



Wild, Natural & Sustainable®

Recommended Salmon Quality Guidelines For Fishing, Tendering & Processing Operations

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Preface

Notice to Users

Salmon is Alaska's single most valuable seafood resource. The complexities of harvesting, processing, transporting and distributing salmon from remote points along Alaska's 34,000 miles of coastline and extensive inland river system create challenges for all those who participate in this fishery. One of these challenges is the consistent production of high quality salmon products.

Consumer surveys show that the approximately one billion pounds of Alaska seafood produced and distributed annually have a favorable reputation with respect to quality. But these products are faced with ever-increasing competition in today's marketplace. The Alaska Seafood Marketing Institute (ASMI) recognizes the critical role quality plays in consumer purchase decisions, and is committed to maintaining and improving the quality of Alaska seafood products so that all members of the industry will benefit from the economic advantage of a consistent, high quality product image in the world marketplace.

The production of high quality seafood requires the collective efforts of fishermen, processors, distributors and resource managers. The ASMI Quality Assurance Program is designed to unite representatives from these industry and government sectors into an effective partnership. ASMI believes this cooperation will be helpful in shaping educational programs aimed at improving seafood quality, and is vital to the future of the state of Alaska and the seafood industry.

These recommended guidelines for Pacific salmon have been developed by ASMI to assist fishermen, tender operators and processors in producing high quality salmon products. The guidelines are not intended to replace the advice of trained and experienced technologists concerning the construction, operation and maintenance of vessels, facilities or equipment, or regarding operating procedures in specific geographic areas. These guidelines are also designed for reference by public service agencies. This information should not, in any way, be construed as replacing existing local, state or federal regulations.

ASMI recognizes the limitations inherent in general guidelines of this type. The reader should be aware that certain guidelines may not apply to all fishing, tendering and processing operations, vessels and facilities in all regions of the state, due to variations in vessel construction, facility design, tides, air or water temperatures, intrinsic characteristics of the fish, or other factors.

Nothing contained in these guidelines is intended to be, or shall be construed to create or form, the basis for any liability on the part of ASMI, its officers, employees or agents, for any injury or damage resulting from the failure of the person who engages in operations or activities subject to the provisions of, or guided by, these guidelines to comply with their provisions, or by reason or in consequence of any act or omission in connection with the implementation or enforcement of these guidelines on the part of ASMI by its officers, employees or agents.

Scope

These guidelines apply to all five species of Pacific salmon (*Oncorhynchus* sp.) that are harvested, transported or processed in Alaska and which may be offered for sale in many styles, including, but not limited to:

- a) Round
- b) Eviscerated, head-on
- c) Eviscerated, head-off
- d) Heads, fins and tail removed
- e) Steaks or portions
- f) Split sides, backbone removed
- g) Fillet, skin-on
- h) Fillet, skin-off
- i) Canned

Definitions

Belly burn is the softening and discoloration of the interior belly wall, caused by enzymatic activity in the body cavity, which may occur between the time the fish dies and when the viscera is removed.

Chilled sea water (CSW) is a type of cooling system, sometimes referred to as "slush ice," which uses a mixture of sea water and ice for chilling and holding chilled fish. If compressed air is bubbled through the mixture of sea water and ice for circulation, it is called a champagne system.

Contamination means direct or indirect transmission of objectionable matter to the fish.

Cold storage facility is any facility, whether a shore-based establishment or on a vessel, in which fish are kept cold by the use of ice or mechanical refrigeration. A cool room is any facility where fish are held at a temperature of 40 F or below. A cold storage room is any facility where fish are held at a temperature of zero degrees F or below.

Dry vessels are fishing or tendering vessels which are not using ice, chilled sea water (CSW) or refrigerated sea water (RSW) systems to chill the fish.

Extrinsic quality is a term which refers to the condition of a fish due to factors which affect the fish during and after it is harvested. Extrinsic quality defects are caused by improper catching, handling, processing and storage procedures.

Fish refers to Pacific salmon everywhere it is used in these guidelines.

Hatch coaming is the raised area on the deck of a vessel around a hatch, and is designed to prevent runoff from the deck from entering the fish hold.

Intrinsic quality is a term which refers to the inherent physical characteristics of a fish before it is harvested, including but not limited to: species, size, sex, physiological condition, and presence of parasites or disease.

Prepare means to kill, eviscerate, dress, clean, cut or divide round fish.

Process means to can, cure, freeze, cook or otherwise preserve fish, at any temperature.

Processing facility is any facility, whether shore-based or aboard a vessel, where fish is either prepared or processed for human consumption.

Refrigerated sea water (RSW) is a type of system which uses sea water' that is cooled by mechanical refrigeration for chilling and holding fish.

Sanitize means to treat surfaces so that the number of microorganisms is substantially reduced.

Unwholesome fish are those of such poor quality that they are unfit for human consumption, as defined by US Food and Drug Administration regulations.

General Information About Fish Quality

Although there are many factors that fishermen, tender operators and processors must consider when defining "high quality" as applied to fish products, two major ones are: 1) the intrinsic quality of the fish before it is harvested, and 2) the extrinsic quality of the fish as it is delivered to the tender, processor, and ultimately, the consumer.

The intrinsic quality of the fish is determined by its physical condition at the time of harvest, and is affected by species, size, sex, stage of maturity and other physiological characteristics. These characteristics are inherent to a particular fish, and will not be significantly altered by handling methods.

Extrinsic quality is determined by the methods employed in the harvesting, handling, processing and storage of fish. Proper handling procedures will result in fish of high extrinsic quality; improper handling methods will result in a loss of extrinsic quality.

Deterioration of extrinsic quality is also caused by the action of microorganisms and enzymes, and by other chemical changes that take place in the fish after death. The flesh of a live fish is normally considered to be sterile, but bacteria naturally can be found living on gills, skin and in the fish's gut. These bacteria flourish after the fish dies, multiplying rapidly as temperatures elevate.

Enzymes are secreted into the fish's digestive tract so that it may digest and utilize the food it eats. After the death of feeding fish, enzyme activity continues, but is not controlled as it was during the fish's life. Digestive enzymes will leach out of the stomach and intestines and begin to attack the proteins in the flesh of the fish, resulting in what is commonly called "belly burn." This digestive action by enzymes is part of the decomposition process, causing undesirable changes and making it easier for bacteria to invade the flesh of the fish. Spoilage occurs more rapidly as a result of this enzymatic activity.

Biochemical changes also contribute to deterioration. The progress of these changes is most evident as the muscles of the fish change from soft and flexible to hard and rigid as rigor mortis sets in, and as they later return to a relaxed state.

The deterioration of fish and fish products caused by bacteria, enzymes and other chemical actions cannot be stopped, but it can be slowed down. To delay deterioration, you should:

- a) Control temperatures to keep bacterial and chemical activity at the slowest rate possible, i.e. chill the fish as quickly as possible to a range of 32 to 35 F.
- b) Prevent unnecessary contamination through good sanitary practices and proper design and construction of equipment and facilities; and c) Handle the product in a manner which minimizes physical damage.

Careful handling reduces risk of physical damage to fish.

Fishing Vessels and Operations

A. Vessel Guidelines

General Design

The design and construction of a fishing vessel must take into consideration both efficiency and performance as a seaworthy harvest unit, as well as capabilities necessary to deliver a high quality catch to the processor. Design and construction must therefore ensure:

- a) Rapid and efficient handling of fish;
- b) Adequate facilities for proper storage and temperature control; and
- c) Use of materials and design that will facilitate cleaning and disinfection, and prevent damage or contamination of the catch.

Due to the limited space available on a fishing vessel, there is a high potential for contamination of the fish with bilge water, sewage, fuel, oil, grease, smoke, chemicals or other objectionable substances. Design and layout must consider these potential problems in the organization of space, functional areas and facilities.

These recommendations provide guidance for design, construction or retrofitting to ensure that vessels are adequately equipped for the proper handling and consistent delivery of a quality catch.

Deck Areas and Fish Holds or Tanks

All vessels should have a suitable holding area for storing the catch, whether it is below or on-deck. Plastic totes with drainage capability are acceptable for use as fish containers when properly sheltered or covered.

Fish holds should have watertight bulkheads designed to protect the fish from contaminants such as bilge water, fuel and lubricants.

Fish holds on dry vessels should have removable floor boards or some other system to facilitate drainage from the hold.

Fish holds should have pumps and sumps with the capability to pump the hold dry.

Fish holds should be adequately insulated to control the transfer of heat from engine, living quarters or heated pipes.

Fuel and hydraulic lines running through fish holds should be enclosed to protect the fish in case of line failure, and insulated where necessary to prevent heat transfer.

Vessels should have hatch coamings high enough to prevent the flow of contaminants from the deck to the fish holds.

Vessels should be equipped with sufficient hatch covers or suitable covering material to eliminate the exposure of fish to sunlight or airborne contaminants. Hatch covers should be watertight to protect fish from salt or fresh water intrusion.

All lights in fish handling areas should be shatterproof or have protective coverings which will prevent product contamination should breakage occur.

There should be no exposed ribs or untreated wood on surfaces in the fish hold or in fish handling areas on deck. The hold lining should be smooth and watertight. A plywood-lined hold, caulked with non-toxic seam compound and coated with a suitable paint or covering is acceptable. Ideally, holds should have an impermeable lining with rounded corners and no obtrusions. Holds should be conducive to easy and complete cleaning to prevent build-up of bacteria.

Fish holds or tanks should be insulated to minimize heat transfer into fish storage areas. A minimum "R" factor of 10 is recommended for chilled storage areas, or a factor of 20 for frozen storage areas. Insulation should be installed so that it is completely sealed, to prevent water, blood and slime from entering and reducing its effectiveness.

On vessels with refrigeration systems, equipment should be in good operational condition, and capable of chilling a full load of fish to a range of 30 to 35 F within a reasonable amount of time. RSW vessels should limit loads to a maximum of 45 pounds of fish per cubic foot of hold space.

On vessels with freezing systems, equipment should be fully operational and capable of reducing the core temperature of a full load of fish to zero degrees F or lower within a reasonable amount of time.

Tanked vessels and freezer vessels should be equipped with recording thermometers which accurately measure and record the temperature of the hold, freezers or cold storage area. Vessels which do not have tanked holds should be equipped with bi-metal thermometers which accurately measure the internal temperature of the fish.

Cart, should be taken to prevent contaminants from coming into contact with fish.

B. Recommended Operating Procedures for Fishermen

General Guidelines for All Gear Types

The best-designed and constructed vessel or equipment will do little to ensure delivery of a high quality catch if fish are not handled and stowed properly. These recommendations will assist you in delivery of a quality catch: Handle fish carefully at all times. This includes, but is not limited to the following steps:

- a) Remove fish from gear gently;
- b) Do not handle fish by the tail;
- c) Do not throw, kick or step on fish;
- d) Protect fish from damage in shaft alley or any other part of the vessel.

Note that pulling a fish by the tail stretches the backbone, breaking blood vessels along the spine. Blood seeps into the surrounding tissue and forms a bruise that cannot be seen until the salmon is filleted or split.

No pughs, forks, picks, hooks or pumps which damage fish should be used.

Fish should be protected from heat, sunlight, air-drying and inclement weather.

Fish should be protected from bilge water, gas, diesel oil, hydraulic fluid, grease and other contaminants.

On vessels with below-deck holds, chutes or other devices should be used to convey fish into the hold gently, to reduce handling and prevent damage caused by throwing or dropping fish into the hold.

Fish held in bulk on vessels without tanked holds should be shelved at no greater than 35-inch intervals.

On tanked vessels, fish holds should be divided, as necessary, to prevent damage to fish due to the vessel's motion.

No pets should be permitted on vessels used for catching or transporting fish.

Live fish should be stunned in the water or as soon as they are brought on board.

Feeding cohos and kings should be eviscerated and washed as soon as they are brought on board.

Handling fish by the tail may result in backbone separation and bruising of the meat.

Round and eviscerated fish should not be intermingled in the holding area. A separate bin or on-deck totes should be used to store eviscerated fish on vessels carrying both round and eviscerated fish.

Fish should be delivered to tenders or processing facilities as rapidly as possible. All fish should be chilled as soon as possible after being caught.

Fish should be held and unloaded in a manner which minimizes physical damage. Use of knotless, small mesh brailers or cargo nets is recommended. No more than 800 pounds of fish should be loaded in a brailer and/or cargo net.

The holds, bin boards and decks should be thoroughly cleaned and sanitized in accordance with the Fishing Vessel Sanitation Procedures described later in these guidelines. The vessel should be cleaned after every delivery.

800 pounds is the maximum recommended weight load for transferring fish with brailers.

Additional Guidelines for Drift Gill Net Operations

Drift gill net sets should not be longer than two hours.

Drift gill nets should not be wound onto the reel until all fish have been picked from the net.

Additional Guidelines for Set Gill Net Operations

Set gill net sets should not be longer than six hours.

Do not drag set nets on the beach unless all fish have been picked from the net.

Salmon should be removed from set nets before gear is exposed at low tide.

Burlap used to protect fish from exposure to sun and air should be washed in salt water after every use and should be replaced often.

Fish must be protected from fecal contamination by pets and other animals.

Fish should be thoroughly washed in salt or fresh water as soon as possible after catching, and should be stored in clean containers until delivery to a tender or processor.

C. Chilling and Chilled Storage During Fishing Operations

General Guidelines for Round Fish

Temperature is the single most important factor affecting the keeping quality of fish. The rate of bacterial growth, and therefore the speed at which fish spoil, depends on temperature. The lower the temperature, the slower the process occurs. It is not possible to completely stop bacterial growth by chilling fish, but the rate of growth and spoilage can be significantly reduced by keeping fish chilled to temperatures as close to freezing as possible.

All fishermen should use ice or some other method of chilling their fish. Whatever method is used, fish should be chilled as soon as possible after catching.

Ice is an excellent, inexpensive medium for cooling and storage of chilled fish, capable of maintaining fish at slightly above 30 °E. The amount of heat which must be absorbed from fish to melt ice is approximately 72 times as great as is necessary to increase the temperature of cold water by two degrees.

If all of the cooling capacity of ice could be applied to the fish, one pound of ice could cool seven pounds of fish from 55 to 32 °E. In practical use, however, much of the cooling capacity of ice is used up on the air and other materials in the fish holding area, making it necessary to use approximately one pound of ice per two pounds of fish. Even at this ration, ice is still over twenty times more efficient than cold water.

If ice is chosen as the chilling and storage medium, enough ice should be used to reduce and hold the temperature of the fish at a range of 32 to 35 °E. Finely divided ice cools most efficiently by providing the most surface contact with the fish. All ice used for chilling fish must be made with clean water from an approved source.

Refrigerated sea water (RSW) and chilled sea water (CSW) or slush ice, are often used for cooling and storage of fish. The primary difference between the two systems is that RSW uses mechanical refrigeration and CSW is cooled by adding ice to the water. RSW offers the advantages of rapid cooling, lower holding temperatures and less pressure on fish. The disadvantages are salt and water uptake, potentially greater protein loss, and anaerobic spoilage.

If a chilled (CSW) or refrigerated (RSW) sea water system is used, the fish should be maintained at 30 to 35 F. All tanks should be prechilled to 30 to 32 F before loading fish.

All sea water used in CSW and RSW systems should be obtained from open waters, away from populated areas or fresh streams.

The internal temperatures of iced fish and/or the temperature of the hold on vessels with CSW or RSW systems should be monitored and logged at regular intervals, preferably every six hours. Bi-metal thermometers should be used to measure the internal temperature of the fish. The thermometer should be carefully inserted in the anal vent of the fish until the reading stabilizes, or for approximately one minute.

Additional Guidelines for Dressed (Eviscerated) Fish

Dressed fish should be iced in plastic tubs, boxes or small removable bins as soon as possible after evisceration. Drainage capability should be provided for these containers.

Neither CSW nor RSW systems should be used for holding eviscerated fish.

D. Freezing and Frozen Storage Aboard Fishing Vessels

Fish should be frozen in either a pre- or post-rigor condition, when the fish is flexible, to avoid tissue damage and/or gaping.

Freezing systems should be tested by measuring the core temperatures of several average-size fish with a thermocouple while the freezer units are operating with full loads of fish.

Fish should be positioned straightly on freezer trays. Overlapping of belly flaps will result in damage after freezing is complete.

Fish should not be removed from freezers until the core temperature has been reduced to a maximum of five degrees F, and preferably to zero degrees E. If brine freezers are being used, core temperatures may be slightly higher, provided that the fish are immediately placed in cold storage and held at zero degrees F or below.

The core temperature of fish in storage should remain at zero degrees F or lower.

Fish should be frozen and held at a constant temperature. Temperature fluctuations should be minimal. The temperature of freezers and storage areas should be monitored at regular intervals.

Fish should be glazed as soon as possible after freezing to prevent dehydration and oxidation.

E. Fishing Vessel Sanitation

General Information

Fish stored in an unsanitary hold will be contaminated with bacteria and will have a greatly reduced storage life. Fish slime and blood make excellent food for bacteria and should be removed as soon as possible after fish have been unloaded from the vessel.

Refrigeration systems are easily contaminated because the circulating water includes considerable amounts of slime and blood that can accumulate in the piping, heat exchangers and other equipment. All RSW systems should be designed to permit proper cleaning and sanitizing of the sea water piping and the heat exchangers. Back-flush lines and cleaning loops are recommended.

Cleaning and Sanitation Procedures

The following steps should be followed when cleaning and sanitizing a fishing vessel:

- a) Flush all fish contact surfaces with clean fresh water or clean sea water.
- b) Scrub all fish contact surfaces with a brush or a high pressure washing system, using a detergent solution.
- c) Rinse with cold fresh water or sea water.
- d) Sanitize with a solution containing chlorine or iodine and, e) After five to 10 minutes, rinse off the sanitizing solution.

Wooden boats should not be steam-cleaned. Fatty and proteina-ceous materials (fish slime and gurry) can be forced into the wood, making the job of thorough cleaning almost impossible.

As soon as possible after fish have been removed from an RSW system, the sea water piping and heat exchangers should be cleaned, sanitized and rinsed, using an alkaline solution as the cleaner and iodine as the sanitizer.

Detergents and Sanitizers

The cleaner used should be one suited to removal of fish gurry. Alkaline detergents are best for removal of fat and protein materials. Most common household

detergents are mixtures of alkaline phosphates and a wetting agent, and are suitable for use on a fishing vessel.

A sanitizing agent containing either chlorine or iodine should be used to kill bacteria left after the vessel has been cleaned. Liquid chlorine solutions (five percent hypochlorite) are suitable, provided they have been properly diluted. Use these preparations according to the labeled instructions. An iodine sanitizer can also be used; it is less corrosive to metal parts of the vessel, but costs about twice as much.

Under no circumstances should sanitizers containing phenols (such as Lysol and Pinesol) be used in a fish hold or on fish handling surfaces. Most phenols are insoluble in water and impart strong undesirable odors which may affect fish taste.

Clean water should be used to rinse all fish contact surfaces before and after scrubbing and sanitizing.

Tendering Vessels and Operations

A. Vessel Guidelines

General Information

All tendering vessels should be designed for rapid and efficient handling of fish and ease of cleaning and sanitation. They should be constructed, operated, and maintained so as to prevent contamination and minimize physical damage and deterioration of fish.

All vessels should have a suitable fish holding area for storing the catch, whether it is below or on-deck. Plastic totes with drainage capability are acceptable for use as fish containers when properly sheltered or covered.

Fish holds should have watertight bulkheads designed to protect the fish from contaminants such as bilge water, fuel and lubricants.

Fish holds on dry vessels should have removable floor boards or some other system to facilitate drainage from the hold.

Fish holds should have pumps and sumps with the capability of pumping the hold dry.

Fish holds should be adequately insulated to control the transfer of heat from the engine, living quarters or heated pipes.

Fuel and hydraulic lines running through fish holds should be enclosed to protect the fish in case of line failure, and should be insulated where necessary to prevent heat transfer.

Vessels should have hatch coamings high enough to prevent the flow of contaminants from the deck to the fish holds.

Vessels should be equipped with sufficient hatch covers or suitable covering material to eliminate the exposure of fish to sunlight or airborne contaminants. Hatch covers should be watertight and designed to protect the fish from fresh or salt water intrusion.

All lights in fish handling areas should be shatterproof or have protective coverings which will prevent product contamination should breakage occur.

There should be no exposed ribs or untreated wood on surfaces in the fish hold or in fish handling areas on deck. The hold lining should be smooth and watertight. Holds should have an impermeable lining with rounded corners and no obtrusions, and should be insulated. Hold construction should be conducive to easy and complete cleaning to prevent build-up of bacteria.

On vessels with refrigeration systems, equipment should be in good operational condition and capable of chilling full loads of fish to a range of 30 to 35 F within a reasonable amount of time. Circulation systems should be adequate to ensure an even temperature throughout the hold.

Tanked vessels should be equipped with recording thermometers which accurately measure and record the temperature of the hold. Vessels which do not have tanked holds should be equipped with bi-metal thermometers which accurately measure the internal temperature of the fish.

Vessels with below-deck holds should be equipped with chutes or other devices designed to convey fish into the holds with a minimum of damage.

B. Recommended Operating Procedures Aboard Tenders

General Guidelines

Fish should be handled carefully at all times. This includes, but is not limited to these practices:

a) Do not handle fish by the tail; b) Do not throw, kick or step on fish; c) Protect fish from damage in the shaft alley or any other part of the vessel.

While receiving fish from a fisherman, do not overload equipment.

On vessels with below-deck holds, chutes or other systems should be used to convey fish into the hold. This will reduce handling and prevent damage. Fish should not be dropped into the hold or on hard surfaces such as the deck. If loading into a tanked hold, lower brailers close to the surface of the water in the hold before releasing fish.

Pughs, forks, picks, hooks or pumps which damage fish should not be used. Alaska regulations prohibit the pugging of fish.

Bacterial spoilage may be hastened by piercing fish with picking hooks.

Fish should be protected from heat, sunlight, air-drying and inclement weather.

Fish should be protected from bilge water, gas, diesel oil, hydraulic fluid, grease and other contaminants.

Fish held in bulk on vessels without tanked holds should be shelved at intervals of no more than 35 inches.

On tanked vessels, fish holds should be divided, as necessary, to prevent damage to fish due to the vessel's motion.

No pets should be permitted on vessels used for transporting fish.

The presence of pets aboard fishing vessels and in processing plants is unlawful.

Round and eviscerated fish should be kept apart in the holding area. A separate bin or on-deck totes should be used to store eviscerated fish on vessels carrying both dressed and round fish.

Fish should be chilled and delivered to processing facilities as rapidly as possible.

Pumps, brailers or elevators used for unloading fish should be operated in a manner that minimizes physical damage to fish, and in accordance with the manufacturers instructions. The recommended maximum load per brailer is 800 pounds. Use of small mesh, knotless brailers is recommended.

Tender vessel holds, bin boards and decks should be thoroughly cleaned and sanitized in accordance with the Tendering Vessel Sanitation Procedures described later in these guidelines. The vessel and equipment should be cleaned after every delivery.

Fish Quality Evaluation Procedures

Both the intrinsic and extrinsic quality of all fish should be evaluated as received. Evaluation of general fish condition should be logged if fish are of questionable quality. The evaluation should include, but need not be limited to:

- a) Correct species identification;
- b) External appearance of eyes, gills, scales, and skin;
- c) Odor;
- d) Internal fish temperature; and,
- e) Sexual maturity.

The internal appearance of viscera, kidney and belly walls may also be noted.

Deterioration of quality caused by refrigeration system failure, adverse weather conditions, contamination by bilge water, fuel, lubricants, phenols (Lysol) or other contaminants, or any other adverse conditions, should be documented.

Fish suspected of being unwholesome or contaminated should be segregated from all other fish on the tender, and the condition of the fish noted.

Fish found during evaluation to be unwholesome or contaminated by bilge water, fuel, lubricants, phenols or other undesirable substances should not be accepted by tenders.

C. Chilling and Chilled Storage Aboard Tenders

General Guidelines for Round Fish

All tender operators should use mechanical refrigeration or some other method of chilling fish. Whatever method is used, fish should be chilled as soon as possible after being loaded on the tender.

If ice is used, the fish should be stored in enough finely divided ice to reduce the temperature of the fish to a range of 32 o to 35 o F within a reasonable amount of time and to hold it within that range. Finely divided ice will ensure the greatest surface contact with the fish. All ice used for chilling fish must be made with clean water from an approved source.

If a chilled (CSW) or refrigerated (RSW) sea water system is used, the fish should be maintained at 30 to 35 E All tanks should be prechilled to 30 to 32 F before receiving fish.

All sea water used in CSW and RSW systems should be obtained from open waters, away from populated areas and fresh water sources.

The internal temperatures of iced fish and/or the temperature of the hold on vessels with CSW or RSW systems should be monitored and logged at regular intervals, preferably every six hours. Hold temperatures can be monitored with a recording thermometer. Bi-metal thermometers should be used to measure the internal temperature of the fish. The thermometer should be carefully inserted in the anal vent of the fish until the reading stabilizes, or for approximately one minute.

RSW tenders should limit their loads to a maximum of 45 pounds of fish per cubic foot of hold space.

Additional Guidelines for Dressed (Eviscerated) Fish

Dressed fish should be stored in ice, either in impermeable tubs with drainage capability, or in boxes or small removable bins.

Neither CSW or RSW systems should be used for holding eviscerated fish.

When using ice to chill fish, it should be finely divided and maintain a temperature range of 32 to 35 F.

D. Tendering Vessel Sanitation

General Information

Fish slime and blood make excellent food for bacteria and should be removed as soon as possible after fish have been unloaded from the vessel.

Refrigeration systems are easily contaminated because the circulating water includes considerable amounts of slime and blood that can accumulate in the piping, heat exchangers and other equipment. All RSW systems should be designed to permit proper cleaning and sanitizing of the sea water piping and the heat exchangers. Back-flush lines and cleaning loops are recommended.

Cleaning and Sanitation Procedures

The following steps should be followed when cleaning and sanitizing a tendering vessel:

- a) Flush all fish contact surfaces with clean fresh water or clean sea water;
- b) Scrub all fish contact surfaces with a brush or a high pressure washing system using a detergent solution;

- c) Rinse with cold fresh water or sea water;
- d) Sanitize with a solution containing chlorine or iodine; and,
- e) After five to 10 minutes, rinse off the sanitizing solution.

Wooden boats should not be steam cleaned. Fatty and proteina-ceous materials can be forced into the wood, making the job of thorough cleaning almost impossible.

As soon as possible after fish have been removed from an RSW system, the sea water piping and heat exchangers should be cleaned, sanitized and rinsed, using an alkaline detergent solution followed by a suitable sanitizer.

Detergents and Sanitizers

The cleaning agent used should be one well-suited to removal of fish gurry. Alkaline detergents are best for removal of fat and protein materials such as fish slime. Most common household detergents are mixtures 'of alkaline phosphates and a wetting agent and are suitable for use on a fishing vessel.

A sanitizing agent containing either chlorine or iodine should be used to kill bacteria remaining after the vessel has been cleaned. Liquid chlorine solutions (five percent hypochlorite) are suitable if properly diluted. Prepare 'these solutions according to the directions provided on the label. Iodine sanitizers can also be used. Iodine solutions are less corrosive to metal parts of the vessel, but cost about twice as much as chlorine sanitizers.

Under no circumstances should sanitizers containing phenols (such as Lysol and Pinesol) be used in a fish hold or on fish handling surfaces. Most phenols are insoluble in water and impart strong undesirable odors which may affect fish taste.

Shore-Based and Floating Processing Facilities and Operations

A. Facility and Equipment Guidelines

General Information

All vessels, vehicles and equipment used in the transportation, unloading or processing of fish should be constructed, operated and maintained so as to minimize physical damage to and deterioration of the fish, and prevent contamination of the fish.

Many aspects of fish processing operations, including facility requirements, equipment and utensils, plumbing, sanitary facilities, water supply and ice, thermal

processing and waste disposal are regulated by the Alaska Department of Environmental Conservation and the US Food and Drug Administration. The guidelines and procedures outlined in this section are intended to be complementary to applicable state and federal regulations and should not, in any way, be construed as replacing or conflicting with such regulations.

All aspects of salmon canning in Alaska should meet the requirements of the current Canned Salmon Control Plan, a voluntary cooperative agreement between the canned salmon industry, the National Food Processors Association and the US Food and Drug Administration.

General Guidelines

The facility should be large enough to accommodate processing operations without interfering with proper sanitary practices. Floors, walls and ceilings should be constructed of materials that can be kept clean, sanitary and in good repair.

Each room should have natural or artificial lighting that is adequate for the operations to be conducted there, and to provide adequate visibility for cleaning and sanitary inspection.

All lights must be shatterproof or have a protective covering which will prevent product contamination should breakage occur.

Ventilation should be sufficient to prevent mold growth, objectionable odors or the accumulation of excessive condensates.

Toilet facilities should be totally enclosed, well-lighted, and ventilated to the outside. They should be adequately screened and equipped with self-closing doors. Facilities should be adequate, operational and in compliance with local and state codes.

Adequate handwashing facilities should be provided, and should be equipped with soap, running water at suitable temperature(s) and drying facilities. Directions should be posted which instruct employees to wash hands thoroughly before reentering the processing area. Where practicable, portable hand dips containing a sanitizing solution should be provided and employees instructed in their use.

Equipment which comes in contact with butchered fish should be constructed of smooth, non-toxic, corrosion-resistant metal or other nonabsorbent material capable of being sanitized, or should be covered by another material with equivalent characteristics and which does not contaminate the fish.

Where applicable, grounds surrounding the plant that are under the control of the operator should be free from conditions incompatible with sanitary food manufacturing, processing, packing or holding operations. Such conditions include,

but are not limited to: litter, refuse, tall weeds or inadequately drained areas that could contribute to contamination of food products by providing a place for insects, rodents or microorganisms to generate.

All outside conveyors and flumes for transporting round fish should be protected so as to prevent fecal contamination by birds and other animals.

Outside holding bins and outside conveyors used to transport butchered fish should be protected so as to prevent fecal or other contamination by birds, insects or other animals and contamination by airborne dust and dirt.

Cloth should not be used at water outlets or on sliming tables.

Water Supplies

The natural water supply intake should be located so as to avoid pollution from shore facilities, marine vessels or processing residuals.

There should be no cross-connections between potable and nonpotable water. For example, a cross-connection can occur when the end of a potable water hose is placed below the surface level in a wash tank full of water, and a cross-connection occurs when a potable water service pipe is directly connected to prime a nonpotable water pump. Cross-connections may occur under other circumstances, and care should be taken to avoid creating circumstances where cross-connections are possible.

Natural water which comes in contact with fish being processed should be sanitized unless the water source is currently approved by a federal state or local agency.

Natural water may be used for unloading, fluming or refrigerated holding of round fish only if:

- a) It has been effectively sanitized;
- b) It has been approved by a federal, state or local agency; or,
- c) If the fish are rinsed with effectively sanitized water before entering storage bins and/or tanks.

Ice should be made from clean water from an approved source. It should be manufactured, handled, stored and used in a sanitary manner. It should not be reused.

B. Recommended Operating Procedures for all Shore-based and Floating Processors

Employee Education

All processing workers should be instructed as to the need to handle fish with care at all times. This includes, but is not limited to:

- a) Handling fish gently;
- b) Not handling fish by the tail;
- c) Not throwing, stepping on, or in any way abusing fish; and,
- d) Not handling fish carelessly.

Throwing and stepping on fish reduces fish quality.

Unloading Fish

Unloading of fish from tenders or fishing vessels should be accomplished with as little delay as possible, while taking care to avoid damaging the fish. Mechanical unloading equipment such as properly designed conveyors, fish pumps or other similar equipment should be used if possible.

All pumps, including the suction end, tubing and discharge end, should be designed and operated so as to avoid physical damage to the fish. The discharge end of wet and dry pumps should deliver fish to containers, bins or conveyors without causing the fish to drop excessive distances. All pumps should be cleaned and sanitized daily.

The recommended maximum individual brailer- or tote-load is 800 pounds.

Elevator buckets and drive mechanisms should be maintained and operated so as to avoid physical damage to the fish. They should be cleaned after every delivery.

Fish should not be allowed to drop excessive distances upon being discharged from a flume, conveyor belt or other transport system, or after being handled on sorting tables. Equipment used in transport and sorting should be cleaned and sanitized at least once a day.

Wagons, totes and bins should be designed and operated so as to facilitate drainage, and should be cleaned and sanitized at least once a day.

Fish Evaluation Procedures at the Processing Facility

Both the intrinsic and extrinsic quality of all fish should be evaluated as the fish is received at the processing plant.

Fish should be evaluated by experienced personnel familiar with regulatory agency requirements, species and company grade specifications.

Fish should be evaluated according to each company's individual grade standards using the general criteria described later in these guidelines.

Any fish which are unwholesome (i.e., do not meet minimum standards for human consumption as established by the US Food and Drug Administration) must be disposed of in an approved manner.

Fish of differing quality should be separated, identified and clearly labeled during all phases of processing operations.

General Guidelines for All Processing Operations

All fish should be kept iced and/or refrigerated before and during processing operations. If ice is used, the fish should be stored in a sufficient amount of finely divided ice to reduce and hold the temperature of the fish within a range of 32 to 35 E If a mechanical refrigeration system is used, the fish should be maintained at 30 to 35 E All mechanically chilled holding tanks should be prechilled to 30 to 32 o F before receiving fish.

Raw fish should be stacked or stored no more than 35 inches deep in clean, well-maintained containers before and during processing operations. It may be necessary to exceed this depth in holding bins.

Any salmon that accidentally fall on the floor immediately should be picked up by the head and nape, and thoroughly rinsed before further processing.

Only authorized persons should be allowed in processing areas. Effective measures should be taken to exclude pests and pets from processing areas and to protect against contamination of fish in or on the premises by all animals, including but not limited to dogs, cats, birds, rodents and insects.

Cutting boards used at butchering or sliming tables should not be made of wood or other porous material. Boards should be sanitized daily and replaced or reconditioned annually (more often if necessary) to remove gouged or otherwise worn surfaces.

All utensils and surfaces which come in contact with fish should be cleaned as frequently as necessary to prevent contamina- tion of the fish. The surfaces of equipment which does not come in contact with fish during processing operations

should be cleaned as frequently as necessary to minimize the accumulation of dust, dirt, food particles and other debris.

The exterior of fresh fish should be washed and rinsed with clean, chlorinated water prior to evisceration, and the fish should be washed both externally and internally after evisceration.

Each facility should have a written cleaning program which includes the use of appropriate detergents and bactericides. The program should provide for intermediate clean-up, sanitizing of equipment at the end of each processing day, and a washdown of equipment each day prior to processing. Plant personnel should be familiarized with these procedures. (Refer to later sections of this publication for a complete description of processing facility sanitation procedures.)

C. Recommended Operating Procedures for Freezing Plants

Freezing Operations

Freezing and frozen storage cannot improve the quality of fish, but it can maintain fish quality at much the same level as it was prior to freezing. Fish should be frozen as soon after harvest as possible and before quality begins to deteriorate.

Fish should be clean, correctly identified, gently laid straight on clean freezer trays or racks, and promptly sharp frozen. Quick freezing rates must be maintained to prevent protein denaturation and tissue damage. Operators should be aware of the factors which affect freezing times, which include:

- a) Freezer type;
- b) Operating temperatures;
- c) Product type;
- d) Product temperatures;
- e) Product thickness; and,
- f) Contact between the product and the freezing surface.

Fish should not be removed from freezers until the core temperature of the fish has been reduced to five degrees F or lower. Core temperatures may be higher if brine or vertical block freezers are utilized.

After freezing, fish should be gently removed from freezer trays or racks and immediately glazed or shrink-wrapped and/or packaged to prevent dehydration and oxidation.

Glazing Operations

Glazing protects fish from quality loss due to dehydration and oxidation. When the product is in frozen storage, sublimation of the glaze will occur, rather than the sublimation of water from the frozen tissue.

Glaze water should be chilled.

The fish should be completely submerged in glaze water, or sufficiently sprayed so as to provide equal coverage of the fish surface.

Glaze water may contain approved additives and should be changed frequently to prevent microbial build-up.

The glaze should be renewed as necessary during cold storage at the facility.

Frozen products which have been glazed should be handled carefully. If the glaze cracks, or a portion of this protective covering is lost, the fish will be susceptible to quality loss.

Cracked or missing glaze exposes frozen fish to dehydration and oxidation.

Cold Storage Operations

Frozen fish should be stored at zero degrees F or lower, with minimal temperature fluctuations.

Sufficient space should be provided in cold storage rooms to allow adequate circulation of cool air: above, below and around all containers.

While in control of the processor, owner or bonded warehouse, frozen fish glaze and/or packaging should be checked periodically and replaced as necessary.

D. Fish Quality Evaluation Criteria

Quality Evaluation Criteria for Fresh Fish

All salmon, while fresh, should exhibit the following characteristics prior to processing in order to be categorized as No. 1:

- a) Eyes should be normal in appearance; b) Gills should be normal in appearance and should smell sea-fresh (practically odorless);
- c) Skin should be shiny, and wrinkles should not remain when fish is bent slightly. Methods of catch may mark the skin;
- d) Skin color should be characteristic of fresh fish of the same species, stage of sexual maturity, place of harvest (fishing district), and approximate date of capture;
- e) Viscera and eggs should be acceptably colored, intact and smell sea-fresh (practically odorless);
- f) Interior walls of the belly cavity may have only minimal appearance of tissue breakdown due to enzymatic action or careless handling. Slight breaks (less than one inch) or slight reddening (blushing) of the flesh are permitted in the No. 1 grade;
- g) Flesh should be resilient when subjected to finger pressure;
- h) Flesh color should be characteristic of fresh fish of the species, harvest location (fishing district) and approximate date of capture
- i) Physical shape should be characteristic of the species and stage of sexual maturity; j) Scale adherence should be reasonably uniform; some scale loss due to the method of catch and subsequent handling procedures is to be expected, but fish displaying substantial scale loss should be carefully examined, as such losses may indicate poor handling practices; and,
- k) Odor should be sea-fresh (almost no odor) and be characteristic of the species. There should be no odor indicating decomposition or contamination.

These evaluation criteria are excerpted from the Alaska Seafood Marketing Institute's Premium Quality Specifications for Fresh and Frozen Pacific Salmon. Copies of the specifications are available from ASMI.

E. Processing Facility Sanitation

General Information

A suitable periodic cleaning schedule should be established for each plant, and should conform, where applicable, with state and federal regulations.

A chlorinated alkaline detergent should be used where needed to clean protein material (fish slime and blood) from fish contact surfaces.

Either gaseous chlorine or a hypochlorite compound can be used as a sanitizing agent (see below).

Under no circumstances should sanitizers containing phenols, such as Lysol or Pinesol, be used in a fish hold or on fish handling surfaces.

Detergents and Sanitizers

Different types of detergents or cleaning compounds are designed specifically for different types of soil and cleaning problems. Alkaline detergents (with a pH greater than seven) are best suited for the removal of fats and proteins, while acid cleaners (with a pH under seven) are best for removing mineral deposits. Chlorinated alkaline detergents are most effective for the removal of proteins which accumulate as a result of fish gurry.

The three most common types of sanitizing agents used in commercial sanitizers are chlorine, iodine and phenols. Sanitizers which contain phenols such as Lysol, Pinesol, creosol or hexachlorophene must not be used in areas where food or materials, including packaging materials, are handled or stored. Fish, ingredients and packaging will readily absorb the flavor and odor of phenols, rendering the exposed products unfit for human consumption, and unmarketable.

Chlorine is available in two basic forms, gaseous chlorine and hypochlorite compounds. Hypochlorite compounds are available in liquid, powder, granular and pellet forms. The free chlorine content of these products ranges from four to 70 percent.

Chlorine is a very effective sanitizer if used properly. The most common misuse of chlorine occurs when solutions are improperly diluted. Chlorine is very effective in solutions with a low pH (eight or below), but the effect of the chlorine diminishes as the pH rises. Solutions of 25 to 100 parts per million (.0025 to .01 percent) are most effective when using hypochlorite for sanitizing. The old adage "If a little is good, more is better," is not true when using hypochlorite solutions because as the solution becomes more concentrated, its pH rises, lowering the effectiveness of the chlorine. To avoid this problem all sanitizers should be used in accordance with labeled instructions.

Gaseous chlorine is recommended as the most economical (on a long- term basis) and most effective type of chlorine to use in fish processing plants.

Iodine is an effective sanitizer, but is more expensive to use than chlorine. Use of iodine is recommended when the corrosive effects of chlorine may damage or reduce the life of equipment such as RSW systems, heat exchangers, etc.

All processors must use US Department of Agriculture (USDA)- approved detergents and sanitizers as listed in USDA Miscellaneous Publication Number 1419, List of Proprietary Substances and Nonfood Compounds Authorized for Use Under USDA Inspection and Grading Programs.

Recommended References

State and Federal Regulations:

1. Title 21 - Food and Drugs, Part 110, Current Good Manufacturing Practice (Sanitation) in the Manufacturing, Processing, Packing or Holding of Human Food, US Food and Drug Administration, effective May 26, 1969, rectified March 15, 1977.
2. Fish Inspection Regulations, Title 18 AAC, Chapter 34, State of Alaska, Department of Environmental Conservation, 1984.

General Reference:

1. John P. Doyle, "Net-Caught Salmon -- Handle with Care," Alaska Seas and Coasts, Volume 6, Number 3 (June, 1978).
2. Donald E. Kramer, "Chilled and Refrigerated Sea Water -- Easier and Faster Cooling of Fish," Alaska Seas and Coasts, Volume 8, Number 4 (October-November, 1980).
3. Edward Kolbe, Onboard Freezing Systems: Some Options for the Small Vessel, (Oregon State University Extension Marine Advisory Program, Publication SG 67, July, 1969).
4. S.W. Roach, Operating Instructions for RSW Systems on B.C. Salmon Packers, (Fisheries Research Board of Canada, Vancouver Laboratory, 1973).
5. Recommended International Code of Practice for Fresh Fish, (FAO/ WHO Codex Alimentarius Commission, 1976).
6. Code of Practice for Frozen Fish, CX/FFP 77/15 (FAO Fish. Circ. C145, Rev. 1).
7. Recommended International Standard for Canned Pacific Salmon, (FAO/WHO Codex Alimentarius Commission, 1969).
8. John P. Doyle, Fishplant Sanitation and Cleaning Procedures, (University of Alaska, Marine Advisory Bulletin No. 1, 1970).
9. Jong S. Lee, Cleaning and Sanitizing Agents for Seafood Processing Plants, (Oregon State University, Extension Marine Advisory Program, Publication SG 21, 1973).

10. Fish Handling at Sea, (Sitka Sound Seafood, April, 1985).
11. Premium Quality Specifications for Fresh and Frozen Pacific Salmon, (Alaska Seafood Marketing Institute, 1985).
12. 1985 Canned Salmon Control Plan: A Voluntaryd Cooperative Agreement Between Participating Salmon Packers, the National Food Processors Association and the Federal Food and Drug Administration, (1985).
13. Commercial Salmon Fleet Quality Study, (Alaska Seafood Marketing Institute, 1984).