that closure provisions should not have to be invoked more than once per year under ordinary circumstances.

A closed safety area should be interposed between the *conditionally approved* area and the source of pollution. The size of such area should be based on the total time it would take for the operating agency to detect a failure, notify the State shellfish control agency, and for the latter agency to stop shellfish harvesting. It is recommended that the area be of such size that the flow time through the safety area be at least twice that required for the notification process to become effective. Due consideration should be given to the possibility that closure actions might be necessary on holidays or at night.

The type of marking which will be required for *conditionally approved* areas will vary from State to State depending upon the legal requirements for closing an area.

The length of time a *conditionally approved* area should be closed following a temporary closure will depend upon several factors including the species of shellfish, water temperature, purification rates, presence of silt or other chemicals that might interfere with the physiological activity of the shellfish, and the degree of pollution of the area. (See section D–1 of this manual for additional information on the natural purification of shellfish.)

5. Restricted Areas.—An area may be classified as *restricted* when a sanitary survey indicates a limited degree of pollution which would make it unsafe to harvest the shellfish for direct marketing. Alternatively the States may classify such areas as prohibited. (See section C–6, this manual.) Shellfish from such areas may be marketed after purifying or relaying as provided for in section D.

Satisfactory compliance.—This item will be satisfied when the following water quality criteria are met in areas designated by States as *restricted*.[11] [12]

a. The area is so contaminated with fecal materials that direct consumption of the shellfish might be hazardous, and/or

b. The area is not so contaminated with radionuclides or industrial wastes that consumption of the shellfish might be hazardous, and/or

c. The coliform median MPN of the water does not exceed 700 per 100 ml. and not more than 10 percent of the samples exceed an MPN of 2,300 per 100 ml. in those portions of the areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. (Note: this concentration might be exceeded if less than 800,000 cubic feet of a coliform-free dilution water are available for each population equivalent (*coliform*) of sewage reaching the area.)

d. Shellfish from *restricted* areas are not marketed without controlled purification or relaying.

Public-health explanation.—In many instances it is difficult to draw a clear line of demarcation between polluted and nonpolluted areas. In such instances the State may, at its

[11] It is not mandatory that States use this classification. Areas not meeting the *approved* classification may be closed to all harvesting for direct marketing.

[12] Routine sanitary surveys and reappraisals of *restricted* areas shall be made on the same frequency as for *approved* areas. (See section C–1.)

option, classify areas of intermediate sanitary quality as *restricted* and authorize the use of the shellfish for relaying, or controlled purification.

6. Prohibited Areas.—An area shall be classified *prohibited* if the sanitary survey indicates that dangerous numbers of pathogenic microorganisms might reach an area. The taking of shellfish from such areas for direct marketing shall be prohibited. Relaying or other salvage operations shall be carefully supervised to insure against polluted shellfish entering trade channels. Actual and potential growing areas which have not been subjected to sanitary surveys shall be automatically classified as *prohibited.*

Satisfactory compliance.—This item will be satisfied when:

a. An area is classified as *prohibited* if a sanitary survey indicates either of the following degrees of pollution:

(1) The area is contaminated with radionuclides or industrial wastes that consumption of the shellfish might be hazardous and/or

(2) The median coliform MPN of the water exceeds 700 per 100 ml. or more than 10 percent of the samples have a coliform MPN in excess of 2,300 per 100 ml. (Note: This concentration might be reached if less than 800,000 cubic feet of a coliform-free dilution water are available for each population equivalent (*coliform*) of sewage reaching the area.)

b. No market shellfish are taken from *prohibited* areas except by special permit as described in section D.

c. Coastal areas in which sanitary surveys have not been made shall be automatically classified as *prohibited.*

Public-health explanation.—The positive relationship between enteric disease and the eating of raw or partially cooked shellfish has been outlined in section C–1. Prevention of the interstate transport of shellfish containing sufficient numbers of pathogenic microorganisms to cause disease is a primary objective of the National Program. Therefore, areas containing dangerous concentrations of microorganisms of fecal origin, or areas which may be slightly contaminated with fresh fecal discharges, should not be approved as a source of shellfish for direct marketing.

7. Closure of Areas Due to Shellfish Toxins.—The State shellfish control agency shall regularly collect and assay representative samples of shellfish from growing areas where shellfish toxins are likely to occur. If the paralytic shellfish poison content reaches 80 micrograms per 100 grams of the edible portions of raw shellfish meat, the area shall be closed to the taking of the species of shellfish in which the poison has been found.[13] The harvesting of shellfish from such areas shall be controlled in accord with the recommendations of sections E–1 and E–2 of this manual.

The quarantine shall remain in effect until such time as the State shellfish control agency is convinced the poison content of the shellfish involved is below the quarantine level.[14]

Satisfactory compliance.—This item will be satisfied when—

a. The State shellfish control agency collects and assays representative samples of shellfish for the presence of toxins from each suspected growing area during the harvesting season. (See section B–2 for assay methods.)

b. A quarantine is imposed against the taking of shellfish when the concentration of paralytic shellfish poison equals or exceeds 80 micrograms per 100 grams of the edible portion of raw shellfish.

Public-health explanation.—In some areas paralytic poison is collected temporarily by bivalve shellfish from free-swimming, one-celled marine plants on which these shellfish feed. The plants flourish seasonally when water conditions are favorable.

Cases of paralytic poisoning, including several fatalities, resulting from poisonous shellfish have been reported from both the Atlantic and Pacific coasts. The minimum quantity of poison which will cause intoxication in a susceptible person is not known. Epidemiological investigations of paralytic shellfish poisoning in Canada have indicated 200 to 600 micrograms of poison will produce symptoms in susceptible

[13] This value is based on the results of epidemiological investigations of outbreaks of paralytic shellfish poison in Canada in 1954 and 1957 (38) (39).

[14] The provisions of this item apply only to shellfish which will be marketed as a fresh or frozen product as properly controlled heat processing will reduce the poison content of the shellfish.

persons and a death has been attributed to the ingestion of a probable 480 micrograms of poison. Investigations indicate that lesser amounts of the poison have no deleterious effects on humans. Growing areas should be closed at a lower toxicity level to provide an adequate margin of safety since in many instances toxicity levels will change rapidly (*38*) (*39*). It has also been shown that the heat treatment afforded in ordinary canning processes reduces the poison content of raw shellfish considerably.

A review of literature and research dealing with the source of the poison, the occurrence and distribution of poisonous shellfish, physiology and toxicology, characteristics of the poison, and prevention and control of poisoning has been prepared (*40*).

In Gulf coast areas, toxicity in shellfish has been associated (*12*) (*76*) with Red Tide outbreaks caused by mass bloomings of the toxic dinoflagellate, *Gymnodinium breve*. Toxic symptons in mice suggest a type of *ciguatera* fish poisoning rather than symptoms of paralytic shellfish poisoning.

Section D

PREPARATION OF SHELLFISH FOR MARKETING

1. Relaying.—State shellfish control agencies may approve the intra- or interstate transplanting of market shellfish from restricted or prohibited areas to approved areas subject to certain limitations. All phases of the operation shall be under the immediate supervision of responsible State(s) shellfish control or patrol agency(s). A memorandum of understanding shall be developed between the agencies responsible for the control of interstate relaying operations. (Shellfish may be transplanted from an *approved* area to another like area at any time without restriction due to sanitary reasons.)

Satisfactory compliance.—This item will be satisfied when—

a. Shellfish are not relaid from *restricted* or *prohibited areas* to *approved areas* without written permission of the State shellfish control agency.

b. All relaying operations are under the *immediate* supervision of the State shellfish control or patrol agency. Supervision shall be such that no polluted shellfish are marketed before the end of the approved relaying period. The supervising officer shall be authorized and equipped to enforce the State regulations on relaying; shall actually supervise the harvesting, transport and relaying of shellfish; and shall patrol the *approved* area during the period that shellfish are undergoing the cleansing process. However, continuous supervision will not be necessary if relaying operations are carried out during a period when shellfish may not be marketed. A continuous record of water temperature, salinity, and any other critical variables must be maintained when it is known that the limiting values may be approached and when the minimum relaying periods are being used.

c. State permission to relay shellfish is given only to responsible persons; responsibility to be determined by the past record of the permit applicant.

d. Relaid shellfish are held in the *approved* area for a period of time sufficient to allow them to cleanse themselves of polluting bacteria. (The time required for purification will be determined by water temperature, salinity, initial bacteriological quality and species of shellfish.)

e. Relaid shellfish are not harvested without written permission from the State shellfish control agency.

f. Areas designated for relaid shellfish are so located and marked that they may be readily identified by the harvesters and so that shellfish in any adjacent *approved* area will not be contaminated. (This requirement applies only to relaying during the harvesting season.)

g. Shellfish are not relayed intra or interstate from restricted or prohibited areas to *approved* areas without written permission of the State(s) shellfish control agency(s). (If shellfish are relayed interstate, a memorandum of agreement shall be devloped outlining the control measures to be used.)

Public-health explanation.—Shellfish transplanted from a polluted to a clean environment will cleanse themselves of the polluting bacteria or viruses. This is a natural phenomenon resulting from the shellfish feeding processes. Bacteria or viruses in the body and shell cavity of the shellfish at the time of transplanting are either used as food or are ejected in feces or pseudofeces.

The length of time required for this cleansing process is influenced by many factors including original level of pollution, water temperature, presence of chemicals inhibitory to physiological activity of the shellfish, salinity, and varying capabilities of the individual animals. Advice on limiting water temperatures, either maxmum or minimum, should be obtained from local marine biologists.

Investigations by marine biologists have confirmed that the psysiological activities of the Eastern oyster (*Crassostrea virginica*) is reduced when the water temperature falls below a certain value. It has been found that the pumping rate of Eastern oysters is reduced at water temperatures below 50° F., and that most animals stop pumping at a water temperature of about 41° F. However, a few oysters show slight activity at temperatures approaching 32° F. (*41*) (*42*). This phenomenon was first noted by shellfish bacteriologists who found that East-

ern oysters harvested from polluted areas during cold weather had coliform contents comparable with those of oysters harvested from clean areas during warmer weather (*43*) (*44*) (*45*).

Gibbard *et al.* (*46*) investigating temperature-induced hibernation was unable to demonstrate coliforms in Eastern oysters within a few days after the water temperatures dropped to 32° F. The rapidity with which hibernating oysters become active when the water temperature rises above the threshold value was discussed by Wachter (*47*) in 1925 and was demonstrated by Gibbard *et al.* (*46*). The latter investigator found that contamination accompanying a sudden two degree increase in water temperature from 41° to 43° F. was reflected in the oysters in one day.

Relaying operations must be carefully supervised by an official State agency since the shellfish may contain pathogenic microorganisms. Control must apply to all phases of the operation including initial harvesting, transportation, replanting, purification period, and final harvesting for marketing if the relaying area is adjacent to a restricted area or to an area containing relaid shellfish which have not been released for harvesting.

2. Controlled Purification.—Shellfish from *restricted* or *prohibited* areas may be marketed after effective controlled purification. Purification shall be permitted only under the immediate supervision of the State shellfish control agency. Water used for purification shall be of high bacteriological quality and its physical and chemical properties shall be favorable to maximum physiological activity of the shellfish. Stringent precautions shall be taken by the State shellfish control agency to insure that shellfish harvested from *restricted* or *prohibited* areas are actually submitted to an effective purification process before marketing.

Purification of shellfish from *prohibited* areas shall not be approved by the State unless relaying is not practical for biological reasons, and no public-health hazard will result from the use of such shellfish.

Satisfactory compliance.—This item will be satisfied when:

a. The controlled purification system, including water treatment, has been demonstrated to be consistently effective for the species of shellfish being purified. Purification may be accomplished in either a natural body of water or in tanks. (In determining the effectiveness of the process at least the following factors shall be investigated: Water temperature, silt or turbidity, dissolved oxygen, presence of chemicals, and time required for purification.) The bacteriological quality of the purified shellfish shall be at least equal to shellfish of the same species harvested from local *approved* areas.

b. A purification plant operating procedure is developed and copies are supplied to the Public Health Service.

c. Water used for purification is obtained from an area meeting the physical and bacteriological requirements of an *approved* growing area, or in the case of treated water the bacteriological limits of the Public Health Service Drinking Water Standards (*48*) are met. If water is to be treated, it shall be obtained from an area meeting at least the sanitary requirements for a *restricted* area.

d. Water used for purification has chemical and physical characteristics conducive to maximum physiological activity of the shellfish. (Consideration shall be given to the following: Presence of chemicals, turbidity, temperature, salinity and dissolved oxygen, and to the adequacy of the facilities of the operating agency for measuring these characteristics.)

e. Shellfish are freed of contamination and foreign material adhering to shells before purification.

f. Shellfish are culled before and after purification.

g. Purification plant operation is under the administrative control of the State shellfish control agency. Purification plants may be operated by agencies other than the State; however, insofar as the National Shellfish Sanitation Program is concerned, the State is responsible for satisfactory operation.

h. Laboratory control is maintained over the purification operation. Controls shall include at least the following: Daily or tidal-cycle bacteriological quality of water; final bacteriological quality for each lot of shellfish purified; and, when they are critical factors, hourly or continuous salinity determinations and tidal-cycle turbidity determinations.

i. The plant operator possesses a satisfactory knowledge of the principles of water treatment and bacteriology.

j. Animals, rodents, and unauthorized persons are excluded from the plant.

k. Plant employees fulfill the qualifications for a shucker as described in section B–28, part II of this manual.

l. The State has an effective system for assuring that shellfish harvested from *restricted* areas will be submitted to purification before marketing. Shellfish harvesting from *prohibited* areas for controlled purification shall be under the immediate supervision of the State.

m. Shellfish from *prohibited* areas are not subjected to purification unless the State shellfish control agency can show that relaying or depletion is not biologically feasible; and that no public-health hazard will result from the use of such shellfish.

Public-health explanation.—The ability of shellfish to purify themselves in clean water was discovered early in the 1900's. The biological process is reasonably well understood and is described by Arcisz and Kelly (*26*) as follows:

"Purification is a mechanical process effected by the physiological functioning of the shellfish in clean water. When shellfish are feeding, the gills act as a filter to strain out some of the material that may be brought in by the water which passes through them. If this water contains sewage, some of the microorganisms in it are entrapped in the mucus on the body of the shellfish and transferred to the alimentary tract. Some of these are perhaps utilized as food (*49*) and the others discharged from the body in the form of feces and pseudofeces. When shellfish from polluted water are placed in clean water, the sewage bacteria are eliminated from the shellfish, and, since no more are ingested, purification is accomplished."

The purification process has been investigated extensively in England and to a lesser extent in the United States and Canada (*50*) (*51*) (*52*). The technique is reliable if proper methods are used, and insofar as is known, is applicable to all commercial species of shellfish.

Many of the earlier investigators suggested that purification be accomplished in tanks using water which had been subjected to a treatment process (*52*). The analogy with water treatment was carried to the point of recommending a chlorine residual in the purification tanks. However, fishery biologists have shown that shellfish pumping is decreased or inhibited by even small quantities of chlorine (*53*) (*54*). The inhibitory effect of chlorinated-dechlorinated water on activity of Eastern oysters has been noted by the Public Health Service Shellfish Sanitation Laboratory.

Since purification depends upon the pumping rate of the shellfish, it is important that the water be free of chemicals or physical characteristics which might interfere with this activity. For example, silt or dissolved organic substances may influence the pumping rates of shellfish (*55*) (*56*). The relationship of water temperature to pumping rates has been mentioned previously.

Shellfish purification facilities have generally been considered to include holding tanks and water treatment facilities (*57*) (*58*); however, investigations in Canada and England have demonstrated that purification can be accomplished with relatively simple installations if the operation is supervised properly (*59*) (*50*) (*60*) (*61*). Accordingly, any purification process of *proven* effectiveness will be accepted by the national program.

Administrative control of the purification process is necessary to insure that shellfish are properly washed and culled, are held for the required length of time, and that the purification water supply is properly controlled.

Section E

CONTROL OF HARVESTING FROM CLOSED AREAS

1. Identification of Closed Areas.—Shellfish harvesters shall be notified by direct notice and warning signs of areas closed to harvesting. Closed areas shall be so marked or described that they may be easily recognized by the harvesters. The measures necessary to accomplish delineation and notification will vary with the structure of the local shellfish industry and with the legal requirements of each State.

Satisfactory compliance.—This item will be satisfied when:

a. The boundaries of the closed areas are marked by fixed objects or landmarks in a manner which permits successful prosecution of any violations of the closed areas.

b. Shellfish harvesters are notified of the location of closed areas by publication or direct notification (such as registered mail) and/or warning signs posted at points of access to each closed area. The method of notification and identification should permit the successful prosecution of persons harvesting shellfish from the closed areas. (The limiting of shellfish harvesting permits to specific areas is an alternative to posting or notification. Where such a system is used, posting will be required only for closed areas which contain market shellfish.)

Public-health explanation.—Previous sections of this manual have described the public-health reasons for limiting shellfish harvesting to areas free of contamination and shellfish toxins. Methods have been described for the evaluation and classification of such areas. However, classification is not effective unless the State can prevent illegal harvesting of shellfish for direct marketing from these closed areas.

For the most part, control of illegal harvesting depends upon the police activities as described in section E–2. However, adequate delineation of the closed areas is fundamental to effective patrol.

The type of area identification will be determined by the structure of the local shellfish industry. Posting a warning sign is one method of informing shellfish harvesters that an area is closed to the taking of shellfish for public-health reasons. However, if the local shellfish industry is highly organized, with shellfish being harvested by only a few operators, identification may be accomplished by officially informing the harvesters that certain areas are closed to the taking of shellfish. It is recommended that the advice of the State's legal counsel be obtained to insure that the marking of closed areas and notifications to shellfish harvesters are such that illegal harvesting can be prosecuted successfully.

2. Prevention of Illegal Harvesting of Shellfish From Closed Areas.—Closed growing areas shall be patrolled by a State agency to prevent illegal harvesting. The patrol force shall be so equipped that its officers will be able to apprehend persons taking shellfish from closed areas.

Satisfactory compliance.—This item will be satisfied when—

a. There is no evidence that shellfish are being harvested from closed areas except by special permit as required to meet local conditions.

b. Closed shellfish growing areas are patrolled by representatives of an official agency, due consideration being given to night, weekend and holiday patrols. (States may delegate patrol activities to local organizations; however, responsibility for effective control will remain with the State insofar as the National Program is concerned.

c. Patrol forces are so equipped that persons observed in closed areas may be apprehended.

d. Complete records of patrol activities, including violations and court actions, are maintained in the central office of the State shellfish control or patrol agency. It will be the responsibility of the State to include local patrol activities in these records. (See section A, subsection 2(e) regarding monthly summaries of patrol activities.)

Public-health explanation.—The primary objective of the National Program is to insure that shellfish will be harvested only from areas which are free of dangerous concentrations of

pathogenic microorganisms, industrial or radioactive wastes, pesticides or shellfish toxins.

Growing areas may be classified as to their public-health suitability for shellfish harvesting on the basis of information obtained by sanitary and toxicological surveys. However, if local shellfish harvesters are not convinced of the need for restrictions, shellfish may be harvested surreptitiously from the closed areas. Thus, patrol failure may nullify the public-health safeguards resulting from sanitary survey activities.

The fact that law prohibits the removal of shellfish from certain areas will deter most persons from attempting to harvest such shellfish provided they are aware of the law and of the areas which are closed. However, local public opinion may not support the need for such closures. In such cases favorable opinion can probably be developed only through an educational program or a locally demonstrated need such as an epidemic or outbreak of paralytic shellfish poisoning. There is also a minority element not concerned with the welfare of their customers and who, through ignorance or purpose, will attempt to circumvent the harvesting restrictions.

Patrols must, therefore, be directed against three classes of individuals; i.e., those who are ignorant of the law, those who believe the law is unjust or unreasonable, and those who have no regard for the law.

Several mechanisms for improving the effectiveness of patrols include educational programs to acquaint shellfish harvesters with the public-health reasons for the closures, elimination of the "temptation element" by depletion, and relaying or purification. Apprehension, prosecution, and punishment of violators is a final resort.

The type of patrol organization needed for any particular situation cannot be specified and is determined by the nature of areas to be patrolled, means of access, methods of harvesting, and species. Patrol equipment should be such that the officers can apprehend persons harvesting shellfish in a closed area. Necessary equipment might include patrol boats capable of operating in open waters; small, high-speed, readily transportable boats, or patrol automobiles. In many instances, two-way radio will be helpful in coordinating patrol activities. Radar surveillance systems might also be of assistance, particularly during foggy weather or at night.

Organization of the patrol activity must take into consideration the need for night, weekend, holiday, and surprise patrols. Either nuisance or continual patrol may be used depending on the nature of the area to be patrolled and the type of industry.

The adequacy of State laws as a basis for prosecution is an important component of this activity. Shellfish patrol will probably be ineffective if State laws are so written or interpreted that violators cannot be successfully prosecuted, or if penalties are so small that they are economically unimportant. The latter point may be important in an area where local public opinion does not support the need for the restriction.

3. Depletion of Closed Areas.—The State shellfish control or patrol agency shall supervise all depletion operations. All market-size shellfish and as many of the smaller size as can be gathered by reasonable methods shall be removed in the initial depletion operation. Depletion of each area shall be carried out at intervals to prevent the development of market-sized shellfish.

Satisfactory compliance.—This item will be satisfied when—

a. The State shellfish control or patrol agency exercises direct supervision over each depletion project including patrol of the area in which the shellfish are relaid. (See section D–1.)

b. All market shellfish and as many of the smaller size shellfish as can be gathered by reasonable methods are removed in the depletion operation.

c. Similar supervised depletion operations are carried out at intervals to prevent development of market-sized shellfish in quantities which would make commercial harvesting economically practicable in the depleted areas.

Public-health explanation.—Complete removal of shellfish from polluted to clean areas under appropriate precautions is the best safeguard against contaminated shellfish reaching the market. In some cases depletion may be more economical and effective than patrol of closed areas.

Appendix A

BACTERIOLOGICAL CRITERIA FOR SHUCKED OYSTERS AT THE WHOLESALE MARKET LEVEL

The development of satisfactory bacteriological criteria for interstate shipments of oysters as received at the wholesale market level has been under consideration since 1950. At that time the Canadian Department of National Health and Welfare pointed out that most of the U.S.-shucked Eastern oysters sold in Canada had high coliform MPN's, high standard plate counts, or both (*2*). The Canadian experience with market standards for oysters was discussed at the 1956 National Shellfish Sanitation Workshop (*2*) and the Workshop adopted on an interim basis the following bacteriological standard for shucked Eastern oysters at the wholesale market level:

"*Class 1, Acceptable:* Shucked oysters with a Most Probable Number (MPN) of coliform bacteria of not more than 16,000 per 100 ml., and/or a Standard Plate Count of not more than 50,000 per ml.

"*Class 2, Acceptable on Condition:* Shucked oysters with a coliform MPN greater than 16,000 per 100 ml., but less than 160,000 per ml., and/or a Standard Plate Count greater than 50,000 per ml., but less than 1 million per ml. (The oysters will be accepted on the condition that the shellfish sanitation authority in the originating State will make immediate investigation of the producer's plant and operations and will submit a report of such investigations to the control agency in the market area. On the basis of this report the control agency in the market will reject or permit further shipments from the producer in question.)

"*Class 3, Rejectable:* Shucked oysters with a coliform MPN of 160,000 or more per 100 ml., and/or a Standard Plate Count of 1 million or more per ml."

In establishing the above interim standards, the 1956 Workshop recognized the limitations of the coliform group as an index of quality in that it failed to reveal whether the shellfish had been harvested from polluted areas or had been exposed to contamination during handling and processing subsequent to removal from the water. A recommendation was made that investigations be conducted to evaluate the significance of other bacterial indices. The fecal coliform group was suggested as a possible substitute for the coliform indices.

In partial fulfillment of this suggestion, a report on an interstate cooperative study to evaluate bacteriological criteria for market oysters was presented at the 1958 Shellfish Sanitation Workshop (*3*). A feature of this report was the development and evaluation of a method for the estimation of fecal coliform organisms following a procedure originally developed by Hajna and Perry (*77*). Gross increases in coliform organisms were observed during normal acceptable commercial practices. The magnitude of changes in coliform organisms was of the same order as those observed in plate counts. The results clearly demonstrated the inadequacy of the coliform group as an indicator of the sanitary quality of shellfish. It was further concluded that the plate count was of equal significance in revealing chance contamination or violations of acceptable storage time and temperature. On the other hand, the results of the examinations for fecal coliform organisms revealed a much higher degree of stability as the shellfish proceeded through commercial channels and thus suggested the greater suitability of this parameter as an index of sanitary quality at the wholesale market level. After due consideration of the report, the 1958 Workshop changed the interim bacteriological standard

for fresh and frozen shucked oysters at the wholesale market level to the following:

Satisfactory.[15] *E. coli* density of not more than 78 MPN per 100 ml. of samples as indicated by production of gas in E. C. liquid broth media nor more than 100,000 total bacteria per ml. on agar at 35° C. will be acceptable without question. An *E. coli* content of 79 to 230 MPN per 100 ml. of sample or a total bacteria count of 100,000 to 500,000 per ml. will be acceptable in occasional samples. If these concentrations are found in two successive samples from the same packer or repacker, the State regulatory authority at the source will be requested to supply information to the receiving State concerning the status of operation of this packer or repacker.

Unsatisfactory.[15] *E. coli* content of more than 230 MPN per 100 ml. of sample or a total bacteria count of more than 500,000 per ml. will constitute an unsatisfactory sample and may be subject to rejection by the State shellfish regulatory authority. Future shipments to receiving markets by the shipper concerned will depend upon satisfactory operational reports by the shellfish regulatory authorities at the point of origin.

In adopting the above standards, the 1958 Workshop recommended that the cooperative studies conducted by city and State laboratories and the Public Health Service be continued.

The 1961 Workshop reviewed still more data collected by the collaborating agencies during the 1958–61 period (*67*) and after considerable deliberation agreed to continued use of the interim bacteriological standards arrived at by the 1958 Workshop.

The 1964 Workhop considered all bacteriological data available up to that time (Nov. 17–19), including data relative to *Crassostrea gigas*, and adopted the following standards on a permanent basis, versus the previous interim basis, as being applicable to all species of fresh and frozen oysters at the wholesale market level, *provided they can be identified as having been produced under the general sanitary controls of the National Shellfish Sanitation Program.*[16]

Satisfactory. Fecal coliform density[17] of not more than 230 MPN per 100 grams and 35° C. plate count[18] of not more than 500,000 per gram will be acceptable without question.

Conditional. Fecal coliform density of more than 230 MPN per 100 grams and/or 35° C. plate count of more than 500,000 per gram will constitute a conditional sample and may be subject to rejection by the State shellfish regulatory authority. If these concentrations are found in two successive samples from the same shipper, the State regulatory authority at the source will be requested to supply information to the receiving State concerning the status of operation of this shipper. Future shipments to receiving markets by the shipper concerned will depend upon satisfactory operational reports by the shellfish regulatory authorities at the point of origin.

In establishing the above bacteriological standards the 1964 Workshop took cognizance of the fact that no known health hazard was involved in consuming oysters meeting the standard; that oysters produced in the Gulf Coast States with warmer growing waters, could meet the standard if harvested, processed, and distributed according to the National Shellfish Sanitation Program requirements, and that the oysters harvested were from "approved" growing areas complying with the standards for growing areas established in part I of the PHS Publication No. 33.

[15] *E. coli* was defined as coliforms which will produce gas from E. C. medium within 48 hours at 44.5° C. in a water bath will be referred to as fecal coliforms.

[16] The standards are not considered meaningful in the absence of such information.

[17] Fecal coliform organisms are those which, on transfer to E.C. medium from gas positive presumptive broth tubes show production of gas after incubation in a water bath at 44.5° C. ±0.2° C. for 24 hours. Where air incubation is at 45.5° C. ±0.2° C. comparative tests must be made to determine comparable time of incubation.

[18] Plate count is the number of bacteria determined by the "Standard Plate Count: procedure for shellfish described in the APHA Recommended Procedures for the Bacteriological Examination of Sea Water and Shellfish."

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National Shellfish Sanitation Program
Manual of Operations

Part II

SANITATION of the HARVESTING and PROCESSING of SHELLFISH

1965 Revision

Compiled and edited by
EUGENE T. JENSEN, Sanitary Engineer Director

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Division of Environmental Engineering and Food Protection
Shellfish Sanitation Branch
Washington, D.C. 20201

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1937. United States Public Health Service Minimum Requirements for Approval of State Shellfish Control Measures and Certification for Shippers in Interstate Commerce. (Revised October 1937)

1946. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry Recommended by the U.S. Public Health Service (Public Health Bulletin No. 295).

1957. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry Part II: Sanitation of the Harvesting and Processing of Shellfish. (Printed as Part II of Public Health Service Publication No. 33.)

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Contents

Foreword

A DECLARATION OF PRINCIPLES

The National Shellfish Sanitation Program is an unusual teaming of State and Federal resources to preserve and manage a natural resource for a beneficial use. Although the current program is of comparatively recent origin, its development can be traced back through several centuries of American history. When the European colonists arrived they found almost unimagined natural wealth. Forest, rich agricultural land, minerals and space itself were present in quantities and a variety previously unknown. To these settlers one of the most valuable and readily usable of these natural resources was the food resources of the sea, particularly the estuaries. It is not surprising that shellfish were foremost among their staple food items.

The value of these renewable natural resources to the early settlers was reflected in colonial legislation designed to encourage their wise use. In 1658—over 300 years ago—the Dutch council of New Amsterdam passed an ordinance regulating the taking of oysters from the East River. Other early legislation, including that of New York (1715), New Jersey (1730), and Rhode Island (1734), was designed to regulate harvesting, presumably as conservative measures to guarantee a continuing supply.

The public health problems which were associated with shellfish in the United States in the first two decades of the present century brought a new dimension to natural resource utilization; i.e., shellfish could not be used for food unless of acceptable sanitary quality. This concept was clearly recognized in the PHS-sponsored conference of 1925 in which the concepts of the present cooperative program were first outlined and the administrative foundation put down. All parties seemed to recognize, and accept as fact, the premises that: (1) shellfish represented a valuable natural food resource; (2) the cultivation, harvesting, and marketing of this food resource were valuable components in the financial bases of many coastal communities; (3) a State and Federal program was necessary to permit the safe use of this resource; and (4) the transmission of disease by shellfish was preventable and therefore not to be tolerated. It is significant that the founders of this program did not take the parochial stand that the only completely safe way to prevent disease transmission by shellfish was to prohibit its use. Instead, they held that this beneficial use of the estuaries was in the best public interest, and that sanitary control should be developed and maintained which would allow safe use. These concepts were recognized in the program which evolved following the report of the "Committee on Sanitary Control of the Shellfish Industry in the United States" in 1925.

In 1954 the Surgeon General of the U.S. Public Health Service called a second national conference to discuss shellfish sanitation problems. Specifically, the 1954 conference addressed itself to the questions of the practicality and need for this tripartite program. There was general agreement that, despite the profusion of technical problems, the basic concepts were sound and that it was in the public interest to maintain the program. Thus, the presence of an irrevocable bond between the application of sanitary controls in the shellfish industry and the continuing beneficial use of a renewable natural resource was again confirmed.

Despite this long-established relationship, the national program has tended to neglect the second of these biphasic goals—use of a valuable natural resource and to concentrate on the negative policy of closure of areas of unsuitable sanitary quality. Little effort has been made by the program to develop a compensatory element which would encourage corrective action by State or Federal agencies. Similarly, the pro

gram has not taken a position on the use of conservation law even when it was known that this would increase the programs consumer protection confidence factor.

In recognition of past history of the shellfish industry in the United States and of the relationship of the National Shellfish Sanitation Program to the effective use of this natural resource, the 1964 Shellfish Sanitation Workshop endorses the following principles:

1. Shellfish are a renewable, manageable natural resource of significant economical value to many coastal communities, and which should be managed as carefully as are other natural resources such as forest, water, and agricultural lands.
2. Shellfish culture and harvesting represents a beneficial use of water in the estuaries. This use should be recognized by State and Federal agencies in planning and carrying out pollution prevention and abatement programs and in comprehensive planning for the use of these areas.
3. The goals of the National Shellfish Sanitation Program are: (1) the continued safe use of this natural resource, and (2) active encouragement of water quality programs which will preserve all possible coastal areas for this beneficial use.

It is the conviction of the 1964 National Shellfish Sanitation Workshop that survival of the shellfish industry is in the best public interest; that by application of the above principles on a State-by-State basis, shellfish can continue to be used safely as food and to make a valuable contribution to the economic structure of the Nation both in the immediate present and in the foreseeable future.

Introduction

In 1925 State and local health authorities and representatives of the shellfish industry requested the Public Health Service to exercise supervision over the sanitary quality of shellfish shipped in interstate commerce. In accordance with this request, a cooperative control procedure was developed. In carrying out this cooperative control, the States, the shellfish industry, and the Public Health Service each accept responsibility for certain procedures as follows:

1. Procedures To Be Followed by the State.—Each shellfish-shipping State adopts adequate laws and regulations for sanitary control of the shellfish industry, makes sanitary and bacteriological surveys of growing areas, delineates and patrols restricted areas, inspects shellfish plants, and conducts such additional inspections, laboratory investigations, and control measures as may be necessary to insure that the shellfish reaching the consumer have been grown, harvested, and processed in a sanitary manner. The State annually issues numbered certificates to shellfish dealers who comply with the agreed-upon sanitary standards, and forwards copies of the interstate certificates to the Public Health Service.

2. Procedures To Be Followed by the Public Health Service.—The Public Health Service makes an annual review of each State's control program including the inspection of a representative number of shellfish-processing plants. On the basis of the information thus obtained, the Public Health Service either endorses or withholds endorsement of the respective State control programs. For the information of health authorities and others concerned, the Public Health Service publishes a semimonthly list of all valid interstate shellfish-shipper certificates issued by the State shellfish-control authorities.

3. Procedures To Be Followed by the Industry.—The shellfish industry cooperates by obtaining shellfish from safe sources, by providing plants which meet the agreed-upon sanitary standards, by maintaining sanitary plant conditions, by placing the proper certificate number on each package of shellfish, and by keeping and making available to the control authorities records which show the origin and disposition of all shellfish.

The fundamental components of this National Shellfish Sanitation program were first described in a *Supplement to Public Health Reports*, "Report of Committee on Sanitary Control of the Shellfish Industry in the United States" (1925). This guide for sanitary control of the shellfish industry was revised and reissued in 1937 and again in 1946. It was separated into two parts by publication of Part II, Sanitation of the Harvesting and Processing of Shellfish in 1957 and by publication in 1959, of Part I, Sanitation of Shellfish Growing Areas. The need for a specialized program of this nature was reaffirmed at the National Conference on Shellfish Sanitation held in Washington, D.C., in 1954 (*1*) and at the Shellfish Sanitation Workshops held in 1956 (*2*), 1958 (*3*), 1961 (*67*), and 1964 (*68*).

This addition of the shellfish sanitation manual has been prepared in cooperation with the State shellfish control authorities in all coastal States, food control authorities in the inland States, interested Federal agencies, Canadian Federal departments, the Oyster Institute of North America, the Pacific Coast Oyster Growers Association, and the Oyster Growers & Dealers Association of North America.

Since the growing and processing of shellfish are two distinct phases of operation in the shellfish industry, the manual has been prepared in two parts: I: Sanitation of Shellfish-Growing Areas; and II: Sanitation of the Harvesting and Processing of Shellfish. This Part II of the manual is intended as a guide for the preparation of State shellfish sanitation laws and regulations, for sanitary control of

the harvesting and processing of shellfish, and for the shellfish industry in the maintenance of sanitary conditions during the harvesting and processing of shellfish. It is intended that States participating in the National Shellfish Sanitation program for the certification of interstate shellfish shippers will be guided by this manual in exercising sanitary supervision over harvesting, shucking, packing, repacking, and reshipping shellfish, and in the issuing of certificates to shellfish shippers.

The manual will also be used by the Public Health Service in evaluating State shellfish sanitation programs to determine if the programs qualify for endorsement. Part III of the Manual, "Public Health Service Appraisal of State Shellfish Sanitation Programs," sets forth appraisal procedures in evaluating State shellfish sanitation programs and is based on the requirements contained in parts I and II.

The provisions of this manual were accepted at the Shellfish Sanitation Workshop held in Washington, D.C., November 17–19, 1964, and unless otherwise stated become effective 60 days after publication (*68*).

EUGENE T. JENSEN,
Chief, Shellfish Sanitation Branch, Division of Environmental Engineering and Food Protection, Public Health Service.

Definitions

And/or.—Where this term is used, *and* shall apply where possible; otherwise, *or* shall apply.

Approved area.—An area which has been approved by the State control agencies for growing and/or harvesting of shellfish for direct marketing.

Classes of shippers.—(a) *Reshippers* are shippers who transship shucked stock in original containers, or shell stock, from certified shellfish shippers to other dealers or to final consumers. (Reshippers are not authorized to shuck or repack shellfish.)

(b) *Repackers* are shippers, other than the original shucker, who pack shucked shellfish into containers for delivery to the consumer. Shippers classified as repackers may shuck shellfish if they have the necessary facilities. A repacker may also act as a shell-stock shipper if he has the necessary facilities.

(c) *Shell-stock shippers* are shippers who grow, harvest, buy, and/or sell shell stock. They are not authorized to shuck shellfish nor to repack shucked shellfish.

(d) *Shucker-packers* are shippers who shuck and pack shellfish. A shucker-packer may act as a shell-stock dealer. (Shucker-packers are classified as repackers if shucked shellfish are *regularly* repacked.)

Dry storage.—The storage of shell stock out of water.

Food-product zone.—The parts of food equipment, including auxiliary equipment (such as blower pipes and drain valves), 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.

Internal temperature.—Actual temperature of shucked shellfish in the container, as opposed to the air temperature of the refrigerator in which the shellfish may be stored.

Person.—Person shall mean an individual, or a firm, partnership, company, corporation, trustee, association, or any public or private entity.

Shellfish.—All edible species of oysters, clams, or mussels, either shucked or in the shell, fresh or frozen.

Shell-stock.—Shellfish which remain in their shells.

Shucked shellfish.—Shellfish, or parts thereof, which have been removed from their shells.

Wet storage.—The temporary storage of shellfish from approved sources, intended for marketing, in tanks containing sea water or in natural bodies of water, and including storage in floats.

Section A

HARVESTING AND HANDLING SHELL-STOCK

1. Boats and Trucks.—All boats used in tonging, dredging, or transporting shellfish, including "buy" boats, and all trucks used for hauling bulk shell-stock shall be so constructed, operated, and maintained as to prevent contamination or deterioration of the shellfish, and shall be kept clean.

Public-health explanation.—Precautions exercised in gathering shellfish from approved growing areas may be nullified by contamination with bilge water or polluted overboard water.

Satisfactory compliance.—This item will be satisfied when—

a. Decks and/or storage bins are so constructed and located as to prevent bilge water or polluted overboard water from coming into contact with the shellfish. Removable false bottoms will ordinarily be required in all small craft, including rowboats, skiffs, and power boats, used in the transport of shell-stock.

b. Bilge pumps are so located that pumpage will not contaminate shellfish.

c. Sacks or other containers used for the storage of shellfish are clean.

d. Boat decks and storage bins are kept clean with water from an approved source.

e. That portion of boats or trucks (decks, storage bins, floorbeds, etc.) and all other equipment (shovels, wheelbarrows, rakes, etc.) in contact with shell-stock during handling or transport from polluted areas to approved areas for relaying are thoroughly cleaned before they are used for the transport or handling of shellfish from approved areas.

f. Trucks used for the transport of bulk shell stock are so constructed as to protect the shellfish from contamination, and are kept clean.

2. Washing of Shell-Stock. Shell-stock should be washed reasonably free of bottom sediments and detritus as soon after harvesting as is practicable. The primary responsibility for washing rests with the harvester. Water used for shell-stock washing should be obtained from an approved growing area, or from other sources approved by the State regulatory agency.

Public-health explanation.—When muddy shell stock are shucked, quantities of mud and bacteria are mixed with the shucked shellfish, thereby contributing to high bacteria counts in the finished product.

These bacteriological changes which take place during the shucking of oysters (*Crassostrea virginica*) in the Middle Atlantic States have been investigated at the Public Health Service's Shellfish Sanitation Laboratory (Kelly and Arcisz: "Bacteriological Control of Oysters During Processing and Marketing," *Public Health Reports*, vol. 69, No. 8, August 1954).

During shucking, the percentage of samples of oysters having coliform Most Probable Numbers (MPN's) in excess of 2,400 per 100 ml. of meats was found to increase from 18 to 72, and the percentage of samples of oysters having coliform MPN's in excess of 24,000 per 100 ml. of meat increased from zero to 14. Mud and detritus adhering to the shells were implicated as responsible for the increase in coliform counts.

Muddy shell-stock also make it difficult to maintain shucking rooms in a clean, sanitary condition.

Water used for shell-stock washing should be of good sanitary quality, to avoid possible contamination of the shell stock.

Satisfactory compliance.—This item will be satisfied when—

a. Shell-stock are washed reasonably free of bottom sediments and detritus as soon after harvesting as is feasible. Washing of naturally clean shell stock is not necessary. Shell-stock

should preferably be washed at the time of harvesting; however, this may not always be feasible because of the harvesting method or climatic conditions. In other instances, shell-stock washing by the harvester might introduce a sanitary hazard because of the possible tendency of the harvester to wash the shell-stock with polluted water from a harbor area, rather than with clean water from a growing area. State shellfish control authorities may, therefore, at their discretion, waive the requirement for shell-stock washing by the harvester when, in the State's opinion, there are climatic, technical, or sanitary reasons for such action.

b. Water used for washing shell-stock is obtained from an approved growing area, or from other sources approved by the State regulatory authority.

3. Disposal of Body Wastes.—During the marketing season, body wastes shall not be discharged overboard from a boat used in the harvesting of shellfish, or from "buy" boats while in areas from which shellfish are being harvested. The State shellfish control agency, when necessary, shall specify the device and practices necessary to eliminate the overboard discharge of body wastes from boats used in harvesting of shellfish. It is recommended that each State shellfish control agency maintain an educational program for all boat owners concerning the public health significance and dangers inherent in the overboard discharge of body wastes.

Public-health explanation.—Gastrointestinal infections may be conveyed by shellfish; hence, it is necessary to protect the shellfish from pollution by disease-causing organisms that may be present in body wastes. This item is intended to protect the shellfish from chance pollution during harvesting. The discharging of body wastes from either harvesting or "buy" boats will be considered in the evaluation of harvesting practices.

Satisfactory compliance.—This item will be satisfied when—

a. No body wastes are discharged from a boat used in harvesting shellfish while in an area from which shellfish are being harvested.

b. No body wastes are discharged from a "buy" boat while in an area in which shellfish are being harvested.

c. It is evident that soil cans, if provided, are used for the purpose intended.

d. Soil cans, where used, are so secured and located as to prevent contamination of the shellfish by spillage or leakage.

e. The contents of soil cans are disposed of by discharge into an approved sewage-disposal system, and soil cans are cleaned before being returned to the boat.[1] (Facilities used for cleaning food-processing equipment may not be used for this purpose.)

4. Licenses for Commercial Harvesters.—Each person who handles unshucked shellfish prior to delivery or sale to a dealer certified under the cooperative program shall have a valid State permit or license to do so.

In the case of leased land, either the lessee shall be licensed or the person who harvests shall be licensed by the State. The State agency having primary responsibility for granting licenses shall maintain a record of all such licenses granted for review by the appropriate Public Health Service regional office.

Satisfactory compliance.—This item will be satisfied when—

a. Each person harvesting shellfish has a valid permit or license to do so.

b. The State agency having responsibility for granting licenses maintains a record of all such licenses granted for review by the appropriate Public Health Service regional office.

c. In the case of leased growing area(s), either the lessee or the person who harvests shall be licensed by the State.

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[1] For use and construction of soil-can-washing facilities, see Public Health Service Publication No. 66, *Handbook on Sanitation of Railroad Servicing Areas*, on sale by the Superintendent of Documents, U.S. Government Printing Office Washington, D.C., 20402, at 20 cents.

Section B

SHUCKING AND PACKING SHELLFISH

1. Wet Storage.—Shellfish in wet storage shall be protected against sewage contamination. Wet storage shall not be practiced by a shipper unless written approval is given each year by the State regulatory authority. This approval is to include a sketch, drawn to scale, showing the approved location of the storage area, floats or the water intake for the wet-storage tanks, and all the potential hazards to which the stored shellfish may be exposed. The approval statement shall describe the measures taken to protect the shellfish from the potential hazards. The presence of usable wet-storage tanks in a plant, or the presence of usable floats in the water, shall be deemed evidence that wet storage is being practiced.

Public-health explanation.—Removal of shellfish from growing beds to storage areas close to shore and habitations, and frequently in shallow water, may subject an accumulated quantity of shellfish to constant or intermittent pollution. Shellfish in wet-storage tanks are similarly subject to pollution if the water is obtained from a polluted source. Shellfish on floats are more directly exposed to chance contamination from boats than are shellfish stored in the growing areas themselves, since it is customary to "float" the shellfish near the surface, where fresh sewage is apt to be found in greatest concentration. Shellfish on floats, therefore, are protected to a less degree by dilution than are shellfish on bottom areas.

Satisfactory compliance.—This item will be satisfied when—

a. Shellfish in wet storage are protected against sewage contamination.

b. Wet storage is practiced only in strict compliance with the terms of the written approval of the State regulatory authority. This approval is to include: (1) a sketch, drawn to scale, showing the location of the storage area or water intakes and the potential hazards to which the shellfish may be exposed; and (2) a statement describing the measures taken to protect the shellfish from the above potential hazards. This written approval shall be valid for not more than 12 months.

2. Plant Arrangement.—Plants in which shellfish are shucked and packed shall, to the extent feasible, be so located that they will not be subject to flooding by high tides. If plant floors become flooded, shucking shall be discontinued until after waters have receded and the building cleaned.

Shucking and packing operations shall be conducted in separate rooms. A shucked-stock delivery window shall be installed in the partition between the two rooms. Packing rooms shall be of sufficient size to permit sanitary handling of the product and thorough cleaning of equipment.

A separate room or rooms, or lockers, shall be provided for storing employees' street clothing, aprons, gloves, and personal articles.

Public-health explanation.—The nature of the shucking operation is such that the shuckers' clothing becomes very soiled. If shuckers enter the packing room, shucked stock, cans, and other equipment may become contaminated. Rooms or lockers should be provided for clothing, aprons, and gloves to eliminate the tendency to store such articles on the shucking benches or in packing rooms, where they interfere with plant cleanup and operation.

Satisfactory compliance.—This item will be satisfied when—

a. Processing establishments are so located that they will not be subject to flooding by ordinary high tides. (A minimum plant elevation of at least 2 feet above high tides is recommended.) If plant floors are flooded, shucking is discontinued until after waters have receded and the building is cleaned.

b. Shucking and packing operations are

carried on in separate rooms. Flytight screening may be accepted in lieu of a solid wall between the shucking and packing rooms, provided that the packing room is so situated that there is no likelihood of the shucked product or packing-room equipment being contaminated by splash from the opening room.

c. The delivery window is equipped with a corrosion-resistant shelf of metal, concrete, or tile, draining toward the shucking room and, if necessary, curbed on the packing-room side.

d. Packing rooms are large enough to permit sanitary handling of shellfish and thorough cleaning of equipment.

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

3. Dry Storage of Shell-Stock.—Shell-stock in dry storage shall be protected from contamination. Rooms, benches, or hoppers shall be provided for the storage of shell-stock. Floor wastes from a shell-stock storage area shall be discharged through a separate drainage system, or, if discharged into a general drainage system carrying sanitary wastes, an airgap shall be provided.

Public-health explanation.—Smooth, wash-stored where polluted ground or surface water or floor drainage can accumulate, the shell-stock may become contaminated. Shell-stock may also be contaminated by domestic animals and rodents (see Section B, Items 12 and 15).

Satisfactory compliance.—This item will be satisfied when—

a. The storage-area floor is constructed of material impervious to water, is free from cracks and uneven surfaces that interfere with proper cleaning or drainage, and is graded to assure complete and rapid drainage of water away from the shellfish.

b. Walls of shell-stock storage rooms and hoppers are smooth and of material which will not deteriorate under repeated washing.

c. Shell-stock storage areas are so constructed that they will not receive floor drainage water from other portions of the plant. If such construction is not feasible, the shell-stock should be stored on racks to prevent them from coming into contact with the floor or with water which might accumulate on the floor. Shell-stock storage areas should not serve as an entry way to other areas of the establishment. Shell-stock storage areas are protected against sewage backflow by the installation of an airgap in the waste line or by provision of a separate drain system.

d. Conveyances or devices used in the transport of shell-stock are so constructed that they may be easily cleaned and are kept reasonably clean. (Use of impervious materials is recommended wherever possible.)

4. Floors.—Floors shall be constructed of concrete or other material impervious to water, and shall be graded to drain quickly, shall be free from cracks and uneven surfaces that interfere with proper cleaning or drainage, and shall be maintained in good condition.

Public-health explanation.—Properly graded floors, of durable, impervious material, maintained in good condition, permit rapid disposal of liquid and solid wastes, and are easily cleaned.

Satisfactory compliance.—This item will be satisfied when—

a. The floors of all rooms in which shellfish are shucked or packed, or in which utensils are washed, are constructed of concrete of good quality, or of equally impervious tile laid closely with impervious joint material, or of metal surfacing with impervious joints, or of any other material which is equivalent to good quality concrete; and when the floors are maintained in good repair.

b. The floor surface is smooth, and graded to drain, and the junctions between floors and walls are impervious to water.

5. Walls and Ceilings.—The interior surfaces of rooms in which shellfish are shucked or packed, or in which utensils are washed, shall be smooth, washable, light-colored, and kept in good repair.

Public-health explanation.—Smooth, washable walls and ceilings are more easily kept clean and are, therefore, more likely to be kept clean. A light-colored paint or finish aids in the distribution of light and in the detection of unclean surfaces. Clean walls and ceilings are conducive to clean shellfish handling.

Satisfactory compliance.—This item will be satisfied when interior surfaces are of tile, concrete, cement plaster, concrete blocks, painted wood, or equivalent material, having a smooth, washable, light-colored surface. (Structural

members may be exposed, provided that they do not interfere with cleaning.)

6. Fly-Control Measures.—All outer openings to toilet and wash rooms, shucking and packing rooms, utensil cleaning and storage rooms, and locker rooms shall be effectively screened during the seasons when flies are present, unless other effective means are provided for preventing the entrance of flies. Effective in-plant fly-control measures shall be used to kill or capture flies which may enter the plant despite the screening. Shell-stock storage rooms shall be screened as necessary, to prevent the entrance of flies into the other portions of the plant. All interior doors or other openings into the packing room should be screened whenever necessary to keep the packing room free of flies.

Public-health explanation.—Flies may contaminate the shellfish with disease organisms, thus nullifying the effectiveness of all other public-health safeguards.

Satisfactory compliance.—This item will be satisfied when—

a. All outer openings are effectively screened whenever flies are present; or other effective devices are provided to prevent the entrance of flies.

b. Screen doors open outward and are self-closing.

c. Flies are not present.

d. Necessary internal fly-control measures are used, and such measures are approved by the State regulatory authority.

7. Lighting.—Ample natural and/or artificial light shall be provided in all working and storage rooms.

Public-health explanation.—Adequate lighting encourages cleanliness of rooms, equipment, and product, and helps to prevent eyestrain.

Satisfactory compliance.—This item will be satisfied when work and storage rooms are lighted to at least the intensity indicated below:

Type of area	Foot-candles of illumination [1]
Working surfaces in packing rooms	[2] 25
Shucking benches and utensil-washing areas	[2] 15
Storage rooms, including cold-storage rooms	[3] 5

[1] Approximate. Measure as incident light.
[2] Overall illumination level in area should be at least 10 ft.-c
[3] Measured 30 inches above the floor.

8. Heating and Ventilation.—Working rooms shall be ventilated, and shall be heated when necessary.

Public-health explanation.—Uncomfortable working conditions impair the efficiency of the workers, and may result in insanitary practices.

Proper ventilation reduces condensation, and aids in retarding the growth of mold.

Satisfactory compliance.—This item will be satisfied when—

a. A comfortable working temperature is maintained.

b. Sufficient ventilation is provided to eliminate odors, discomfort, and excessive condensation.

9. Water Supply.—The water supply shall be easily accessible, adequate, and of a safe and sanitary quality.

Public-health explanation.—The water supply should be accessible in order to encourage its use in cleaning operations; it should be adequate to insure proper washing, rinsing, and bactericidal treatment of the equipment; and it should be of a safe and sanitary quality, to avoid contamination of the equipment and product.

Satisfactory compliance.—This item will be satisfied when—

a. The water supply is approved as safe by the responsible State authority, or complies with the Public Health Service *Drinking Water Standards.* (Private water systems are so constructed and operated as to be at least equal to the recommendations contained in Public Health Service Publication No. 24, "Manual of Individual Water Supply Systems.")[2] [3]

b. All shell-stock storage rooms, shucking and packing rooms, and utensil washrooms are provided with water outlets.

c. An automatically regulated hot-water system is provided which has sufficient capacity to furnish water with a temperature of at least 130° F. during all hours of plant operation.

[2] This publication is obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402; price 40 cents.

[3] The regulatory agency should collect water samples for bacteriological examination at not less than semiannual 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.

d. Sufficient water is available for all plant needs. (Nonpressure supplies will not constitute compliance.)

e. Hot and cold water outlets are provided at each sink compartment, except that warm water only may be acceptable at handwashing sinks, as provided by Section B, Item 10e.

10. Plumbing and Related Facilities.—Plumbing shall be installed in compliance with State and local plumbing ordinances, or, in the absence of such ordinances, shall be substantially equivalent to the recommendations contained in the *American Standard National Plumbing Code ASA A40.8–1955.*[4] Lavatories with running hot and cold (or warm) water shall be so located that their use by plant personnel can be readily observed. Signs shall be posted in toilet rooms and near lavatories, directing employees to wash their hands before starting work and after each interruption. Conveniently located, separate toilets shall be provided for each sex; however, separate toilet facilities for each sex shall not be required when family shucking is carried on and satisfactory toilet facilities are located nearby, or when the plant has fewer than 10 employees.

Public-health explanation.—The organisms causing typhoid fever, paratyphoid fever, dysentery, and other gastrointestinal diseases may be present in the body discharges of cases or carriers, and may thus be present in the drainpipes in the plants. Correctly installed plumbing protects the water supplies from back siphonage through improperly installed fixtures or equipment. A safe water supply in a plant contributes to product purity and to the safety of the workers.

Handwashing facilities, including running water, soap, and sanitary drying facilities, are essential to the personal cleanliness of food-service workers. The posting of a handwashing sign is necessary to remind plant employees of this important public-health practice.

Satisfactory compliance.—This item will be satisfied when—

a. Plumbing is installed in compliance with State and local plumbing ordinances, or is substantially equivalent to the recommendations contained in the *American Standard National Plumbing Code ASA A40.8–1955.*

[4] This publication is obtainable from the American Society of Mechanical Engineers, 29 West 39th St., New York, N.Y.

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

c. There is at least 1 lavatory for every 20 employees among the first 100 employees, and at least 1 lavatory for each 25 employees in excess of the first 100. (Twenty-four lineal inches of wash sink or 18 inches of a circular basin, when provided with water outlets for such space, will be considered equivalent to 1 lavatory.)

d. Handwashing facilities are convenient to the work areas, and are so located that the person responsible for supervision can readily observe that employees wash their hand 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 are 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 are available near the lavatory. (Other sanitary drying devices, if approved by the State regulatory agency, are also acceptable.)

g. Handwashing signs are posted in toilet rooms and near lavatories.

h. The toilet-room doors are tight-fitting and self-closing.

i. The toilet rooms are kept clean and in good repair.

j. A supply of toilet paper is available in the toilet rooms.

k. At least 5-foot-candle illumination (natural or artificial) is provided in toilet rooms; and toilet rooms are 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 are provided for each sex, excepting that separate

facilities need not be required when family shucking is carried on and satisfactory toilets are located nearby, or when the plant has fewer than 10 employees. The number of water closets provided complies with applicable State laws. In the absence of such laws, the following number of water closets should be provided:

Number of employees	Number of water closets [1]	
	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	[2] 5	[2] 5

[1] Wherever 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.

[2] One additional fixture for every 30 employees over the first 100.

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

11. Sewage Disposal.—Sewage shall be discharged into public sewers wherever possible. Where private sewage-disposal systems must be utilized, they shall be constructed according to State and local requirements; provided, that privies shall be acceptable only where water-carriage systems are not feasible. All newly constructed individual water-carriage systems shall be at least equal to the recommendations contained in the "Manual of Septic Tank Practice," Public Health Service Publication No. 526.[3] All sewage-disposal facilities shall be so constructed and maintained that waste will be inaccessible to flies and rodents.

Public-health explanation.—The organisms causing typhoid fever, paratyphoid fever, and dysentery may be present in the body discharges of cases or carriers. When sewage-disposal facilities are of a satisfactory type, there is less possibility that the shellfish being processed may become contaminated with fecal material carried by flies or rodents.

[3] This publication is obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402; price 40 cents

Non-water-carriage sewage-disposal systems should be of a sanitary type, so that excreta are not accessible to flies or rodents.

Satisfactory compliance.—This item will be satisfied when—

a. Sewage is discharged into public sewers wherever possible.

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

c. No human excreta are accessible to flies or rodents.

12. Rodent Control.—Shellfish-processing plants shall be free from rodents.

Public-health explanation.—Rodents may contaminate the shellfish, utensils, or containers.

Satisfactory compliance.—This item will be satisfied when—

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

b. Rodenticides which are highly toxic to humans are not stored in shellfish-processing plants, and are not used except under the supervision of a licensed pest-control operator or other qualified specialist. (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.)

13. Construction of Shucking Benches and Tables.—The tops of shucking benches and tables, and contiguous walls to a height of at least 2 feet above the bench top, shall be of smooth concrete, corrosion-resistant metal, or other durable, nonabsorbent material, free from cracks, and so constructed that drainage is complete and rapid and is directed away from the stored shellfish. Shucking blocks shall be easily cleanable. Wooden shucking blocks, if used, shall be of solid, one-piece construction, and shall be easily removable. Shucking blocks of lead or other toxic materials are prohibited. Stands or stalls, if any, shall be of painted, finished material.

Public-health explanation.—Unless shucking benches, stands, blocks, and stalls are made of smooth material and are easily cleaned, they will become very dirty and may contaminate the shellfish.

Satisfactory compliance.—This item will be satisfied when—

a. Shucking benches and contiguous walls to a height of at least 2 feet above the bench tops are of smooth concrete, corrosion-resistant metal, or other durable, nonabsorbent material, free from cracks.

b. Benches drain completely and rapidly, and drainage is directed away from any shellfish on the benches.

c. Shucking blocks are easily cleanable; of nontoxic material; of solid, one-piece construction; and, unless an integral part of the bench, are easily removed from the shucking bench. (Lead is acceptable for weighting breaking blocks only where the shellfish or knife will not come into frequent contact with the metal.)

d. Stands (or stalls) and stools are of painted, finished material.

e. Shuckers' stools have no attached padding, and are so constructed as to be easily cleaned.

14. Construction of Utensils and Equipment.—The food-product zone of utensils and equipment, including that used for ice-handling, shall be made of smooth, corrosion-resistant, impervious, nontoxic material which will not readily disintegrate or crack; and the utensils and equipment shall be so constructed as to be easily cleaned, and shall be kept in good repair.

Public-health explanation.—Colanders, schucking pails, skimmers, blowers, and other equipment or utensils which come into contact with the shucked shellfish and which have cracked, rough, or inaccessible surfaces, or which are made of improper material, are apt to harbor accumulations of organic material in which bacteria or other microorganisms may grow. These microorganisms may later cause illness among those who eat the shellfish, or spoilage in the shucked shellfish.

The slime and foreign material which accumulate in blower airpipes below the liquid level afford an excellent breeding place for bacteria. This material may be dislodged and forced into the batch of shucked shellfish then in the blower, thus increasing the bacterial content of the shellfish.

Satisfactory compliance.—This item will be satisfied when—

a. All pails, colanders, skimmers, paddles, tables, storage containers, returnable containers, blowers, and other equipment which come into contact with shucked shellfish, or with ice used for direct cooling of shellfish, are constructed of corrosion-resistant, nonabsorbent, nontoxic, smooth material which will not readily crack or disintegrate. (The use of enameled, tinned, or galvanized material in the food-product zone of equipment other than single-service shipping containers is not acceptable.)

b. There are no exposed screw, bolt, or rivet heads in the food-product zones, and all joints in the food-product zone are welded or soldered flush and have a smooth surface. (The use of welded joints which have been ground smooth is recommended, because soldered joints have been proven to be generally unsatisfactory for equipment used in the shellfish industry.)

c. Tanks, tubs, and shucked-stock storage containers are so located that their top rim is at least 2 feet above the floor.

d. All utensils and equipment are in good repair.

e. All equipment, including external and internal blower airlines and/or hoses below a point 2 inches above the overflow level of the tank, and blower drain valves, is so constructed as to be easily cleanable; when perforations in skimmers and colanders are smooth, to facilitate cleaning; when all internal angles in the food-product zone are filleted or otherwise fabricated to have an internal radius of at least ¼ inch; and when there are no V-type threads in the food-product zone of the blower. (The use of wire mesh in the food-product zone of equipment is not acceptable).[7] Non-food-product zones of equipment should be so constructed that they can be kept in a clean, sanitary condition; seams and joints should be welded, whenever possible; outside seams should be welded or filled with solder; and there should be no inaccessible spaces in which dirt or organic material might accumulate.

[7] Sanitary Standards describing the construction of valves, fittings, and pumps may be obtained from International Association of Milk and Food Sanitarians, Inc., Box 347, Shelbyville, Ind. Public Health Service Publication No. 943, *Shellfish Industry Equipment Construction Guides*, obtainable from PHS regional offices, contains guides for sanitary construction of shellfish blower tanks, skimmers, returnable shipping containers, and shucking buckets and pans.

f. The blower drain is not directly connected with a sewer.

g. A stand or shelf constructed of corrosion-resistant material, located so that the rim of the receiving container will be at least 2 feet above the floor, is provided under all chutes from skimmers and blowers, unless blowers discharge directly to a skimmer.

h. Air-pump intakes are located in a protected place.

i. Containers are clean; are fabricated of nontoxic metal, waxed paper, glass, or other impervious material; are so designed and fabricated that the contents will be protected from contamination during shipping and storage; covers of returnable containers are so designed as to protect the pouring lip of the container; and returnable containers are sealed so that tampering can be detected.

j. All blower tanks, skimmers, returnable shipping containers, shucking buckets and pans purchased and/or installed after September 30, 1965, shall comply with the sanitation requirements contained in the *Shellfish Industry Equipment Construction Guides* published by the Public Health Service. (Copies are available from State shellfish sanitation agencies or PHS regional offices.)

15. General Cleanliness.- Premises shall be kept clean and free of litter and rubbish. Miscellaneous and unused equipment and articles which are not necessary to plant operations shall not be stored in rooms used for shell-stock storage, shucking, packing, or repacking. No domestic animal or fowl shall be permitted to be in a shellfish-processing plant. The shell-stock storage, shucking, and packing portions of the plant, when in operation, shall be restricted to the handling of shellfish. Unauthorized persons shall be excluded from the plant.

Public-health explanation.—The presence of unused equipment and material interferes with the proper cleaning of the plant and equipment, and may, therefore, contribute indirectly to contamination of the food product. Shell or shucked stock may be contaminated by domestic animals, fowls, or rodents.

Satisfactory compliance.—This item will be satisfied when—

a. Material and equipment not in routine use are not stored in rooms used for shell-stock storage, shucking, packing, repacking, or container storage.

b. The shell-stock storage, shucking, and packing portions of the plant are not used for other operations while shellfish are being processed.

c. No domestic animals, rodents, or fowl are permitted in shellfish-processing plants.

d. Only personnel engaged in packing operations, supervisory personnel, authorized inspectors, or other persons specifically authorized by the plant manager, are allowed in the shell-stock storage, shucking, or packing rooms during periods of operation.

e. Premises are clean and free of litter and rubbish.

f. Shuckers do not go into or through the packing room for any purpose. (An exception may be made in small operations, where an employee may work in both the packing room and the shucking room. In such cases, the employee should be required to change aprons and wash his hands thoroughly before entering the packing room.)

16. Cleaning of Buildings and Equipment.- Shucking benches, shucking stools, floors, and, if necessary, walls of the shell-stock storage rooms and packing and shucking rooms shall be cleaned within 2 hours after the day's operations have ceased. Windows and skylights shall be kept clean. Refrigerators shall be kept clean. All equipment, utensils, and work surfaces, including the external and internal blower airlines and blower drain valves, shall be cleaned by scrubbing with water and detergent and rinsing with potable water within 2 hours after the day's operations have ceased.

Public-health explanation.—Clean workrooms and refrigerators reduce the chance of contaminating shellfish during shucking and processing. Shucked shellfish cannot be kept clean and safe if permitted to come into contact with equipment which has not been sanitized. Bactericidal treatment is not effective unless the equipment is first thoroughly cleaned.

The determination of adequate cleanup facilities will depend upon the method of bactericidal treatment selected (see Item 17) and plant-by-plant determination of what equipment and utensils may best be washed in a sink and what equipment may best be washed "in place." Detergents and brushes, including

special brushes that may be needed for cleaning equipment such as blower lines, should be available.

SINK WASHING

Wash sinks should be made of impervious, nontoxic material. Sink compartments should be large enough to permit the complete immersion of the largest utensil to be sink-washed. A second compartment should be provided in the sink for clean-water rinsing between washing and bactericidal treatment, unless some other acceptable method, such as a spray rinse, is provided. In the case of bactericidal treatment by immersion in hot water (Item 17a(2)), both the bactericidal treatment and rinse may be accomplished simultaneously in the second compartment. If bactericidal treatment by means of immersion in chemical solutions (Item 17a (3)), is selected, a separate compartment should be provided for this operation.

Number of Compartments Required in Sink

Method of bactericidal treatment	Method of rinse	
	Immersion	Spray
Steam cabinet	2	1
Hot water (170° F.)	2	(1)
Bactericidal solution	3	2

[1] Not applicable.

IN-PLACE WASHING

Utensils and equipment which have to be washed "in place" will require the same three steps of wash, rinse, and bactericidal treatment. A watertight container, such as a blower tank, is best washed by preparing a solution of the detergent in the container itself and using this to scrub all parts of the unit. Rinsing, preferably, should be accomplished either by complete filling or by thorough spray rinse. The bactericidal treatment methods are described in item 17.

Satisfactory compliance.—This item will be satisfied when—

a. Shell-stock storage, shucking, and packing rooms are cleaned within 2 hours after the day's operations have ceased.

b. All utensils, equipment, and work surfaces, including the external and internal blower air-lines below the tank's liquid level, are cleaned by scrubbing with water and detergent and rinsing with potable water within 2 hours after the day's operations have ceased.

c. Cleaned benches, blocks, and stalls are flushed or sprayed as often as necessary, and at least once each week, with a solution containing not less than 100 parts per million of available chlorine, or other disinfecting agents in effective concentrations as approved by the State regulatory authority.

d. Refrigerators are clean.

e. Adequate cleanup facilities, including sinks, bactericides, detergents, and brushes, are available within the plant. Where chemical bactericides are used, a third compartment or spray rinse must be installed to permit a clean-water rinse between washing and bactericidal treatment. (Sink compartments should be large enough to permit complete immersion of the largest utensil to be washed.)

f. All shelves, tables, and other equipment in the shucking and packing rooms are clean.

g. Wash tanks, blowers, and containers for shucked-stock holding are flushed or spray-rinsed with tapwater after each emptying. (Dismantling is not necessary.) Periodic clean-water flushing of shucking benches, utensils, table surfaces, and other equipment during working periods is recommended.

17. Bactericidal Treatment of Utensils and Equipment.—All utensils and equipment in the shucking and packing rooms which come into contact with shucked shellfish shall be subjected to an effective bactericidal process at the end of each day's operation.[1]

Large equipment which might be recontaminated before use shall be cleaned at the end of each day's operation, and shall be subjected to effective bactericidal treatment immediately before use.

Returnable shipping containers, if used, are subjected to an effective bactericidal treatment process on the day they are to be used, and are protected against contamination until filled.

[1] Containers which have been subjected to bactericidal treatment should have a residual bacterial plate count of not more than 1 per milliliter of capacity, and equipment not over 50 colonies per 8 square inches (i.e., 1 per square cm.) of food-contact surface, in 3 out of 4 samples. (See *Standard Methods for the Examination of Dairy Products* for information on apparatus and procedure for making rinse and swab counts.)

Amounts of Chlorine Compounds Required To Give Approximately 100 p.p.m. of Chlorine by Readily Available Measuring Devices

Volume of water (gallons)	Dry chlorine compounds—available chlorine			Liquid hypochlorite solutions—available chlorine	
	15 percent	*25 percent*	*70 percent*	*1 percent*	*5 percent*
20	5⅓ tbs.	3⅓ tbs.	1½ tbs.	3 cups.	10 tbs.
40	11 tbs.	6⅔ tbs.	2⅔ tbs.	3 pts.	1¼ cups.
60	1 cup.	10 tbs.	3½ tbs.	4¾ pts.	2 cups.
80	1⅓ cups.	13⅓ tbs.	4½ tbs.	6½ pts.	2½ cups.
100	1⅔ cups.	1 cup.	6 tbs.	4 qts.	3 cups.
150	2¾ cups.	1½ cups.	9 tbs.	6 qts.	4¼ cups.
200	3⅓ cups.	2 cups.	12 tbs.	2 gals.	3 pts.

NOTE

Dry measure

1 tablespoon (tbs.)—approximately 0.3 ounce.
1 cup or ½-pint—approximately 5 ounces.

Liquid measure

1 tablespoon or 3 teaspoons—approximately 15 milliliters.
1 cup or ½-pint—approximately 16 tablespoons.

Public-health explanation.—Shellfish furnish an excellent growth medium for bacteria or other microorganisms. Small numbers of bacteria which might remain on improperly sanitized equipment may multiply to tremendous numbers in the finished pack.

Satisfactory compliance.—This item will be satisfied when—

a. All utensils and other equipment have been treated by one or more of the following methods:[9]

(1) 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 [10] located in the coldest zone. (Absence of a thermometer violates this item.)

If steam is used in the bactericidal treatment of blowers, a suitable cover and indicating thermometer are provided. A vent or valve should be installed at the bottom of large steam cabinets, to permit the discharge of cold air when steam is admitted.[11]

(2) Immersion in hot water of at least 170° F., for at least ½ minute. (An accurate indicating thermometer is provided and used.[10] [11] Ordinarily, a booster heater is necessary for water to be maintained at 170° F.

In the bactericidal treatment of blowers by this method, the blower may first be filled with water and then brought up to 170° F. by the addition of steam. This temperature should be checked by the indicating thermometer, and the ½-minute contact period measured after reaching this value. In practice, it has been found desirable to provide a connection to, or a removable section in, the blower line above the liquid level of the tank, where steam or hot water can be introduced.

(3) Immersion for at least 1 minute in, or exposure for at least 1 minute to, a flow of 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

[9] In medium and large shucking plants, a steam cabinet with auxiliary steam boiler is a most satisfactory type of equipment for bactericidal treatment of utensils and equipment.

[10] Thermometers should be accurate to within 2° F., should have scale divisions not greater than 2° F., and should be so installed as to be easily read. Accuracy of thermometer should be checked at least once each year by the State regulatory agency.

[11] Steam or hot-water treatment shall not be accepted as satisfactory compliance unless the equipment or containers are completely immersed or completely exposed for the required time or longer, at the required temperature or higher, throughout the period of exposure.

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.

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.

b. Large items which cannot be stored in a protected place are given effective bactericidal treatment immediately before starting each day's operation.

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

Public-health explanation.—The results of cleaning and bactericidal treatment may be negated by improper storage of the treated equipment.

Satisfactory compliance.—This item will be satisfied when the treated equipment is stored where it will be protected from contamination or unauthorized handling. (The utensils may be stored in the steam chest, in a special cabinet, or in the packing room on clean shelves, stands, tables, or racks. Storage racks should be at least 2 feet above the floor.)

19. Source of Shellfish.—All shellfish shall be obtained from a source approved by an official regulatory agency.

Public-health explanation.—The positive relationship between sewage-polluted shellfish and enteric disease has been demonstrated many times. The bacterial content of shellfish will, in general, mirror the bacterial quality of the water in which they have grown. Because shellfish pump and filter a large quantity of water, the bacteria count of the shellfish will normally exceed the bacteria count of the water in which they grow. The shellfish-water bacteria ratio depends upon the shellfish species, water temperature, presence of certain chemicals, and varying capabilities of the individual animals. If the water in which the shellfish are grown contains sewage, it may be assumed that the shellfish will also contain sewage bacteria or viruses, some of which may be capable of causing disease in man.

Furthermore, there is evidence that organisms of the Salmonella group, at least, will survive in shellfish for a considerable length of time after harvesting. Kelly and Arcisz ("Survival of Enteric Organisms in Shellfish," Reprint No. 3249, vol. 69, no. 12, Dec. 1954, pp. 1205–1210, *Public Health Reports*) have shown that viable *S. schottmuelleri* will persist for at least 49 days in shell oysters, *Crassostrea virginica*, stored at a temperature of 40° F. However, there was little evidence of multiplication of the bacteria in the shellfish during the storage period. In the same study, it was reported that *S. schottmuelleri* persisted in soft clams, *Mya arenaria*, stored at a temperature of 40° F., throughout a normal storage period.

Other public-health hazards may result from the presence of a naturally occurring paralytic shellfish poison in certain species of shellfish. The occurrence of this poison is apparently related to the concentration of a dinoflagellate, *Gonyaulax*, in the water of the growing area. Species of shellfish which may accumulate this poison under appropriate conditions include *Mytilus californianus*, *Mytilus edulis*, *Mya arenaria*, *Saxidomus gigantius*, *Donax serra*, and *Modiola modiolus*. The poison occurs only in well-defined areas and, in some instances, only during certain seasons. It is not widespread over all shellfish-producing areas.

Cooking does not insure safety of shellfish since, in ordinary cooking processes, shellfish may not be sufficiently heated to insure a kill of pathogenic organisms, although a considerable reduction will take place. One investigator has found that oysters must be held in a water bath at 138°–142° F. for 1 hour before the coliform count is reduced to zero. (See Salafranca, E. S., "The Effect of Salt, Vinegar, and Heat on the Coliforms in Oysters," *The Philippine Journal of Fisheries*, vol. 2, no. 1, 1953.) Also, normal cooking processes cannot be relied upon to destroy paralytic shellfish poison if it should be present.

The primary safeguard in the entire shellfish sanitation program is, therefore, that of

obtaining shellfish which are free of disease-causing organisms, and which contain, at most, only relatively small quantities of poison. If shell-stock from sewage-polluted or highly toxic areas are shucked, then almost all of the other sanitary safeguards of the cooperative certification program will have been circumvented.

Satisfactory compliance.—This item will be satisfied when all shellfish are obtained from one or more of the following sources: (a) An approved growing area; (b) a State-certified shellfish shipper; or (c) a State-approved shellfish-treatment plant.

20. Refrigeration of Shell-Stock.—Shell-stock of shellfish species which have poor keeping qualities (such as the soft-shell clam, *Mya arenaria*, and the mussels, *Mytilus edulis* and *Mytilus californianus*) shall be refrigerated during shipment and holding.

Public-health explanation.—If shell-stock of shellfish species which have poor keeping qualities are not refrigerated during prolonged storage, the quality of the product will be impaired and the bacteria counts will be increased.

Significant increases in coliform counts in shell oysters stored overnight may also occur under some conditions.

Satisfactory compliance.—This item will be satisfied when:

a. Shell-stock of shellfish species with poor keeping qualities are stored at a temperature of 50° F. or less, but are not frozen, and when, at points of transfer, such as loading docks, shell stock are not permitted to remain unrefrigerated for prolonged periods.

b. Shell-stock are protected from the sun during warm weather to the extent necessary to prevent spoilage.

21. Shucking of Shellfish.—Shellfish shall be shucked in such a manner that they are not subjected to contamination. Shell-stock shall be reasonably free of mud when shucked.[12] Only live shellfish shall be shucked.

Water used in fluming or washing shell-stock shall be from a source approved by the State regulatory agency. Use of overboard water must be specifically approved by the State agency, and its use limited to shell-stock washing.

Public-health explanation.—If shellfish are not reasonably clean at the time of shucking, a considerable quantity of the adhering material will be mixed into the shucked shellfish during the shucking process, thus contributing to high bacteria counts in the final product. (See Public-health explanation, Section A, Item 2, Washing of Shell-Stock.)

The bacteria count of the final pack is related to the time intervening between shucking and attainment of a temperature of approximately 45° F., i.e., the length of time the shellfish are at a temperature favorable to the rapid growth of bacteria. Factors in the shucking-room procedure which influence the length of time shucked shellfish are above 45° F. include the quality and species of the shellfish being shucked, the speed of the individual shucker, the practice of returning "overage" or "bluff" to the shuckers, the frequency with which the shucking containers are delivered to the packing room, the air temperature, and the temperature of the shell-stock being shucked.

The total elapsed time which shellfish may be held on the shucking bench without causing high bacteria counts is closely related to the packing-room procedures, the size of containers into which the shucked shellfish are being packed, the temperature of blower water, the temperature of the oysters, and the method of cooling.

From the standpoint of bacteriological quality, it is preferable that the elapsed time between shucking and the attainment of a temperature of 45° F. not exceed 4 hours. More rapid cooling is very desirable.

The return of overage (bluff) from the packing room to the shucker would ordinarily result in at least a portion of the shellfish being held on the shucking bench for more than 2 hours and would permit an undesirable growth of bacteria. When bench grading of shellfish is practiced, it is especially important that all grades of shellfish be delivered to the packing room at least once every 2 hours when the temperature of the shellfish exceeds 45° F. To en-

[12] The primary responsibility for washing the shellfish free of mud is placed on the harvesters. However this does not relieve the plant operator of responsibility for compliance with this item. (See Section A, Item 2.) Bacteria counts of mud from Tangier Sound averaged about six times higher than bacteria counts of oysters from the same growing area. See "Bacteriological Survey of an Oyster Bed in Tangier Sound, Maryland" by M. W. Vaughn and A. W. Jones, Chesapeake Science, Vol. 5, no. 4, Winter 1964.

courage frequent delivery of the shucked shellfish to the packing room, it is suggested that the shucking containers be limited to a size that an average shucker might reasonably be expected to shuck full in 1 hour.

Storage of shucked shellfish on the shucking benches for long periods of time increases the possibility of contamination of the shucked shellfish by splash or flies.

Bacteriological examination of the water in dip buckets has shown very high coliform counts. Since water from the dip bucket may be carried over into the shucked shellfish, there is a need for controlling the sanitary quality of the water.

Satisfactory compliance.—This item will be satisfied when—

a. Water used for fluming or washing shellstock is obtained from a source approved by the official State regulatory agency.

b. Shell-stock are reasonably free of mud when shucked.

c. Only live shellfish are shucked.

d. The use of "dip" buckets is prohibited. (Where conditions dictate the need for frequent rinsing of the shucker's hands and knife, it is recommended that water outlets be installed at the shucking bench convenient to each shucker, or that a flow-through type of dip bucket, in which the water is continually replaced by clean tapwater, be installed.)

e. Shucking containers are rinsed with running tapwater before each filling.[13]

f. The return of overage (bluff) from the packing room is not permitted.

22. Shell Disposal.—Shells from which meats have been removed shall be removed promptly from the shucking room.

Public-health explanation.—Shell accumulations in the shucking room make it difficult to keep the room clean, and the chances of contaminating the shucked product are increased.

Satisfactory compliance.—This item will be satisfied when shells are promptly removed from the shucking room to prevent interference with the sanitary operation of the plant. Any method of shell removal which results in the prompt removal of shell without contaminating the shucked product is acceptable. These methods include, but are not limited to, conveyors, baskets, barrels, wheelbarrows, or shell drop-holes. (It is recommended that unused portions of body meats, such as clam siphons, not be disposed of with shells. Fly-control measures may be necessary in the vicinity of shell piles.)

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 bactericidal treatment immediately prior to filling.

Public-health explanation.—Single-service containers which have not been stored and handled in a sanitary manner may become contaminated and thus may contaminate the packaged shellfish.

Satisfactory compliance.—This item will be satisfied when—

a. Single-service containers and covers are kept in original cartons until used, and are kept clean and dry.

b. Containers which may have been contaminated during storage are cleaned and given bactericidal treatment immediately prior to filling, or are discarded.

c. Plant employees use every reasonable precaution to prevent the food-contact surfaces of containers from coming into contact with their person or clothing.

d. Container-storage rooms are kept clean and free of rodent or insect infestation; containers are so stored that the presence of rodents may be easily detected;[14] and container-storage rooms are not used as general storerooms for unused equipment and materials.

e. Single-service containers in the packing rooms are kept on stands or tables at least 2 feet above the floor, and are protected against contamination from splash.

24. Packing of Shucked Shellfish.—Shucked shellfish shall be packed without exposing them to contamination. Shucked shellfish shall be packed and shipped in clean, single-service containers made of impervious materials, or in clean, properly designed, returnable containers[15] so sealed that tampering can be detected. Each individual package of fresh

[13] Food and Drug Administration requirements limit the amount of water in the shucking containers to one fourth of the capacity of the container.

[14] Containers should be stored on open racks or pallets at least 8 inches above the floor and 18 inches away from the walls.

[15] Returnable containers will be accepted only for interplant shipment of shucked shellfish.

or frozen shellfish shall have permanently recorded on the package or label, so as to be easily visible, the packer's, repacker's or distributor's name and address, and the packer's or repacker's certificate number preceded by the abbreviated name of the State. Containers holding 1 gallon or more shall have the identification on the container wall, unless the cover becomes an integral part of the container during the sealing process.

Each shucker packer and repacker shall legibly code-date each package of fresh and frozen shucked shellfish to indicate the date of packing or repacking. (A recommended code-dating system is included in Appendix B.)

Public-health explanation.—Unless shucked shellfish are packed in clean containers, all precautions taken to produce a clean and safe product may be negated.

The State permit number facilitates tracing the product to the plant in which it was actually prepared. The date or code on the product further assists the regulatory authority in tracing shellfish to their point of origin.

Satisfactory compliance.—This item will be satisfied when—

a. Skimmer tables are so located that they will not receive drainage from the delivery window.

b. Shuckers do not place shucking containers on skimmers.

c. Shellfish are not exposed to contamination during packaging.

d. Containers are closed as soon after filling as is feasible.

e. The name and address of the packer, repacker, or distributor, and the certificate number, preceded by the abbreviated name of the State, of the packer or repacker, are permanently recorded on the package so as to be easily visible. Wording, such as "Packed for" or "Distributed by," is used wherever necessary to clarify the name on the label. Containers holding 1 gallon or more have the identification on the side wall, rather than on the cover, unless the cover becomes an integral part of the container during the sealing process.[16] (The presence of containers or covers with a plant number other than that on the unexpired certificate for the plant will be considered a violation of this item. Packing into containers with other plant certification numbers is not permitted. Recording identification information on containers by use of a rubber stamp will not be acceptable for compliance with this item.) Returnable shipping containers may be identified with tags of at least 2⅝ x 5¼ inches in size and made of substantial water-proof stock.

f. Each container or package of fresh or frozen shucked shellfish of the shucker packer or repacker has legibly recorded on the label or package, code symbols giving the date of packing, or if repacked, the date of repacking: *Provided*, that this requirement shall not apply to returnable containers.[15] Such code dating of frozen shellfish need not be on the outer wrap. (The packaging code shall be made available at the request of the State shellfish-regulatory authority.)

25. Refrigeration of Shucked Shellfish.—Shucked shellfish shall be cooled to an internal temperature of 45° F. or less within 5 hours after shucking. Storage temperatures shall not exceed 45° F. Storage at 34°–40° F. is strongly recommended.

A temperature of 0° F. or less shall be maintained in the frozen-storage rooms.

Public-health explanation.—Shucked shellfish are an excellent medium for the growth of bacteria. Thus, it is very important that the packaged shellfish be cooled promptly, so that bacteria will not multiply. Also temperatures above 45° F. may accelerate physical deterioration and spoilage of shucked stock. Alternate freezing and thawing of shellfish may cause deterioration and spoilage.

Research by the Public Health Service with *Crassostrea virginica* and *Crassostrea gigas* stored in ice and at 37.5° F. sustained slight increases in coliform MPN's during the first 5 days of storage. After the storage period of 5 days, there was a continuous increase in MPN values until the 25th day, at which time the coliform MPN's exceeded the original values by at least 50 times. Oysters from the same lots stored at 50° F. sustained a continuous increase in coliform MPN's exceeding 1,000 times the original count within 5 days. In the same studies oysters stored in ice and at 37.5° F. sustained only slight increases in standard plate counts after being stored for 5 days. However,

[15] Additional information on product quality, quantity and identification may be required by Federal and/or State laws.

with a storage temperature of 50° F. the same oysters sustained plate count increases which exceeded 180 times their original count within 5 days.

The fecal coliform MPN's decreased slightly from their original MPN values during storage in ice, at 37.5° F. and at 50° F., with the exception that there was a frequent increase in fecal coliform MPN's at the 50° F. storage temperature. (See *Time and Temperature Effects on Stored Oysters*, by C. B. Kelly, Proceedings 1964 Shellfish Sanitation Workshop, available from Shellfish Sanitation Branch, Public Health Service, Department of Health, Education, and Welfare, Washington, D.C., 20201.) Appendix B contains charts, figures 1, 2, and 3, which present the above information in graphic form. Appendix B also contains in graphic form the length of time necessary to cool oysters in various size containers to 40° F. under dry refrigeration and in crushed ice.

Satisfactory compliance.—This item will be satisfied when—

a. Shucked shellfish are cooled to an internal temperature of 45° F. or less within 5 hours after shucking, and are stored and shipped under similar temperature conditions.

b. Packaged shellfish to be frozen are properly stacked to insure rapid freezing, and are frozen at an ambient air temperature of 0° F. or less, with packages frozen solid within 12 hours after the start of freezing; and frozen shellfish are handled in such a manner as to remain frozen solid, and are held at 0° F. or less.[17]

c. All containers holding shucked shellfish shall be kept covered while under refrigeration.

26. Ice.—Ice shall be obtained from a source specifically approved by the State regulatory agency, and shall be stored and handled in a clean manner.

Public-health explanation.—Ice may become contaminated during freezing or in subsequent storing and handling.

[17] It is recommended that freezing and frozen-storage compartments be equipped with at least the following equipment: (1) Automatic temperature-regulating control; (2) an indicating thermometer, so installed as to indicate accurately the temperature within the storage compartment; and, (3) except for plate freezers, a recording thermometer installed on each freezing or storage compartment in such a manner as to record accurately the temperature within the compartment at all times. Recording-thermometer charts should be retained for at least 1 year.

Shucked shellfish packed in non-hermetically sealed containers may also be contaminated by dirty ice. When containers of shellfish are stored in ice, a partial vacuum is formed within the container which may draw water from the melting ice into the container.

Satisfactory compliance.—This item will be satisfied when—

a. Ice is manufactured in an establishment or machine approved by the proper State regulatory authority.

b. Ice is stored and handled in such a manner that it will not be contaminated.

c. Ice, other than that manufactured in the shellfish-processing establishment, is washed before use.

27. Records.—Complete and accurate records shall be kept by every shellfish dealer.

Public-health explanation.—In case of an outbreak of disease attributable to shellfish, it is necessary that health departments be able to determine the source of contamination, and thereby to prevent any further outbreaks from this source. This can be done most effectively by following the course of a shipment, through all the various dealers who have handled it, back to the point of origin by means of records kept by the shellfish dealers.

Satisfactory compliance.—This item will be satisfied when each shucker-packer, repacker, shell-stock shipper, or reshipper establishes and maintains a ledger record or record system satisfactory to the State control agency indicating from whom shellfish were purchased or secured; the date purchased or secured; State designated areas from which the shellfish were harvested; and the names and addresses of persons to whom shellfish were sold. (An example ledger form is contained in App. B.)

28. Health of Personnel.—Any person known to be infected with any disease in a communicable form, or to be a carrier of any disease which can be transmitted through the handling of shellfish, or who has an infected wound or open lesion on any exposed portion of his body, shall be excluded from the shucking or packing plant. An owner or manager who has reason to suspect that any employee has contracted a communicable disease shall immediately notify the proper health officials. Pend-

ing appropriate action by the health officials, said employee shall be excluded from the plant.

Public-health explanation.—Persons who are infected with, or who are carriers of, organisms of typhoid fever, dysentery, septic sore throat, or certain other communicable diseases, might transmit such disease to others through shucked shellfish. A person with an infected wound or open lesion on the exposed portion of his body might transmit toxin-producing bacteria to the shucked shellfish, and thus cause food poisoning to consumers thereof.

Careful, daily observations of the health of employees, with proper inquiries when indicated, and exclusion of employees who are ill, will tend to prevent possible contamination of the shucked stock with pathogenic organisms.

Satisfactory compliance.—This item will be satisfied when—

a. Persons with infected wounds or open lesions on the exposed portion of their bodies, and those who are known to be carriers of, or infected with, typhoid fever, dysentery, or other communicable diseases likely to be transmitted by shucked shellfish, are excluded from the plant.

b. Daily observations of employees are made by the supervisor, with reasonable inquiries being made when signs of illness appear.

c. Upon an inquiry indicating the possibility of a communicable disease, the ill employee is excluded from the plant pending clearance by the health officials.

d. Employees having diarrhea or sore throat promptly report this to the manager.

29. Supervision.—The management shall designate a reliable individual to be accountable for compliance with the items of this manual having to do with plant and personnel cleanliness.

Public-health explanation.—Handwashing by food-service employees is a very important public-health measure. Unless someone is made specifically responsible for this practice, it is apt to be forgotten or overlooked. Similarly, one person must be responsible for plant clean-up. Clean floors, walls, and benches reduce the chance of contamination of the shellfish or utensils during shucking or packing operations. Periodic disinfection of the plant will reduce the possibility of contaminating the shellfish.

Satisfactory compliance.—This item will be satisfied when a reliable individual has been designated by the management to supervise the activities enumerated in Section B, Items 16, 28, and 30, and when there is evidence that he has been executing these duties. Designation of such an individual does not relieve management of responsibility for compliance with these items.

30. Cleanliness of Employees.—Employees shall wash their hands with soap and water before beginning work, and again after each interruption. (Supervision of handwashing is a specific responsibility of management, Section B, Item 29.)

When manual handling of shucked shellfish becomes necessary, sanitized rubber gloves shall be worn, or the hands shall be washed and disinfected immediately before such manual handling.

Finger cots, gloves, and/or shields, if worn by shuckers, shall be sanitized as often as necessary and at least twice daily. (Use of waterproof finger cots or shields is recommended as preferable to those made of an absorbent material.) Any person who handles shucked shellfish shall wear a clean apron or coat.

Employees shall not use tobacco in any form in the rooms in which shellfish are shucked or packed.

Public-health explanation.—The hands of all employees frequently come into contact with their clothes; hence, it is important that the clothes worn during the handling of shucked shellfish be clean. The nature of the work makes it necessary that protective outer garments be worn. Finger cots, gloves, and/or shields, unless sanitized periodically, will accumulate bacteria which will contaminate the shucked shellfish.

Disease or toxin-producing bacteria may be carried on the hands of shuckers and/or packers; hence, handwashing is very important.

Satisfactory compliance.—This item will be satisfied when—

a. Clean aprons or coats are worn by any persons handling shucked shellfish.

b. Aprons or coats not in use are stored in a room or locker provided for this purpose.

c. Finger cots, gloves, and/or shields, if worn by shuckers, are sanitized as often as necessary

and at least twice daily, and are properly stored until used. (See Section B, Item 18.)

d. Sanitized rubber gloves are worn during, or the hands are washed and disinfected *immediately* before, any manual handling of the shucked shellfish. (A bucket or pan of the bactericidal solution should be present in the packing room during periods of operation.)

e. There is no evidence of spitting, or of the use of any form of tobacco, by employees in rooms in which shellfish are shucked or packed.

f. Employees wash their hands with soap and water before beginning work and after each interruption, and utensil sinks are not used for handwashing.

Section C

PACKING AND SHIPPING SHELL-STOCK

A shell-stock shipper deals only in shellfish which are still in the shell; hence, his plant sanitation requirements are not as extensive as those of a shucker-packer or repacker. A shipper holding only a shell-stock certificate shall not shuck shellfish or repack shucked shellfish. Operators of "buy" boats and "buy" trucks shall be considered shell-stock shippers.

Shellfish in the possession of a shell-stock shipper shall be protected against contamination. The shell-stock shipper shall keep records of his purchases and sales, and shall tag shell-stock shipments so that they may be identified.

To effectuate the needed sanitary safeguards, the shell-stock shipper shall comply with items 1 and 2 below, and with the items of sections A and B indicated for each type of shell-stock operation in table II.

1. Washing of Shell-Stock.— Shell-stock shall be reasonably free of mud at the time of shipment.

Public-health explanation. See Section A, Item 2, concerning reasons for washing shell stock. If shellfish are washed in polluted water, the shellfish may be contaminated. Therefore, water used for shell stock washing should be of approved sanitary quality. Preferably, shell-stock should be washed at the time of harvesting or as soon thereafter as is feasible.

Satisfactory compliance. This item will be satisfied when:

a. Shell-stock are reasonably free of mud at the time of shipment. The qualifications applicable to washing of shell-stock under Section A, Item 2a, also apply to this item.

b. Water used for shell-stock washing is from a source approved by the official State regulatory authority.

2. Packing and Shipping of Shell-Stock.— Shell-stock shall be packed and shipped in clean containers, under conditions which will prevent contamination. When consigned in bulk, shell-stock shall be shipped in clean con-

TABLE II

Shell-stock operation type	Applicable item — sec. A		Applicable item — sec. B											
	1	3	1	3	9	10	11	12	15	19	20	25	27	28
Shore establishment † buys, stores, packs.	—	—	X	X	a	a, d, f, g, h, i, j, k, m*	X	X	a, c, d, e	X	X	X**	X	X
Harvests or Buy Boats, all operations on boat.	X	X	—	—	—	—			a, c, d	X	X	—	X	X
Buy Trucks, all operations on truck.	e, c, f	—	—	—	—			—	a, c, d	X	X	—	X	X

*= Item b also applies to pressure systems.
**= Applies if shucked shellfish are handled.
†= If shore establishment operates boats or trucks, requirements for Buy Boats and Buy Trucks are also applicable.
X Required.
— = Not required.

veyances, under conditions which will prevent contamination.

Shell-stock in transit shall be identified by a tag or label fastened to each shipping container and bearing the number of the shipper, his name and address, the name and address of the consignee, and the kind and quantity of shell-stock in the container. The following classes of shell-stock shippers shall be exempt from this requirement: Harvesting Only; Buy Boats; and Buy Boats with Storage on the Boats.

Public-health explanation.—Shellfish must be protected during shipment to avoid contamination and spoilage. Shipments must be tagged, to make it possible for the control authorities to identify shipments of shellfish.

Satisfactory compliance.—This item will be satisfied when—

a. Shipping containers and vehicles are clean.

b. Tags at least 2⅝ by 5¼ inches in size, and made of substantial, waterproof stock, and carrying the name, address, and number of the dealer, the name and address of the consignee, and the kind and quantity of the shell-stock, are securely fastened to each individual container of shell-stock. (Bulk shipments, "e.g., unpackaged," of shell-stock to a certified shipper require only a single tag or bill of lading which gives the required information.)

Section D

REPACKING OF SHELLFISH

The packaging of shucked shellfish in plants other than those in which they were initially shucked exposes the shucked shellfish to additional handling and increases the possibility of contamination. Combining in one pack shucked shellfish from more than one dealer permits the possibility of contamination of the entire pack if shellfish from any one of the dealers should be contaminated. When repacking is practiced, tracing of shellfish to the source is difficult.

When repacking is practiced, it shall be done in accordance with the requirements of table III and the items which follow in this section.

1. Shucked Shellfish Intended for Repacking.—Shucked shellfish to be repacked shall be received at the repacking plant in approved shipping containers at a temperature of 45° F. or less. Frozen shellfish which have thawed shall not be repacked or repackaged.

Public-health explanation.—Shellfish which are not shipped in properly sealed, easily cleanable containers may become contaminated. Shellfish which have not been properly refrigerated may have excessively high bacteria counts.

If frozen shellfish are thawed during repacking, high bacteria counts in the final pack may result.

Satisfactory compliance.—This item will be satisfied when—

a. All shucked shellfish are received in properly designed [19] containers. (Returnable containers should be so sealed that any tampering will be evident.)

b. Shellfish are received at a temperature of 45° F. or less. Frozen shellfish which have thawed are not repacked or repackaged.

2. Refrigeration During Repacking.—The temperature of the shellfish shall not exceeed 45° F. during the repacking process. Frozen shellfish shall not be thawed during the repacking process.

Public-health explanation.—Bacteria multiply rapidly at high temperatures, but are unable to do so at low temperatures. Adequate cooling, therefore, helps to produce a low bacteria count in the final product.

TABLE III

Item number in Section B	Item	Applicable satisfactory-compliance items
2	Plant arrangement	a, d, and e.
4	Floors	all items.
5	Walls and ceilings	all items.
6	Fly-control measures	all items.
7	Lighting	all items.
8	Heating and ventilation.	b.
9	Water supply	all items.
10	Plumbing and related facilities.	all items.
11	Sewage disposal	all items.
12	Rodent control	all items.
14	Construction of utensils and equipment.	all items.
15	General cleanliness	all items.
16	Cleaning of buildings and equipment.	a, b, d, e, f, and g.
17	Bactericidal treatment of utensils and equipment.	all items.
18	Storage of equipment	all items.
19	Source of shellfish	all items.
23	Handling of single-service containers.	all items.
24	Packing of shucked shellfish.	c, d, e, f, and g.
26	Ice	all items.
27	Records	all items.
28	Health of personnel	all items.
29	Supervision	all items.
30	Cleanliness of employees.	a, b, d, e, and f.

[19] See Section B, Item 14.

Satisfactory compliance.—This item will be satisfied when—

a. The internal temperature of nonfrozen shellfish being repacked does not exceed 45° F. during the repacking process. (This may be accomplished by expeditious handling, by continuous refrigeration of the shellfish being repacked, or by the provision of a refrigerated room for the repacking operation.)

b. Frozen shellfish are not thawed during the repacking process.

3. Cleaning of Returnable Shipping Containers.—Returnable shipping containers shall be thoroughly cleaned as soon after emptying as is practicable.

Public-health explanation.—Containers are most easily cleaned before the organic material has had time to dry.

Satisfactory compliance.—This item will be satisfied when returnable shipping containers are thoroughly cleaned as soon after emptying as is practicable.

Section E

RESHIPPERS

Persons who reship shellfish from certified shell-stock shippers, shucker-packers, or repackers to other certified shippers or to final consumers should be licensed and certified as reshippers. Use of this shipper classification is left to the option of the State.

(A reshipper is not permitted to shuck shellfish, nor to repack shucked shellfish.) Requirements for a reshipper depend upon the type of product handled and the methods of operation. If shell-stock are handled, the applicable requirements outlined for a shell-stock dealer must be met (Sec. C).

If only shucked shellfish are handled, the required items are—

1. Section B, Item 19, "Source."
2. Section B, Item 25, "Refrigeration."
3. Section B, Item 27, "Records."

Appendix A

INSPECTION OF CERTIFIED SHELLFISH SHIPPERS

General: Section A–2 of Part I specifies that shellfish shippers certified by States under the Cooperative Program shall meet the construction requirements of Part II of this manual prior to certification, and shall maintain satisfactory sanitary conditions during periods of operation. Establishments not meeting these two requirements will not be eligible for inclusion on the Public Health Service list of State certified shellfish shippers.

Plants will be considered as meeting the basic sanitary standards of Part II of this manual when the two following conditions are met: (1) the same sanitation item is not violated repeatedly, and (2) a sanitation rating of at least 80 percent, as determined by a standarized inspection procedures, is achieved.

Sanitation rating of shucker-packer and repacker establishments should be determined by use of an inspection report equivalent to PHS–769, a copy of which is included as page 28 of this manual. The percentage values assigned to each item are shown on the sample inspection report. Percent values are not shown for items B–1, B–19, C–1, C–2, D–1, D–2, and D–3 since any violations of these items are applied against the tentative percentage rating for the plant. Percentage values for these items are given in table IV. Section C of the inspection report (PHS–769) should not be used unless the shucker-packer ships a portion of his product in the shell. Section D of the inspection report (PHS–769) should not be used unless the shucker-packer also repacks shellfish.

Sanitation ratings for shell-stock shippers should be determined by use of an inspection report equivalent to the "Shell-Stock Shipper Inspection Report," a copy of which is included as page 29 of this manual. The percentage values assigned to each item are shown on the sample inspection report.

Sanitation Rating for Shucker-Packers: In computing a sanitation rating for a shucker-packer the violations recorded under section B on the inspection report should be totaled using the indicated percentage values. This total, when subtracted from 100, will give a tentative percentage sanitation rating. If items B–1 or B–19 are violated an additional 25 percent or 50 percent should be subtracted from the tentative rating (see table IV). Similarly any violations recorded under sections C and D should should also be subtracted according to the table IV schedule.

TABLE IV

Percentage Values for Use in Establishing Sanitation Ratings of Shucker-Packers by Use of Standardized Inspection Report, PHS-769

Section	Item number	Item	Percent values
B	1	Wet Storage	25
	19	Source of Shellfish	25
C	1	Shell-Stock Washing	1
	2	Shell-Stock Shipping Container	2
D	1	Shellfish for Repacking	2
	2	Refrigeration	4
		Frozen Shellfish	1
	3	Returnable Containers, Cleaned	1

Sanitation Ratings for Repackers: The instructions for rating a shucker-packer should be followed in rating a repacker except that section B items not applicable to the operation of the repacker should be indicated on the inspection report and should be taken into consideration in computing the tentative sanitation rating according to the following formula:

$$\text{Tentative sanitation rating (percent)} = \frac{(\text{Percent compliance section B})\ (100)}{(\text{Percentage of section B applicable})}$$

Any violations noted for items B–1, B–19, C–1, C–2, D–1, D–2, or D–3 should be subtracted from the tentative rating according to the table IV schedule to obtain a final rating.

Sanitation Ratings for Shell-Stock Shippers: The required physical facilities and operating procedures for shell-stock shippers varies with the type of establishment. Therefore, all items on the inspection report will not apply to every shipper. (See section C, Part II, this manual.) In completing the inspection report those items which are not applicable to the particular shipper should be so indicated. These "not applicable" items should be taken into consideration in computing the sanitation rating for the shipper according to the following formula:

$$\text{Sanitation rating (percent)} = \frac{(\text{Percent compliance})\ (100)}{(\text{Percent applicable})}$$

PHS-769-1
Rev. 5-65

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

Form Approved
Budget Bureau No. 68-R633

SHUCKING-PACKING PLANT INSPECTION REPORT

PLANT NAME AND LOCATION

CERTIFICATE NO

PRODUCT

NUMBER OF SHUCKERS

SECTION B (Shucking-Packing)

1. WET STORAGE:	
Protected; State approved	*
2. PLANT ARRANGEMENT:	
Not subject to flooding	1.0
Separate shucking and packing rooms	1.0
Proper delivery window	0.5
Adequate packing & clothing rooms	1.0
3. DRY STORAGE OF SHELL STOCK:	
Floors, impervious, graded to drain	2.0
Walls, smooth, well-constructed	0.5
Conveyances easily-cleanable, clean	0.5
Not used as passageway	0.5
Floor drain protected against backflow	0.5
4. FLOORS:	
Impervious; smooth; graded to drain	1.0
5. WALLS AND CEILINGS:	
Smooth; washable; light-colored	2.0
6. FLY CONTROL MEASURES	
Adequate screens or fans; self-closing, outward opening screen doors	1.5
Approved internal fly-control measures	1.0
Free from flies	1.0
7. LIGHTING:	
Ample; properly distributed	2.0
8. HEATING AND VENTILATION:	
Comfortable temperature, well ventilated	0.5
9. WATER SUPPLY	
Safe; adequate quantity	15.0
Outlet in each room	0.5
Ample; regulated, hot water supply	2.0
Hot & cold water at each sink vat	0.5
10. PLUMBING AND RELATED FACILITIES:	
Approved, no cross-connections	6.0
Adequate number and location of lavatories; hot and cold water; mixing valves; soap, single-service towels	2.0
Handwashing signs posted	0.5
Adequate number and location of toilets; clean; good repair; ventilated; lighted; supply of toilet tissue	2.0
Toilet room doors, self-closing, tight	1.0
No overhead drains	0.5
11. SEWAGE DISPOSAL: Satisfactory	1.0
12. RODENT CONTROL:	
Rodent free; proper construction	1.5
Safe use and storage of rodenticides	1.0
13. CONSTRUCTION OF BENCHES:	
Smooth; impervious, self-draining	2.0
Blocks easily cleanable; non-toxic	0.5
Stalls & stools cleanable; painted	0.5
No attached padding on stools	0.5
14. EQUIPMENT CONSTRUCTION:	
Material, smooth surfaces & joints, good repair; easily cleanable, equipment installed complies sub-item)	2.5
Container rims 2' above floor	0.5
Blower not connected directly to sewer	0.5
Blower air intake protected	0.5
15 GENERAL CLEANLINESS	
No miscellaneous equipment or material	1.0
Plant used only for shellfish	0.5
No animals, fowl, unauthorized persons	1.0
Premises clean, no rubbish	0.5
Shuckers do not go into packing room	0.5
16 CLEANING	
Building & equipment cleaned within 2 hrs	2.0
Benches and blocks disinfected weekly	0.5
Sinks, bactericides, detergents, and brushes	0.5
Blowers and tanks rinsed between uses	0.5
Refrigerators clean	0.5
17. BACTERICIDAL TREATMENT OF EQUIPMENT Approved	2.0
18. STORAGE OF EQUIPMENT	
Treated equipment properly stored	1.5
19. SOURCE OF SHELLFISH	
Approved	*
20. SHELL STOCK COOLING:	
Refrigerated or protected as necessary	1.0
21 SHUCKING SHELLFISH:	
Wash water from approved source (See item 9)	*
Shell stock free of mud	1.0
Bluff not returned	2.0
Dip buckets not used	0.5
Shucking containers rinsed after each use	0.5
22. SHELL DISPOSAL: Prompt	0.5
23 SINGLE-SERVICE CONTAINERS:	
Store rooms clean, no rodents, trash, insects	1.5
Kept clean and dry until used	1.5
Contaminated containers sanitized or discarded	1.0
24. PACKING SHUCKED SHELLFISH:	
Shellfish not contaminated during packing	1.0
Containers closed as soon as feasible	1.0
Clean, properly designed containers	0.5
Containers identified, Code-dated	1.0
25 COOLING SHUCKED SHELLFISH	
Cooled to 45° in 5 hrs	2.5
Stored at 45° or less	2.5
Frozen and stored at 0° or less	0.5
26 ICE	
From approved source, protected from contamination, washed	1.5
27 RECORDS Complete, accurate	1.5
28 PERSONNEL HEALTH	
Infected persons and carriers excluded	1.5
29 SUPERVISION Effective	2.0
30 CLEANLINESS OF EMPLOYEES	
Clean aprons or coats, properly stored	1.0
Finger cots sanitized, no tobacco used	0.5
Packing-room workers wear rubber gloves or wash and disinfect hands	2.0
Handwashing by employees	2.0

SECTION C (SHELL STOCK)

1 WASHING SHELL STOCK	
Shell stock clean at time of shipment	*
Wash water from approved source (See item 9)	*
2 SHIPPING SHELL STOCK:	
Shipping containers clean identified	*

SECTION D (REPACKING)

1. SHELLFISH FOR REPACKING	
In approved containers at 45° or less	*
2 REFRIGERATION DURING REPACKING	
Temperature does not exceed 45	*
Frozen shellfish not thawed	*
3 CLEANING OF RETURNABLE CONTAINERS	
Cleaned soon after emptying	*

REMARKS

DATE

SANITARIAN

*These items not included in computation of initial sanitation rating for Shucker-Packers.

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PHS-769-3
Rev 5-65

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

Form Approved
Budget Bureau No 68-R033

SHELL STOCK SHIPPER OR RESHIPPER INSPECTION REPORT

PLANT NAME AND LOCATION

CERTIFICATE NO

PRODUCT

NUMBER OF EMPLOYEES

Items not applicable to shipper being inspected should be indicated in appropriate block as "NA"

		NA
SECTION A		
1. BOATS AND TRUCKS:		
Construction satisfactory	1	
Kept clean, containers clean	1	
Cleaned after relaying operations	1	
3. BODY WASTE DISPOSALS:		
Not discharged in harvesting area	1	
Soil cans—used for purpose intended, secured, proper disposal	1	
SECTION B		
1. WET STORAGE:		
Protected; State Approved	20	
3. SHELL STOCK STORAGE:		
Floors, impervious, graded to drain	2	
Walls, smooth, well-constructed	1	
Conveyances easily-cleanable; clean	1	
Not used as a passageway	1	
Floor drain protected against backflow	1	
9. WATER SUPPLY:		
Safe; adequate quantity	15	
10. PLUMBING AND RELATED FACILITIES		
Approved, no cross-connections	3	
Lavatories; soap; single-service towels	2	
Handwashing signs posted	1	
Toilet rooms clean; good repair; ventilated; lighted; supply of toilet tissue	2	
Toilet room doors self-closing, tight	1	
No overhead drains	3	
11. SEWAGE DISPOSAL:		
Satisfactory	2	
12. RODENT CONTROL:		
Rodent free; proper construction	2	
Safe use and storage of rodenticides	1	
15. GENERAL CLEANLINESS:		
No miscellaneous equipment or material	2	
No animals, fowls, unauthorized persons	1	

		NA
15. GENERAL CLEANLINESS (Cont'd):		
Premises clean; no rubbish	1	
19. SOURCE OF SHELLFISH:		
Approved	20	
20. SHELL STOCK COOLING:		
Refrigerated or protected as necessary	2	
25. REFRIGERATION OF SHUCKED SHELLFISH:		
Internal temperature of stored shellfish 45° or less	1	
Frozen shellfish storage 0° or less	1	
27 RECORDS: COMPLETE, ACCURATE	3	
28 PERSONNEL HEALTH:		
Infected persons and carriers excluded	3	
SECTION C		
1 WASHING SHELL STOCK:		
Shell stock clean at time of shipment	1	
Washwater from approved sources (See item 9)		
2. PACKING AND SHIPPING SHELL STOCK:		
Shipping containers clean	1	
Shipments properly identified	1	
SECTION E: (Applies only to reshippers)		
1 SOURCE, (Sec. B, Item 19)	25	
2 REFRIGERATION, (Sec. B, Item 25):		
Internal temperature 45° or less	25	
Frozen shellfish 0° or less	25	
3 RECORDS, (Sec. B, Item 27)	25	

REMARKS

DATE

SANITARIAN

(Sections and item numbers refer to PHS Publication 33, Part II, Rev. 1961)

U.S. GOVERNMENT PRINTING OFFICE 1965 O—736-724

Appendix B

RECOMMENDED CODE-DATING SYSTEM FOR SHUCKER-PACKERS AND REPACKERS

The following code-dating system is recommended to the States in establishing their code-dating system for shucker-packers and repackers as required by item 24:

A five-digit number and letter system should be established which will reflect the year, the month, the day of the month, and the morning or afternoon in which the shellfish were packed or repacked. Larger packers may wish to indicate morning or afternoon packing by using the letter "A" or "P" in their code system.

Example: 31012
- 3—1963
- 10—10th month, October
- 12—day of month

Example: 40510
- 4—1964
- 5—5th month, May
- 10—day of month

It is further recommended the repackers be required to precede their code-dating digits with the letter "R" to indicate the product is repacked.

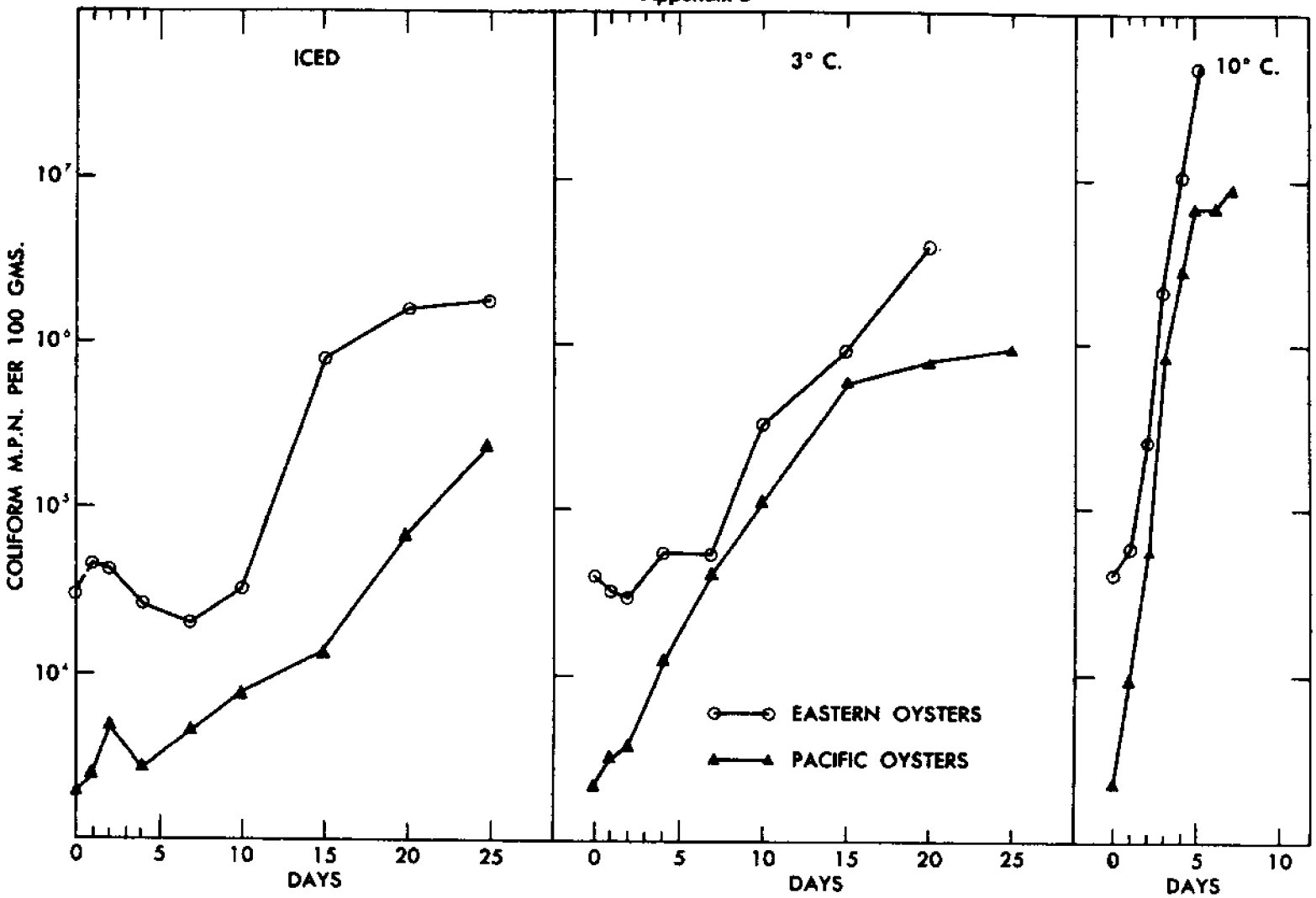


Figure 1. Coliform M.P.N. in Pacific and Eastern Oysters stored in ice and at 3° C. (37.5° F.) and 10° C. (50° F.).

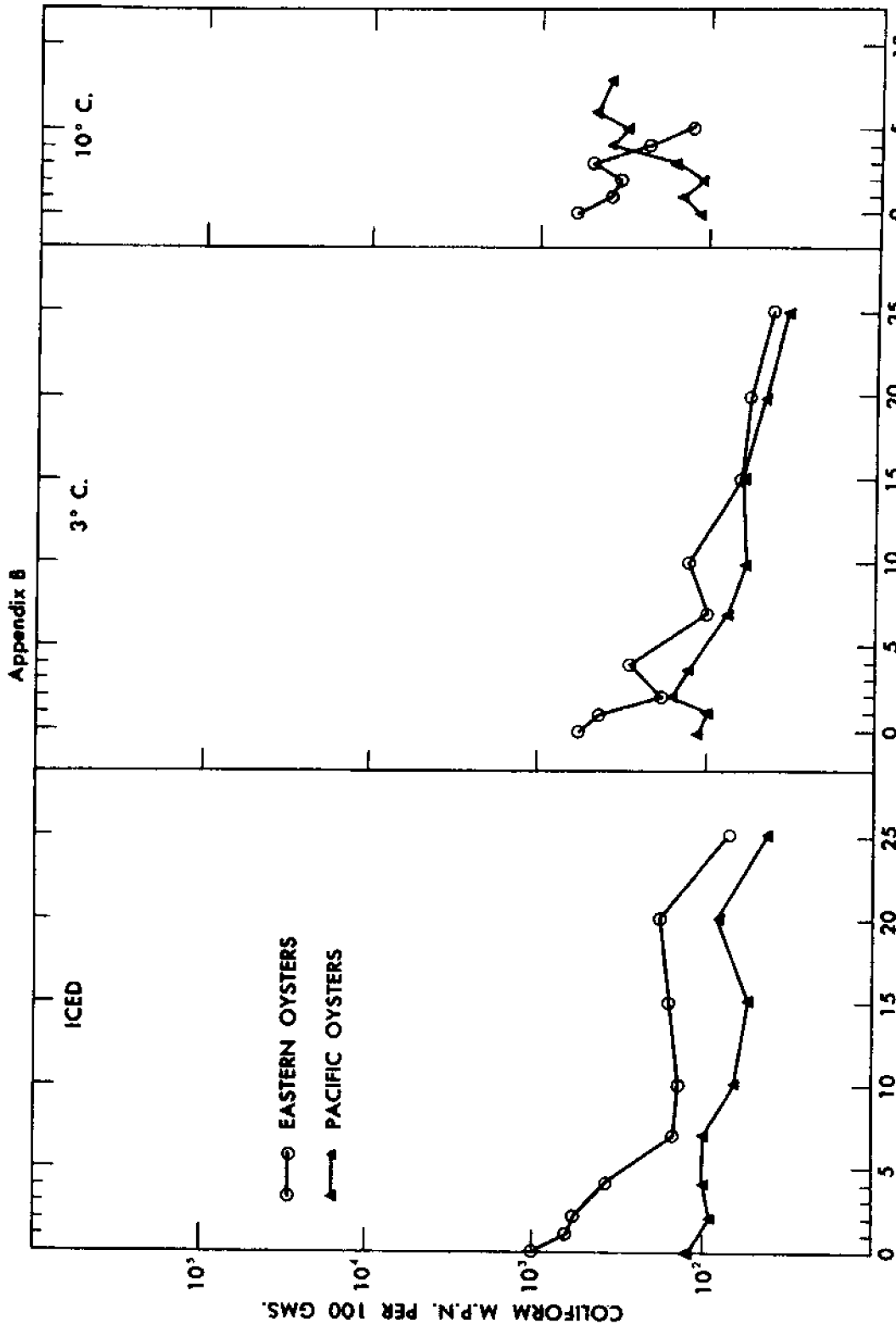


Figure 2. Fecal coliform M.P.N. in Pacific and Eastern oysters stored in ice and at 3° C. (37.5° F.) and 10° C. (50° F.).

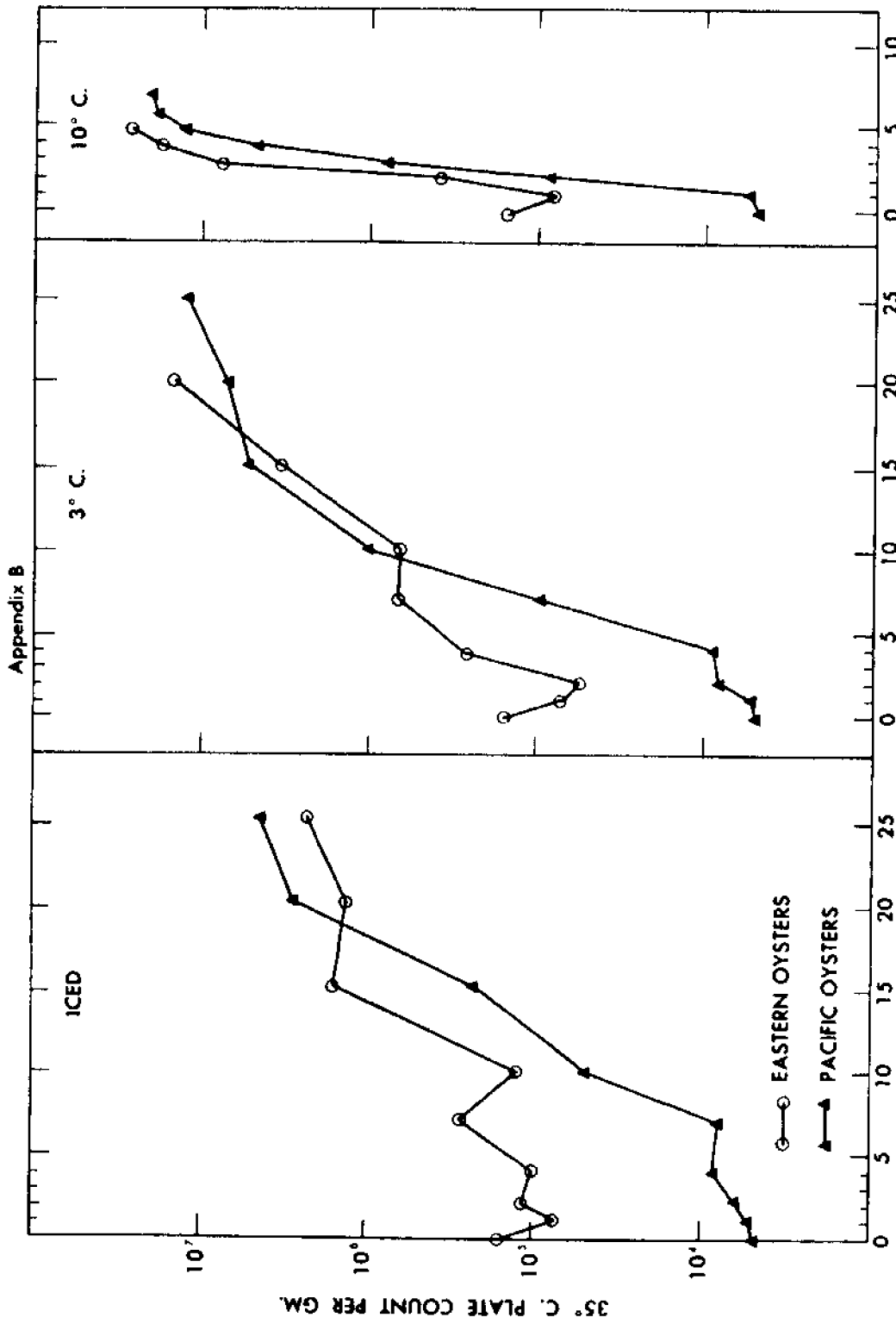


Figure 3. 35° C. plate counts in Pacific and Eastern oysters stored in ice and at 3° C. (37.5° F.) and 10° C. (50° F.).

Appendix B

Name of firm: John Doe
Address: 12 Spring Road, Benton, Florida
State certification No.: 10

Shucker-Packer Ledger Report

Quantity purchased or harvested (indicate oysters, clams, or mussels)	Date of harvest	Date of purchase	State area designation from which harvested	Name and address, or State permit or license number of harvester	Quantity sold (indicate oysters, clams, or mussels)	Date sold	State permit or license number, or name and address of purchaser
(Example of use of form by shucker-packers)							
40 bushels oysters	1/12/66	(*)	WL—Wash.	Wash.—28	40 gallons oysters	1/12/66	Redwood Foods Inc., Tacoma, Wash.
20 bushels oysters	1/14/66	1/15/66	GH—Wash.	Wash.—7	30 gallons oysters	1/15/66	Sea Food Corp., Olympia, Wash.
10 bushels oysters	1/14/66	1/15/66	N—Oreg.	John Jones 12 Shady Lane, Portland, Oreg. Oreg.—12	31 pints oysters	1/15/66	Cash sales to individual buyers through salesroom.
					12 gallons oysters	1/16/66	Toms Grocery, 120 Sentinel Highway, Aberdeen, Wash.

*Date of purchase not applicable since shucker-packer dredged these oysters from his own leased ground

Appendix B

Name of firm: John Doe
Address: 12 Spring Road, Benton, Florida
State certification No.: Fla.—12
State permit or license No.: 1267

Shell-Stock Shipper Ledger Report

Quantity purchased or harvested (indicate oysters, clams, or mussels)	Date of harvest	Date of purchase	State area designation from which harvested	Name and address, or State permit or license number of harvester	Quantity sold indicate oysters, clams, or mussels)	Date sold	State permit or license number, or name and address of purchaser
(Example of use of form by shell-stock shippers (includes "Buy" boats and "Buy" trucks))							
20 bushels clams	1/2/66	1/3/66	NA—Fla	Fla.—162	5 bushels clams	1/4/66	Fla.—34.
10 bushels oysters	1/3/66	(*)	AB—Fla	Fla.—12	5 bushels clams	1/5/66	Shipped to Wholesale Inc., 40 Maine Ave., Washington, D.C.
5 bushels clams	1/4/66	1/5/66	DF—Fla	John Jones 24 Reo Place Benton, Florida	½ bushel clams	1/5/66	Jane Doe, 7 Maryland Rd., Benton, Fla.
					10 bushels clams	1/6/66	Delmar Restaurant, 101 Riverside Dr., Miami, Fla.
					4 bushels clams	1/6/66	Shipped to Kraften Foods, Inc., 106 Trane Ave., Atlanta, Ga.
					8 bushels oysters	1/6/66	Shipped to Groceries, Inc., 124 Bourbon St., New Orleans, La.
					4½ bushels clams	1/9/66	Destroyed.
					2 bushels oysters	1/10/66	Destroyed.

*Date of purchase not applicable since oysters were tonged by shell-stock dealer Fla.—12 himself from leased ground.

Appendix B

COOLING RATES OF FRESH OYSTERS

Central Laboratory Report*

Object

At the request of the USPHS the rate of cooling fresh oysters was determined on various size cans in crushed ice and under dry refrigeration.

Conclusions

The attached graphs contain the cooling rate curves for 1 gallon (610 x 708), ½ gallon (610 x 314), 1 pint (307 x 314), 12 fl. oz. (307 x 300), and ½ pint (307 x 202) cans cooled in crushed ice and cooled in a dry refrigerated chest. As expected, the cooling rate in crushed ice was faster than in dry refrigeration. Following the inital lag period, the cooling rates were generally the same regardless of initial temperatures.

Procedure

Fresh standard grade oysters were heated in a steam-jacketed kettle to the desired initial temperature and filled into the cans for the first run at each refrigeration condition. In subsequent runs the oysters were warmed in a water or air bath to the desired initial temperature.

The temperatures in the cans were taken with heat penetration thermocouples connected to a potentiometer. The junction of the thermocouple was located at the geometric center of the can.

The first cooling rate determination was made with the cans packed in crushed ice. The cans were covered with ice at all times and a drain carried away the water as the ice thawed. The ice temperature was 31°–32° F.

The second determination was made in a refrigerated chest at a temperature of 31°–32° F. A small fan in the chest kept the air gently circulating.

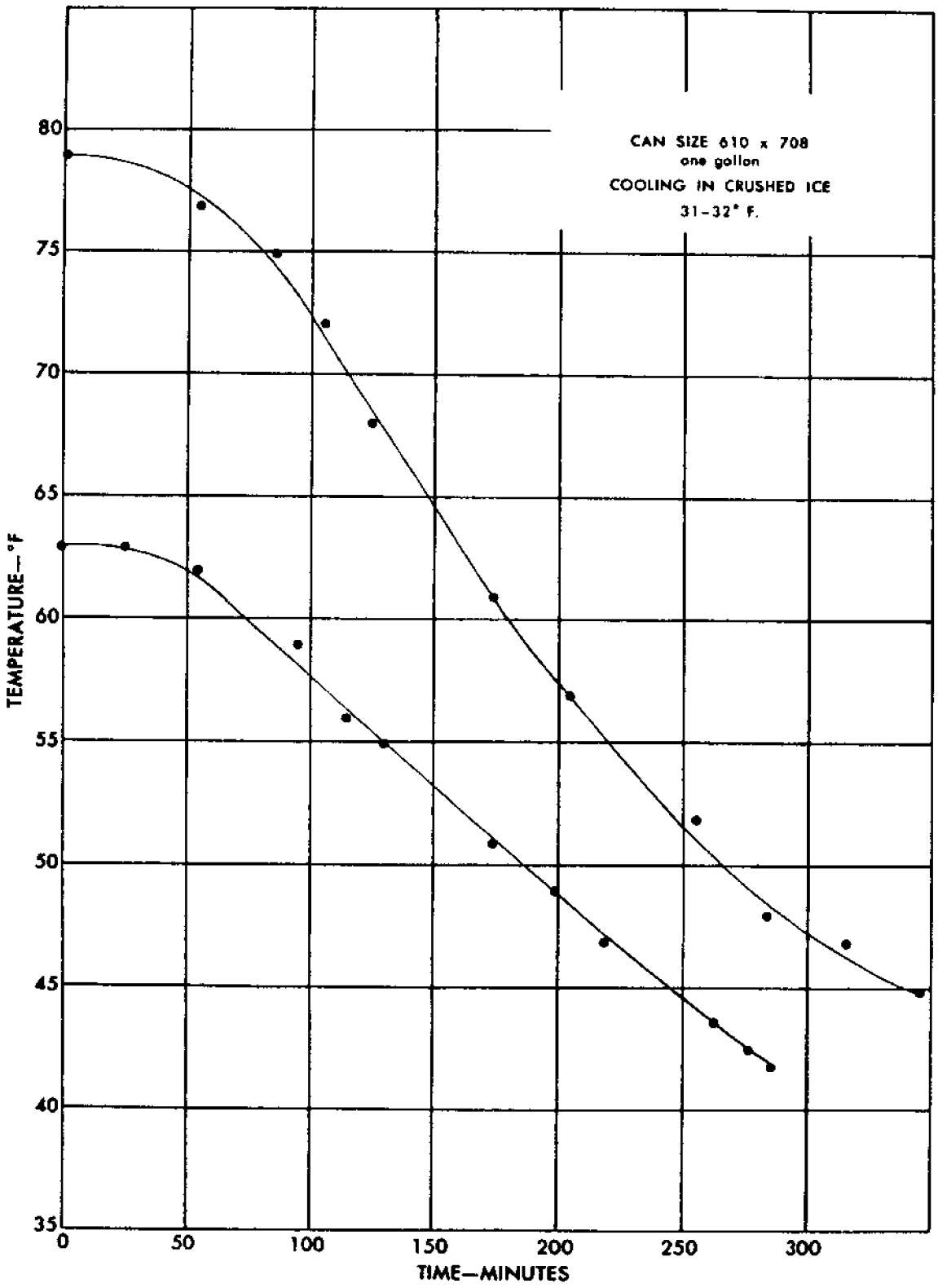
Fresh oysters were used for each refrigeration condition and no deterioration other than some sloughing from physical agitation was noted.

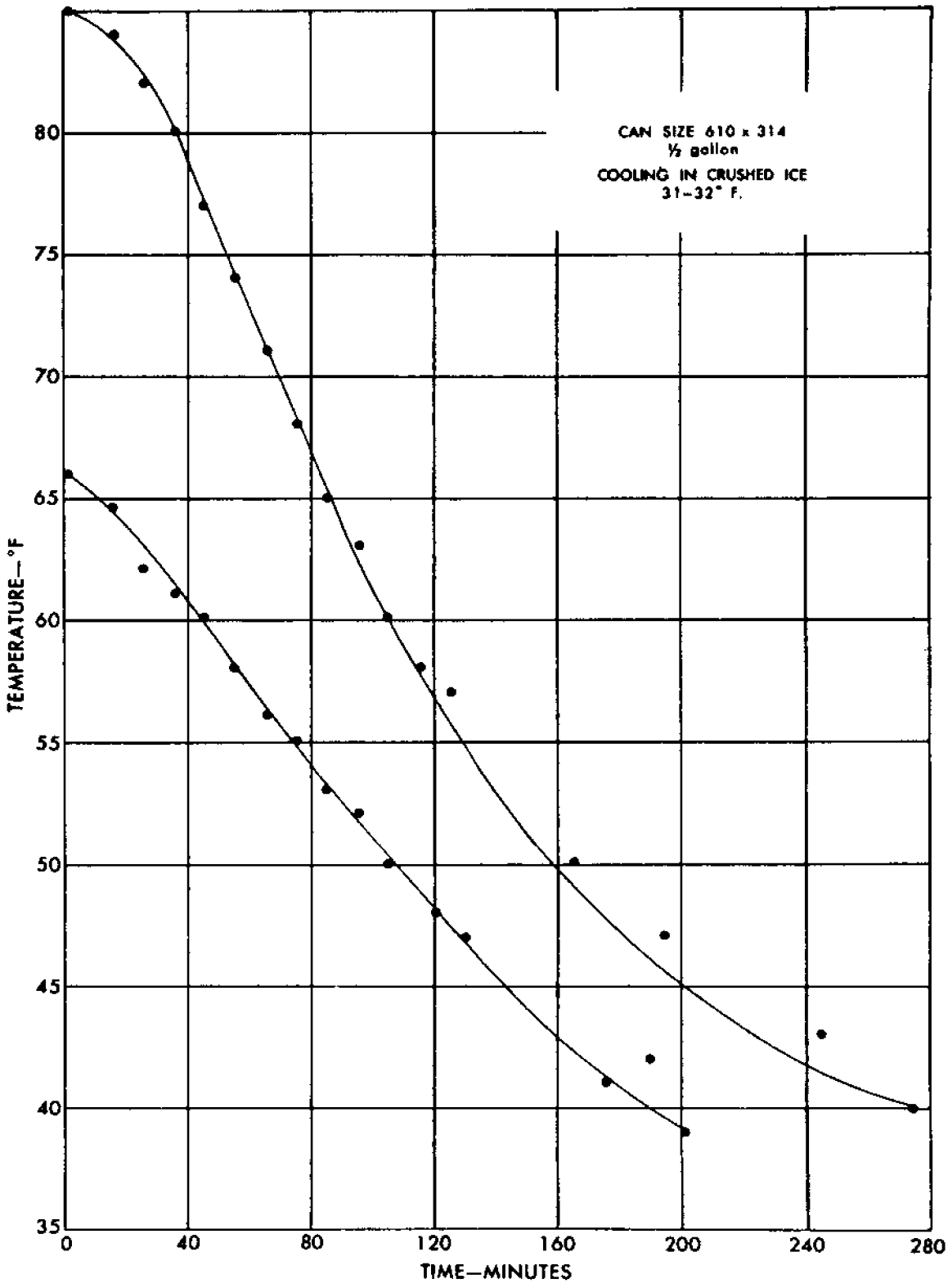
Discussion

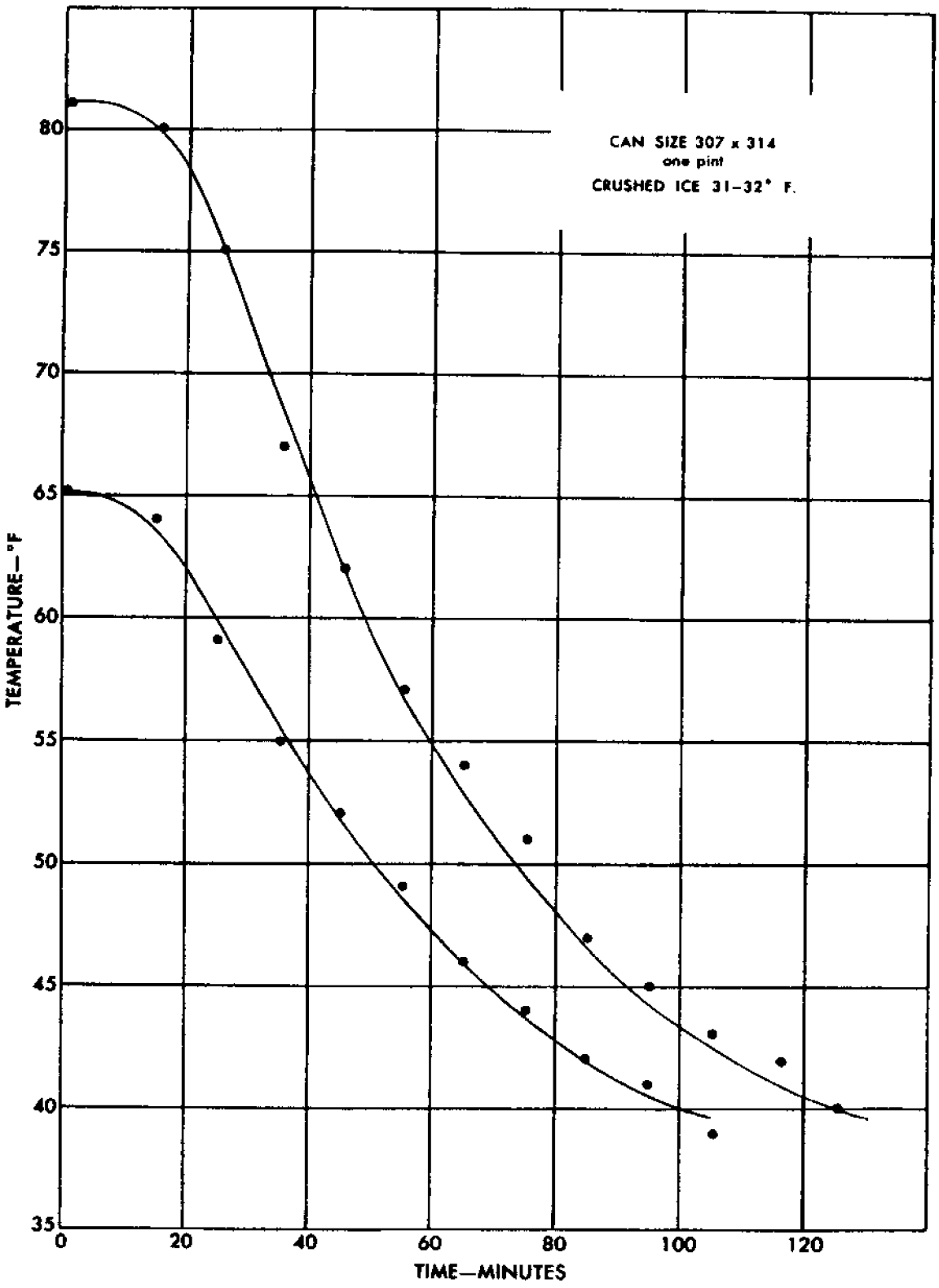
The original request was for cooling rates at initial temperatures of 50° F. increments. We believe that from the attached curves which represent maximum and minimum initial temperatures, the time to cool to any given temperature from any given initial temperature can be interpolated very closely.

D. B. MORDEN,
Meat, Fish, and Dairy Group.

*Prepared by the American Can Company, Technical Service Division at the request of the U.S. Public Health Service.


CAN SIZE 610 x 708
one gallon
COOLING IN CRUSHED ICE
31-32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
50
100
150
200
250
300
TIME—MINUTES


CAN SIZE 610 x 314
½ gallon
COOLING IN CRUSHED ICE
31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
40
80
120
160
200
240
280
TIME—MINUTES


CAN SIZE 307 x 314
one pint
CRUSHED ICE 31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
20
40
60
80
100
120
TIME—MINUTES

May 1965

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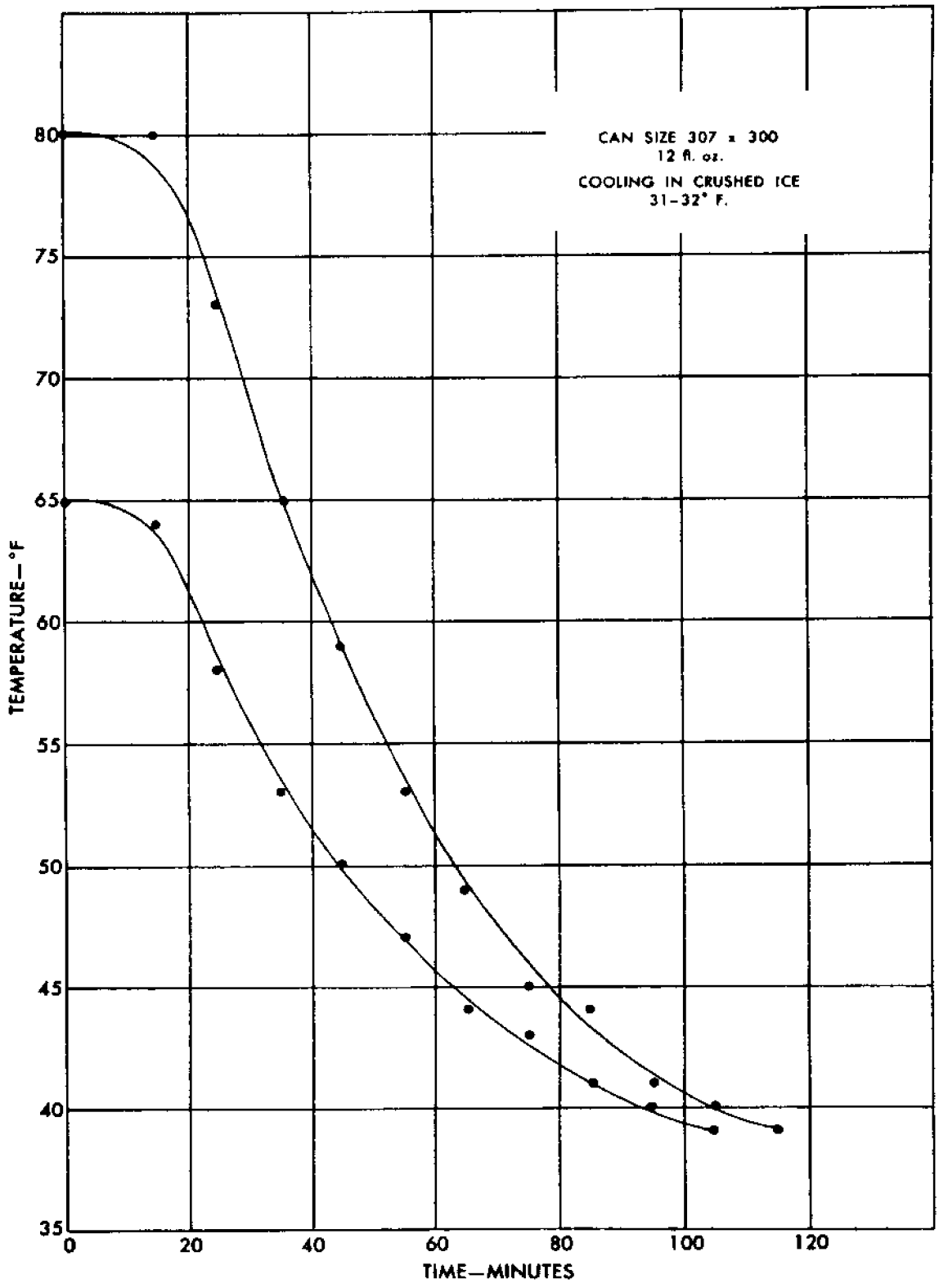
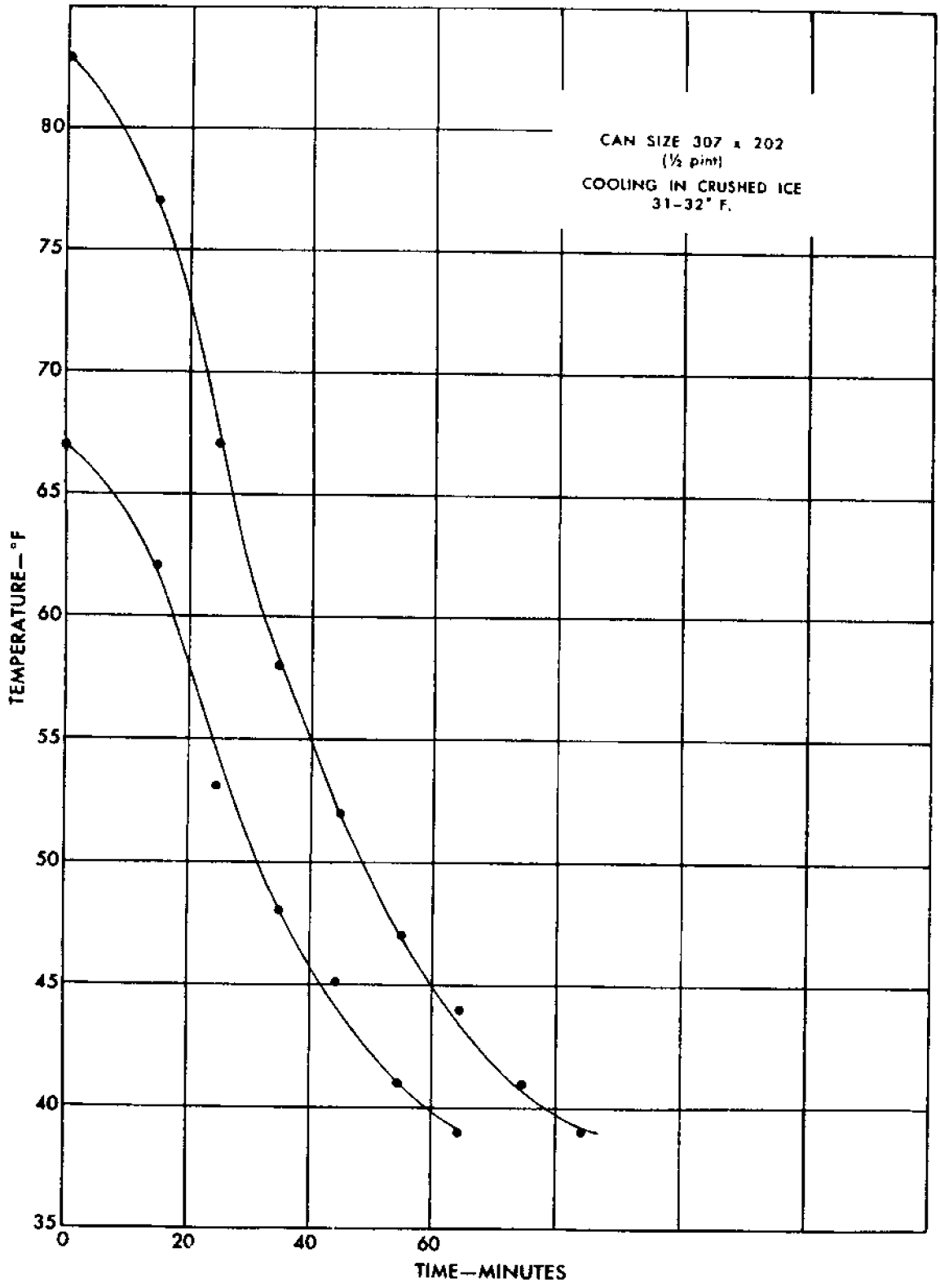
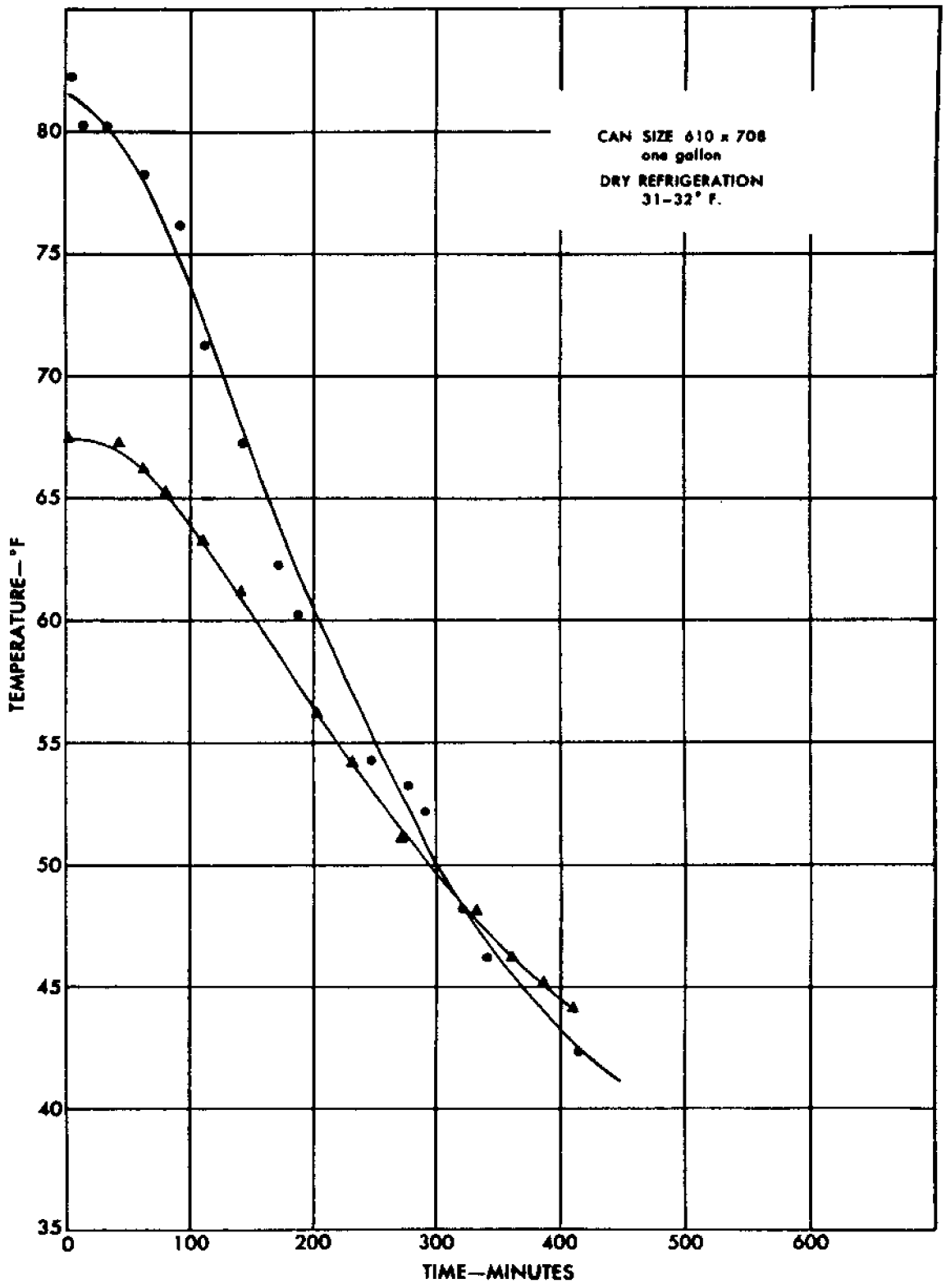
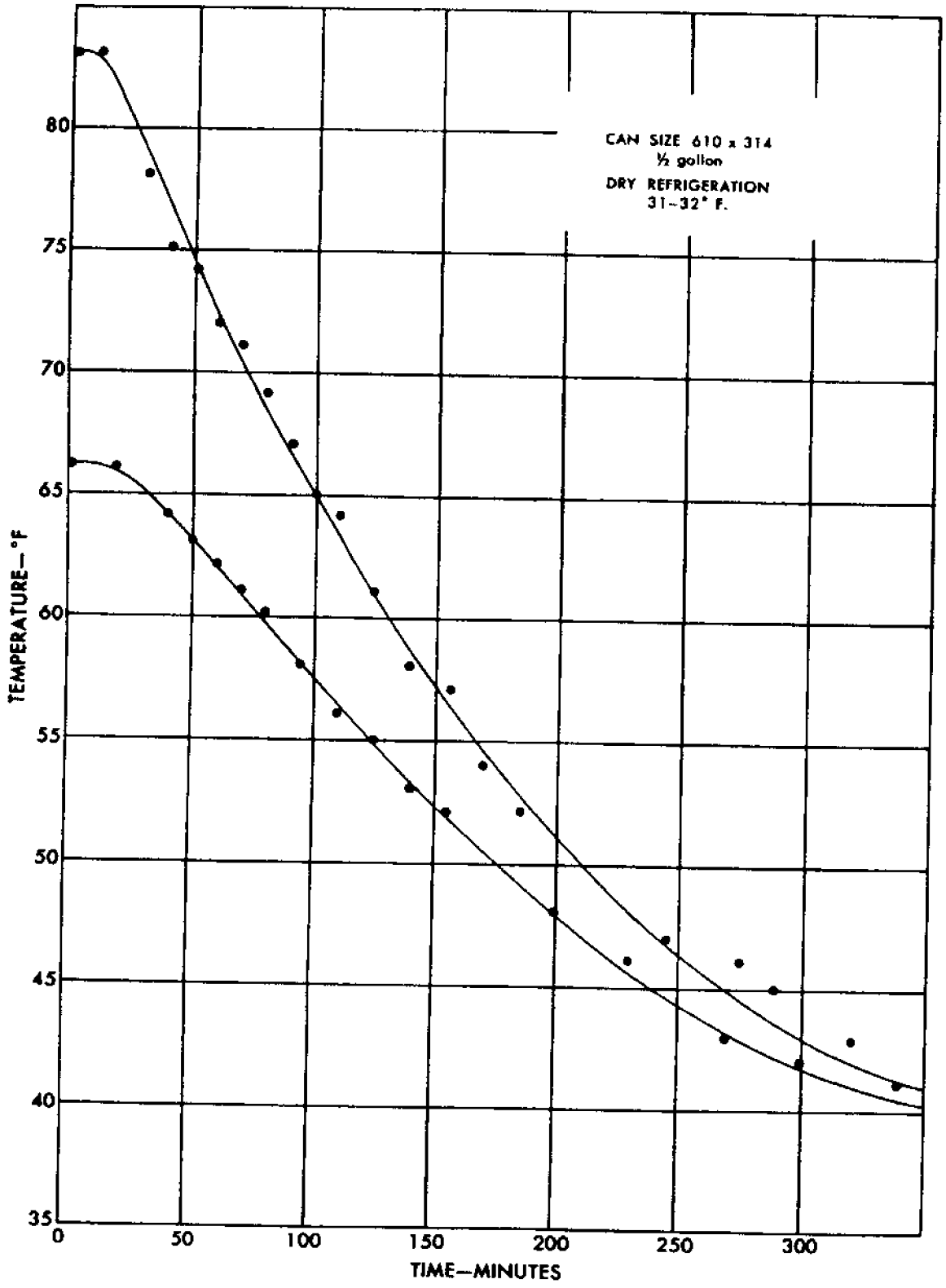

CAN SIZE 307 x 300
12 fl. oz.
COOLING IN CRUSHED ICE
31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
20
40
60
80
100
120
TIME—MINUTES

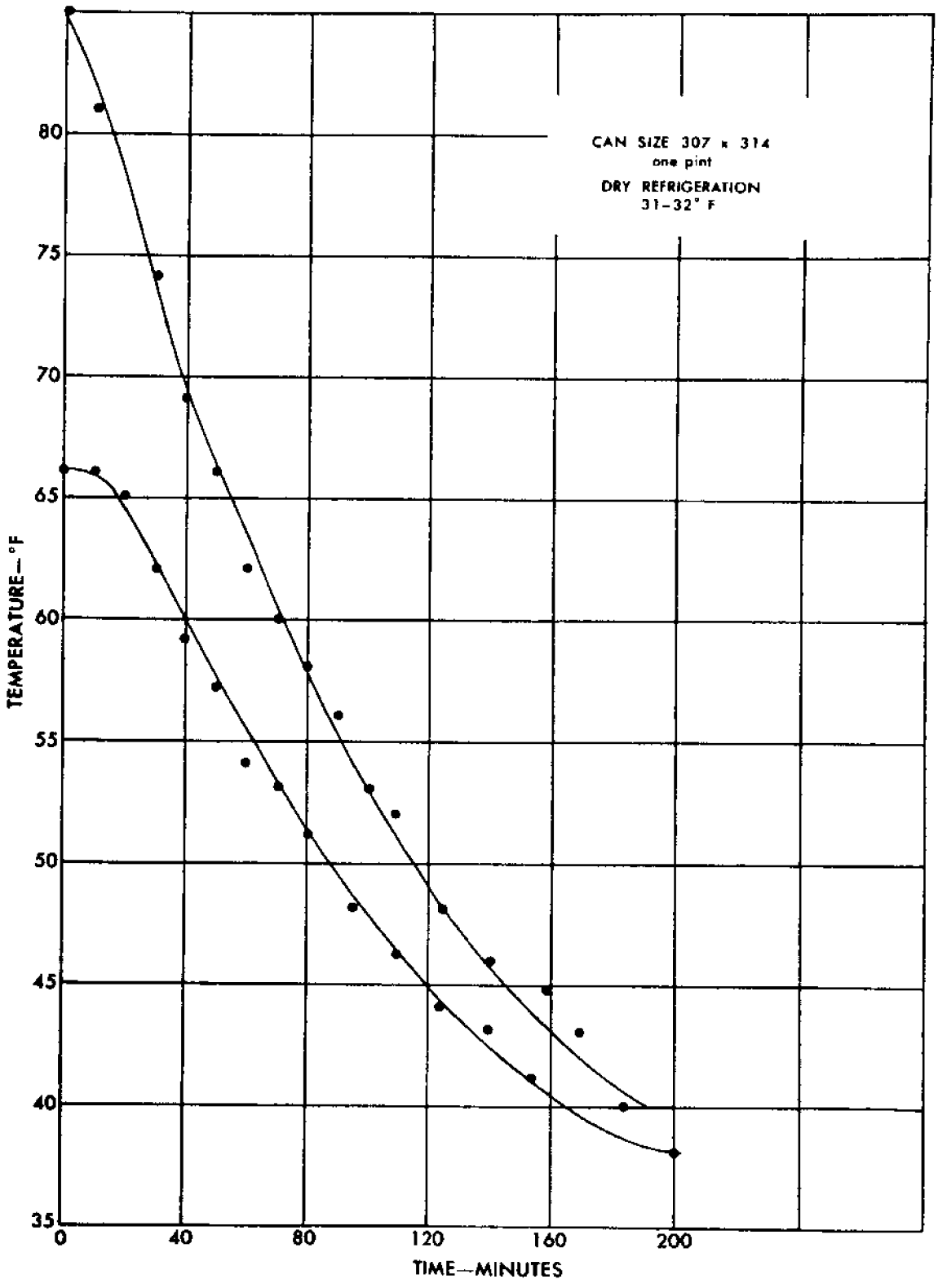

CAN SIZE 307 x 202
(½ pint)
COOLING IN CRUSHED ICE
31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
20
40
60
TIME—MINUTES

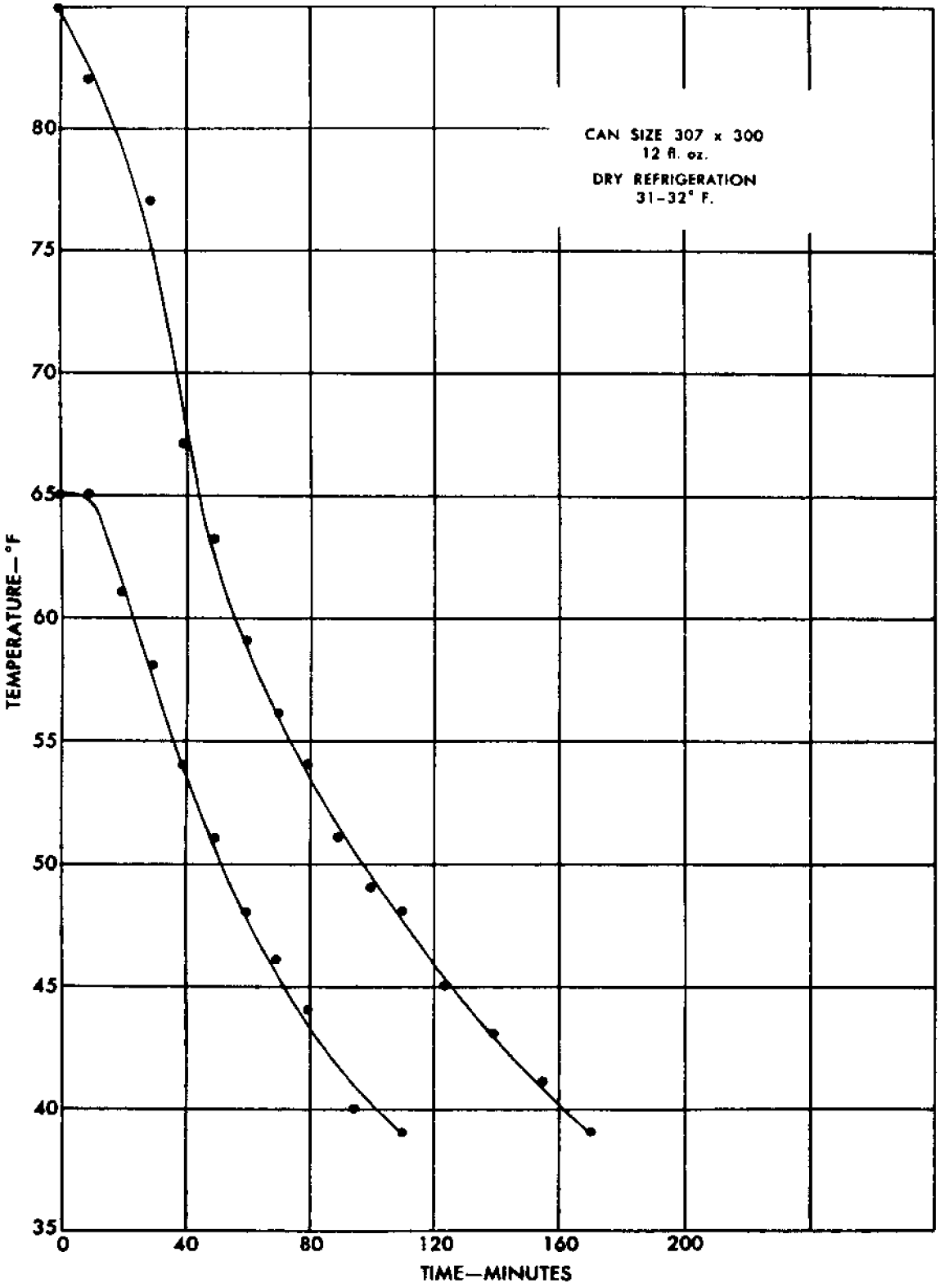

CAN SIZE 610 x 708
one gallon
DRY REFRIGERATION
31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
100
200
300
400
500
600
TIME—MINUTES

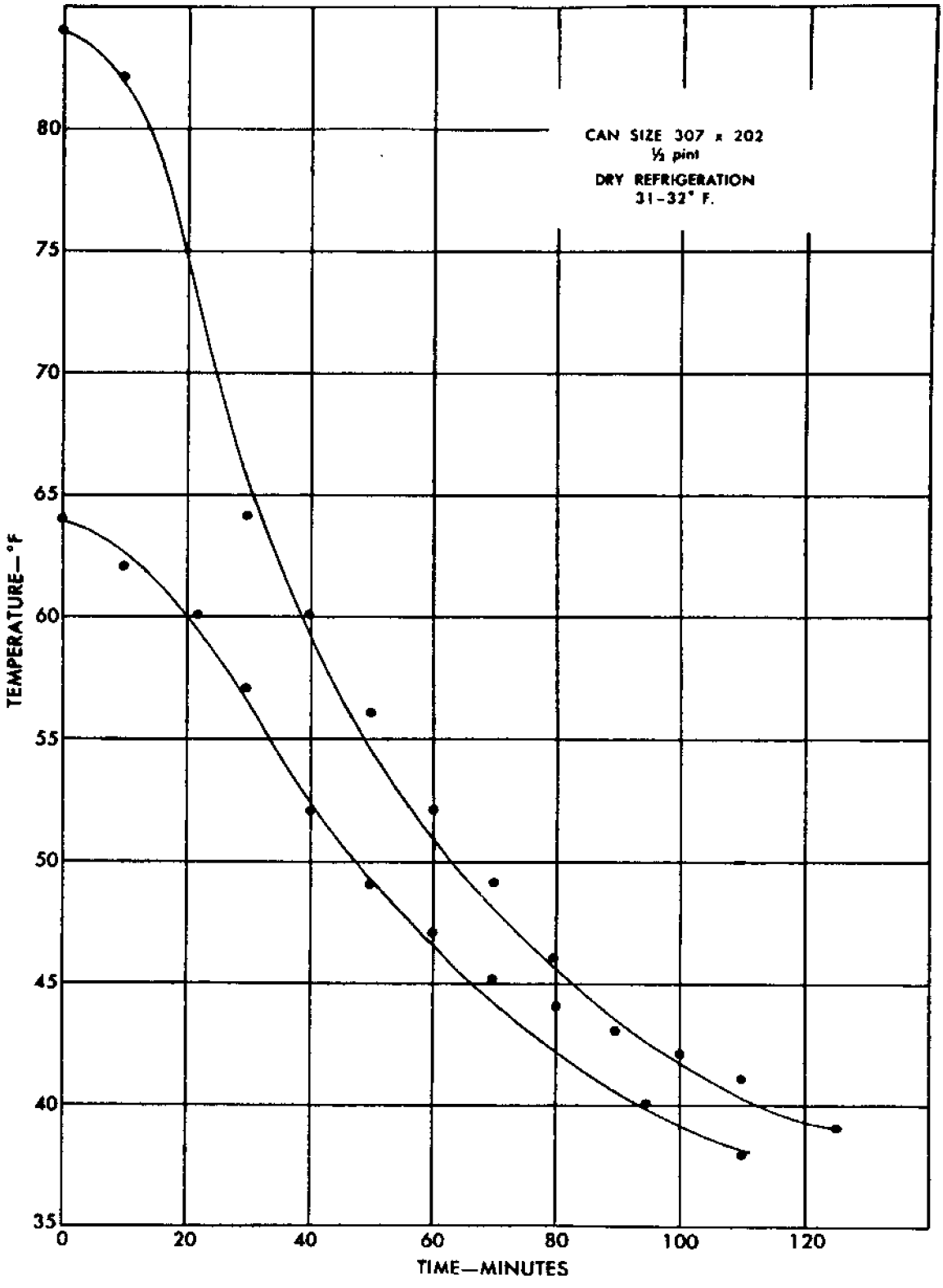

CAN SIZE 610 x 314
½ gallon
DRY REFRIGERATION
31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
50
100
150
200
250
300
TIME—MINUTES

May 1965

45


CAN SIZE 307 x 314
one pint
DRY REFRIGERATION
31–32° F
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
40
80
120
160
200
TIME—MINUTES


CAN SIZE 307 x 300
12 fl. oz.
DRY REFRIGERATION
31–32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
40
80
120
160
200
TIME—MINUTES


CAN SIZE 307 x 202
½ pint
DRY REFRIGERATION
31-32° F.
TEMPERATURE—°F
80
75
70
65
60
55
50
45
40
35
0
20
40
60
80
100
120
TIME—MINUTES

Appendix C

HEAT SHOCK METHOD OF PREPARATION OF OYSTERS FOR SHUCKING

The Eastern oyster *Crassostrea virginica* in some areas is found in clusters which prevents rapid or conventional shucking as with the same species in other oyster growing areas. This natural phenomena has presented questions as to how best this natural resource might be utilized as a food source and remain within economic possibilities.

Dr. A. D. Tennant [1] in Canada investigated the short-term dipping of soft shell clams in near boiling water for various periods of 3 to 30 seconds. It was reported that this short-term heat shock resulted in a reduction of coliform and fecal streptococci numbers. The reduction obtained after 3 to 10 seconds' immersion was not significantly less than that recorded after longer periods of heat treatment with the animals still alive after the immersion. There was no significant increase in the MPN values in "shocked" clam meats during 7-day refrigeration periods, and the short period of immersion did not impair the keeping qualities of the packed, refrigerated clam meats. The "shocking" process also reduced the amount of surface contamination carried to the shucking tables by the shell-stock and facilitated shucking without effecting the palatability of the product.

It has further been found that immersing the cluster-type oyster in comparatively hot water (145°–150° F.) for a short period of time (up to 3½ minutes) facilitates the removal of oyster meat up to 99 percent of that contained in the cluster. This process has been investigated under a cooperative project by the Public Health Service and the South Carolina State Board of Health.[2] The "heat shock" process resulted in an overall reduction in the coliform and fecal coliform MPN's at all percentile levels. The greatest reduction occurred in the samples examined immediately after shocking. Holding on the shucking bench appears to result in a slight increase in these two groups of bacterial indices as compared to oysters examined immediately after shocking; however, these levels remain significantly lower than the levels obtained on samples from the cold shucking process. Accordingly, it has been concluded that with application of sanitary precautions the beneficial use of this food source may be fully realized.

The following sanitary measures are delineated for use where the "heat shock" method of preparation of oysters for shucking is permitted by State shellfish sanitation authorities. These are intended to apply only to the cluster-type oyster, but may be adaptable to other species in other areas.

1. Washing of Shell-Stock.—Shell-stock subjected to the heat shock process shall be washed immediately prior to the heat shock operation in potable water. Experience has shown that wash water temperatures between 65° F. and 75° F. are effective for adequately washing shell-stock. Shell-stock shall be protected from contamination prior to and during the prewash cycle.

Public-health explanation.—Although Item 2 of section A requires that shell-stock be washed reasonably free of bottom sediments and detritus as soon after harvesting as is practicable, it is necessary to again wash shell-stock immediately prior to heat shocking to reduce the bac-

[1] Tennant, A. D. "An Investigation of the Bacterial Flora of the Soft Shell Clam (*Mya arenaria*) in New Brunswick and Nova Scotia." Master of Science Thesis. McGill University. Montreal. Abstract available from Shellfish Sanitation Branch, Division of Environmental Engineering and Food Protection, Public Health Service, Department of Health, Education, and Welfare, Washington, D.C., 20201.

[2] Russell, Ralph T. Hammerstrom, R. J., Pringle, Somers B., and Walsh, Martin. "Studies of the 'Heat Shock' Process for Oysters." See Proceedings Shellfish Sanitation Workshop. Nov. 17-19, 1964.

terial load in the dipping tank. Invariably some mud or detritus will adhere to the shell-stock; hence, the necessity to again wash the shell-stock before it is immersed in the heat shock water where the mud or detritus may be released by the warmer water. The cleaner the shell-stock, the more rapidly the oysters will arrive at the optimum temperature for shucking and there will be less variation in heat transfer among different lots.

Satisfactory compliance.—This item will be satisfied when—

a. All shell-stock subjected to the heat shock process are washed immediately prior to the heat shock operation in flowing potable water. Water temperatures not less than 65° F. nor more than 75° F. are recommended.

b. Shell-stock are handled in a manner which prevents their contamination during the prewash cycle.

2. Temperature and Change of Dip Water.—During the heat shock process the water shall be maintained at not less than 145° F. or more than 150° F. The water shall be completely drained or removed from the heat shock tank at least once each 3-hour period. An accurate [4] indicating or recording thermometer shall be available and used during the heat shock process for temperature measurements. Recording thermometers are recommended so as to provide a record of the temperatures used.

Public-health explanation.—Experience and research indicates the temperature range of 145°–150° F. to be adequate to facilitate removal of oysters from the shell without apparent physical change to the oyster. A temperature range is specified rather than an exact temperature because of varying climatic conditions during the year. Dip water is required to be changed at least every 3 hours to avoid bacterial concentration or build up of mud or detritus.

Satisfactory compliance.—This item will be satisfied when—

a. Heat shock water is maintained at not less than 145° F. or more than 150° F.

b. The heat shock watertank is completely flushed at 3-hour intervals or less in such manner that all mud and detritus remaining in the dip tank from previous dippings is eliminated.

c. An indicating or recording thermometer, accurate within 2° between 145° F. and 150° F. is available and is located in the heat shock water during all periods of shock operation.

3. Time Interval of Immersion.—Shell-stock subjected to the heat shock process shall not be immersed in the heat shock water for periods longer than 3.0 minutes. An accurate timing device shall be available and used to control the time of immersion. Only approved containers of ½-bushel [5] capacity shall be used in the heat shock process. It is recommended that an automatic timer or an automatically electrically controlled timer be used.

Public-health explanation.—Industry practice and investigation reveals that an immersion time varying between 2 and 3 minutes is all that is necessary to facilitate the shucking process. A maximum time of immersion is specified to prevent any physical change in the oyster which would prevent it from being classified as a fresh product. The maximum time specified is based on the use of ½-bushel quantities of shell-stock in ½-bushel wire baskets or other ½-bushel containers approved by the shellfish sanitation control agency.

Satisfactory compliance.—This item will be satisfied when—

a. Shell-stock is not subjected to the heat shock process for periods longer than 3 minutes.

b. An accurate timing device is available and used to control the time of immersion.

c. Only approved containers of ½-bushel capacity are used during the heat shock process.

4. Dip Tank Volume.—At least 8 gallons of heat shock water shall be maintained in the dip tank for each ½-bushel container of shell-stock being heat shocked.

Public-health explanation.—The minimum of 8 gallons of dip water per ½ bushel is necessary to prevent bacterial buildup and extreme variations of temperature in the heat shock water.

Satisfactory compliance.—This item will be satisfied when there are at least 8 gallons of heat shock water in the heat shock tank for each ½-bushel container of shell-stock undergoing the heat shock process.

[4] Thermometers should be accurate to within 2° F.; should have scale divisions not greater than 2° F.; and should be so installed as to be easily read. Accuracy of thermometer should be checked at least once each year by the State regulatory agency.

[5] Defined as 1,075.2 cubic inches or as one-half the U.S. standard bushel of 2,150.4 cubic inches.

5. Cooling of Heat Shocked Shell-Stock.—On removal from the shock immersion water, all heat shocked shell-stock shall be subjected to an immediate cooldown with potable tap water. Heat shocked shell-stock shall be handled in a manner which prevents contamination reaching the shell-stock during the cooling operation.

Public-health explanation.—After undergoing the heat shock process, the internal temperature of the oyster meat was elevated to temperatures within a range of 98° F. to 110° F. in field studies and 116°–147° F. in laboratory studies. It is therefore necessary to reduce the internal temperatures of the oyster meat immediately to prevent bacterial growth, but not to the extent that the purpose of the process is nullified.

Satisfactory compliance.—This item will be satisfied when—

a. All heat shocked shell-stock are subjected to cooling with potable tap water immediately upon removal from heat shock process water.

b. All heat shocked shell-stock are handled in such manner as to preclude contamination during the cooling process.

6. Refrigeration of Shocked Shucked Shellfish.—The oyster meats from all shell-stock which have been subjected to the heat shock process shall be cooled to an internal temperature of 45° F. within 2 hours after the heat shocking process.

Public-health explanation.—Oyster meat temperatures of shell-stock which have been subjected to the heat shock process are higher than those of conventionally shucked oysters. Therefore, it is necessary that such meats be cooled quickly to 45° F. after the heat shock process to deter bacterial growth.

Satisfactory compliance.—This item will be satisfied when all oyster meats of shell-stock which have been subjected to the heat shock process are cooled to at least 45° F. within 2 hours after the heat shock process and are placed in storage at 45° F. or below. (This requirement will require the use of ice in the shucking containers, blowers, skimming tables, or wash tanks, or the use of refrigerated water, wherein the meats will be in direct contact with crushed or flaked ice, or with refrigerated water.)

7. Records of Heat Shock Time and Temperatures.—Each plant operating the heat shock process shall maintain an accurate daily record, on a ledger form satisfactory to the State supervisory agency, of the time and temperature of immersion of at least three lots of shellfish during each day of operation as well as recording the time of change of heat shock water. It is preferable that records show the time of day each recorded lot is immersed and the time of day each recorded lot is removed from the water, and that the individual recordings be at intervals of 2 or 3 hours. These records shall be preserved for at least 3 months for the information of the supervising State agency.

Public-health explanation.—Records are needed to maintain a summary or abbreviated history of each hot dip operation. They are of assistance to the supervisory agency in determining whether the operation is carried out in accordance with these or other State regulations covering the process. They are also of assistance to the operator in maintaining the process within the limitations imposed by State authorities.

Satisfactory compliance.—This item will be satisfied when—

a. Each operator maintains an accurate daily record of the time and temperature of immersion of at least three lots of shellfish during the day of operation and records the time of change of heat shock water. This record shall be on ledger forms satisfactory to the State supervisory agency. (Plants using recording thermometers will be deemed in compliance with this item if suitable indication is made on the chart when the shell-stock are first immersed and when they are removed from the heat shock water, as well as the time of change of heat shock water.)

b. The above records are preserved and are on file at the plant for inspection by State authorities.

8. Cleaning and Bactericidal Treatment of Heat Shock Process Tank.—At the close of each day's operation the heat shock tank shall be completely emptied of all water, mud, and detritus, and shall be cleaned in accordance with the requirements for cleaning of equipment established by item 16, section B, part II. Prior to the start of the next day's operation, the heat shock tank shall be given bactericidal treatment

in accordance with the requirements of item 17, section B, part II. Heat shock process tanks shall be of such construction that they may be easily cleaned.

Public-health explanation.—If the water, mud, and detritus were allowed to remain in the heat shock tank under declining temperature conditions, it would constitute an excellent medium for growth of bacteria. Emptying the tank and cleaning it at the close of the day's operation will more likely insure that the next day's dipping operation will start under optimum conditions of cleanliness. Bactericidal treatment prior to the start of the next day's operation will insure destruction of any pathogenic bacteria remaining after the cleaning operation or introduced during the interim storage period. It will also prevent carryover of thermophillic or thermoduric bacteria from the previous day's operation.

Satisfactory compliance.—This item will be satisfied when—

a. The heat shock process tank is thoroughly cleaned at the close of each day's operation in accordance with the requirements for cleaning of equipment established by item 16, section B, part II.

b. The heat shock process tank is flushed with water from an approved source after cleaning and is allowed to drain and dry overnight.

c. Bactericidal treatment complying with the requirements of item 17, section B, part II, is provided the heat shock tank prior to the start of the day's dipping operation.

d. All heat shock process tanks are of such construction that they may be easily cleaned.

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APPENDIX G
ALASKA SHELLFISH GROWER'S ASSOCIATION CONTACTS

John Church
P.O. Box 1528
Wrangell, AK 99929

Charles Clement
P.O. Box 302
Metlakatla, AK 99936

Don Erickson
9452 Herbert
Juneau, AK 99801

Stephen Laposki
Oysters 'n Such
P.O. Box 863
Sitka, AK 99835

Robin Larsson
P.O. Box 1499
Wrangell, AK 99929

Warren Pellet, Sr.
P.O. Box 394
Sitka, AK 99835

Information Officer
Pacific Biological Station
Nanaimo, B.C. V9R SK6
CANADA
(604) 758-5202

Brian Paust
Alaska Marine Advisory Program
P.O. Box 1329
Petersburg, AK 99833
(907) 772-3381

Don Kramer
Seafood Specialist
Marine Advisory Program
P.O. Box 103160
Anchorage, AK 99510
(907) 274-9691

Tim Koeneman
Shellfish Biologist
Alaska Dept. of Fish and Game
P.O. Box 667
Petersburg, AK 99833
(907) 772-3381

FRED Division (Region 1)
c/o Mr. Tom Kron
Alaska Dept. of Fish and Game
230 S. Franklin
Juneau, AK 99801
(907) 465-4230

Evelyn Biggs-Chisum
3321 South 211 St.
Seattle, WA 98188
(206) 824-5442

Joseph Sullivan, PhD
Fish Pathology Section
Alaska Dept. of Fish and Game
FRED Division
333 Raspberry Road
Anchorage, AK 99502

Alf Roald Saetre
19707 64th Ave. W., Suite 108
Lynnwood, WA 98036
(206) 385-3803 or 774-9144