OPERATIONS INVOLVED IN CANNING

The canning of fishery products may be divided into a number of definite steps applying equally well to all types, although details of methods and processes vary with the individual product. To discuss points of importance in certain operations common to all canning procedures in the description of individual products would cause duplication, or the information would be presented in disjointed fragments whereby most of its value would be lost. Therefore, a general discussion of the steps in canning follows.

SECURING THE RAW MATERIAL

The quality of the product and the price range at which it is to be sold usually determines the choice of fishing gear and the method of fishing. For instance, tonging could hardly be used extensively in obtaining oysters for canning. It would be too slow for mass production or would require the efforts of so many men that production costs would be raised so that canned oysters could not be packed at a price the consumer could afford. Since the oyster tonger can operate only in the shallower waters, this method would also limit the catch by restricting the fishing area.

The pack of canned shrimp has been increased and the price reduced largely because it has been found possible to procure a larger supply at less cost by adopting nets of the otter-trawl type, instead of the haul seine formerly used. The trawl nets have been found to be more efficient since they can be operated at depths and in areas previously unfished, and can also be operated more cheaply.

NOTE.—[FL-79. This section is reprinted from Research Report 7, Fish and Wildlife Service, U. S. Department of the Interior, 1944. The complete report (366 pp.) on commercial canning of fishery products is obtainable from the Superintendent of Documents, Washington 25, D. C. Price $1.00 a copy].

Raw material taken from the same area by different types of gear may differ in quality when landed at the cannery. Fish taken by gill nets are "drowned" and always receive more handling than fish taken by other types of gear such as the trap, which means that decomposition is accelerated and the length of time the raw material will remain in good condition is reduced. Therefore gill nets are suitable for use only where the fishing grounds are in close proximity to the cannery and transportation facilities permit frequent pick-ups from the fishermen and prompt delivery at the cannery.

In canning salmon, the trap or pound net is considered the best type of gear since this apparatus is the most efficient where its use is practicable or permissible. It is also easier to control the flow of raw material which is usually of better quality when it reaches the plant because the fish may be held alive until needed. The fish are not handled so much and fewer water-marked salmon, fish closely approaching the spawning stage, are taken.

As a rule, the method which supplies the largest amount of good-quality raw material most cheaply should decide the type of gear to be used. The most efficient apparatus cannot always be adopted; sometimes it is too efficient and causes depletion of the fishing grounds and therefore may be prohibited by law or regulation. Finally, due to political considerations, the use of certain types of gear has been forbidden in some States.

In some areas the cannery owns the fishing craft, and the men who operate the gear are paid a fixed monthly or daily wage. On other fishing grounds the cannery supplies the equipment, contracting to purchase the catch on a poundage basis. In still other instances the fishermen may own boats and gear, selling the catch to the cannery operator according to a scale of prices previously arranged by contract. In some cases the catch may be sold on the open market to the highest bidder.

Open-market purchase is not practicable for the majority of packers and is only economical when the fresh market is in a depressed condition. The packer should have a steady supply of raw material and should be able to estimate his packing costs accurately, especially if the pack has been sold under contract previous to manufacture as is often the case. As a rule the packer cannot risk depending on fluctuating market prices or on securing a steady and adequate supply of raw material on the open market.

It is also to the advantage of the fisherman, equally with the packer, to have a steady market for his catch at a definite price. Costs of operation, especially of boats and gear, are high. This is one reason why many fishermen do not operate their own gear. The fisherman may "catch the top of the market," but too often

he finds the price that he obtains at open sale leaves him no return for his efforts.

Canners of fishery products, especially those operating on a small scale, often find it more desirable to lease rather than to purchase fishing craft and apparatus at least for the first few seasons of operation. Where the canning season is short and it is difficult if not impossible to turn boat and outfit to other fisheries for the balance of the year the fisherman probably should not attempt to operate his own outfit.

TRANSPORTING AND RECEIVING

All raw material in any one lot should be equally fresh on receipt from the fisherman. Sometimes when fishing is poor the fisherman is apt to delay delivery, hoping to secure a better boat load. Unless it is possible to enforce regular deliveries there is considerable variation in the freshness of the material.

Since fishery products spoil quickly, the time elapsing between the time of catch and that of receipt at the cannery should be as short as possible. It is not possible to set a certain specified time for this period; it is affected by many variables such as temperature and humidity. For example, in Alaska, salmon will usually remain in good condition for canning for 48 hours, but during certain seasons some fish or portions thereof will show an appreciable degree of staleness after 12 hours.

If fish or crustaceans are piled to any great depth in the hold of a vessel, pressure will cause overheating which rapidly advances the rate of deterioration. Heavy pressure also contributes to softening the texture of the lowest layer, mechanically tearing and bruising the flesh, and increasing contamination due to the greater amount of slime dripping down from the excessive upper layers.

Raw material is sometimes transported in boxes holding about 500 pounds, net weight. These boxes may be piled to any depth since the pressure is divided and no individual fish is subjected to a heavier pressure than the weight of the other fish in that particular box. The holds may also be divided into pens, which are capable of further subdivision by removable floors at different levels.

The raw material should be handled as little as possible and any carelessness in handling should be penalized. "Forking" or "peughing" should be forbidden absolutely or restricted only to the head of the fish. Peugh holes in the body not only provide an easy entrance for spoilage organisms, thus hastening deterioration, but also cause dark discolored streaks in the flesh which are often visible in the canned product. Trampling upon, throwing or bruising the cargo not only lowers the quality of the raw material but often makes it unusable in products of any grade.

GRADING

The raw material should be graded and sorted into different bins on arrival at the packing plant. A standardized system of grading has not been developed in the preparation of any canned fishery product but a number of methods are in use varying according to locality, experience of the packer and the product. In general, grading is dependent on freshness, size and species of fish and color of the flesh. Careful grading is essential to the preparation of a high quality canned product.

The condition of the fish on arrival may be determined by a number of factors. Odor is important in judging freshness, but the sense of smell varies with the individual. While some are hyper–sensitive, others cannot recognize the difference between fresh and slightly stale fish. The ability to judge by odor also seems to vary with the health of the individual and is affected by smoking and drinking.

A rapid determination of freshness may best be made by judging firmness, appearance of the gills, eyes, and the flesh of the belly cavity near the backbone. The flesh of fresh fish is firm and resilient, so that when pressed with a thumb in the thick portion of the back, the impression will gradually disappear when the thumb is removed. If fish are fresh the gills will be clear pink to deep red in color, firm, free from slime, and with an odor which may best be described as a "salt water odor," rather agreeable and free from any suggestion of taint. The eyes of fresh fish are bright, clear and protuberant. The flesh near the belly cavity around the backbone, should be free from discoloration and may be stripped away from the backbone only with difficulty, leaving many shreds clinging to the bone.

When deterioration sets in, the flesh becomes soft and flabby in texture, and the impression will remain if a thumb or finger is pressed into the thick back flesh. The gills acquire a faded brown color, which may become gray or grayish–green in a rotten fish, and are covered with a thick lumpy slime. The odor of the gills is rank and unpleasant if the fish is stale, changing to a characteristic tainted or putrid odor as decomposition continues. The eyes are dull, opaque, sunken and often bloodshot. The flesh around the backbone shows a dull red discoloration and may be stripped away easily and cleanly.

In some packs such as shrimp and sardines, size is an important factor in grading. Carelessness in sorting to size will result in poor appearance and may cause difficulties in filling.

A catch may include several species. A single delivery of salmon may include five, some of which are more highly regarded than

others though all are about equal in food value. If carelessly graded according to variety the contents of a can may be composed of pieces from two species of noticeably different appearance.

The color of the flesh is of importance in the production of several fishery products. In the Columbia River chinook salmon there is variation of color within the species and fish of several shades may be taken in the same delivery. The deeper shades of color are considered more desirable, so separation according to shade is necessary in the production of a "fancy" pack. Variation in color also occurs in some species of clams but in this instance the lighter color is preferred for "high quality" packs, especially of minced clams. Mixing of grades operates principally to the loss of the packer since such products are sold at the price of the lower grade.

DRESSING AND WASHING

Dressing and washing is the first step in the actual process of manufacturing the canned product and consists of removing viscera and other waste material, and of freeing the raw material from blood, slime or dirt by the use of generous quantities of water. Dressing or cleaning must be carefully and closely supervised at all times in order to prevent needless loss of edible material which is sometimes sufficient to destroy the margin of profit. Careless cleaning may also result in the inclusion of waste in the canned product. This is considered as adulteration by the U.S. Food and Drug Administration.

Washing may be of three general types, soaking or tank washing, washing by agitation, and spray washing. Tank washing may act as a source of contamination rather than a means of cleansing unless the water is changed frequently. Soaking or tank washing is effective in removing blood but softens texture if the fish are left too long in the tank, unless a salt brine is used. Oversoaking in salt may toughen the texture or make the canned product unpalatable.

Agitation increases the efficiency of washing. The earliest development of this type of washer in fisheries is the wooden flume conveyor in which the fish are carried from the cleaning and trimming section to the pre-cooking or preparation stage by a current of rapidly running water. Another simple type of agitating washer is the tank equipped with a propeller. Unless the propeller is guarded by a heavily screened cage or is geared to move slowly it may bruise the fish. Compressed air is sometimes used to agitate water as in the oyster shucking "blower" which is probably the most efficient type of agitating washer.

The drum or squirrel-cage washer is also used widely in the canning of fishery products. It consists of a drum of heavy small mesh wire screen with a central axle and equipped with longitudinal baffles of angle iron at intervals around the inner circumference. The drum revolves in a tank of water. This type is used in washing herring, Maine sardines and shrimp. Comparatively few fish are bruised, it requires little water and also acts as a scaler.

Washing fish mechanically by means of strong jets or sprays of water has increased in fish canning establishments during the past few years, and should be used even more extensively being more efficient and economical. Spray washing methods depend on pressure of water rather than volume. A combination of a spray wash with the revolving drum has been found satisfactory in washing some types of fish which must also be scaled.

PREPARATION FOR THE CAN

Some articles such as salmon and shad are simply cut into container-length pieces after washing and undergo no other preparatory treatment. Other packs, such as tuna and sardines, undergo several additional steps.

Close control of precooking, mixing, grinding and other preparatory steps is essential. For example, in steaming oysters to open the shells an excess shrinkage of several ounces in the bushel occurs if either the time or temperature exceed the normal requirements. This loss can and should be avoided.

Preparation should be continuous with the remaining steps in canning and delays should be avoided as far as possible. In some canneries material is prepared before it is required and held for several hours in order that the plant may go into full operation in the minimum length of time. In warm weather a very brief delay is sufficient for spoilage to set in and an appreciable amount of deterioration may occur which is not visible to the naked eye.

FILLING

Filling may be accomplished either by hand or by machine. Filling machines have been greatly improved in recent years but are not yet adapted for use with odd sized containers or products requiring careful handling. The principle of the filling machine is to deliver a certain volume rather than a definite weight of material. There is, however, little variation in the weight filled into individual containers. The principal objection to machine filling is that it is not always done as neatly as is desirable; for instance, salmon may occasionally be cross-packed and will not have the appearance of a smooth cylinder when removed from the container. When good workmanship in packing is desired, hand filling should be used, but it is slower and more costly.

In filling, a headspace of about 1/8 to 3/16 inch should be allowed in the top of the can in order that a proper vacuum may be obtained. The tendency is to over-fill rather than under-fill a container. Canned fishery products usually weigh somewhat more than the amount stated on the label as the packer does not wish to be penalized for packing an under-weight product. Studies indicate that while the excess weight per container given away by the packer may be only an ounce or even less, the total amount lost in a season's production is considerable (Clark, Clough, and Shostrom, 1923; Sieverling, 1937). Careful control of filling will reduce this source of loss. Accurate scales or weighing machines are an economy in filling.

Filling should be carefully supervised for other reasons. Foreign objects may get into the containers at this time, through carelessness or deliberate sabotage. A nail or other fragment of metal may have been left in a can previous to filling; a portion of a cotton glove may be drawn into a can during the filling process or trays of filled cans may be left unscreened and exposed, with the result that a fly may be included in the product. These objects have all been found in containers. Even where damages are not awarded, legal costs are expensive and each instance means a loss of sales through newspaper publicity. Cans should be absolutely clean when they reach the filler while the filling area should be screened and protected against flies or similar sources of contamination.

EXHAUST OR VACUUM AND SEALING

Sufficient exhaust or vacuum may be obtained by (1) filling a hot precooked product into the container and sealing immediately, (2) by heating after the product has been packed into the container and (3) by mechanical means. The choice of method will depend on the product, space available in the cannery and scale of production.

Products such as soups and chowders are precooked, filled into the container while hot and sealed immediately. Others, such as fish roe, are "exhausted" by passing the container through a steam heated exhaust box. A mechanical apparatus (vacuum-sealing machine) which combines the functions of exhausting and sealing is used in most salmon canneries and is especially suitable when space is at a premium as on floating canneries. Vacuum-sealing machines have not yet proved to be economical for small scale operation as in the packing of specialty articles but they are being improved, and their use may soon extend even to small scale operations. The older system of using a heat exhaust to obtain a partial vacuum, sealing the cans in a second operation, has not been entirely displaced, but is apparently fast becoming obsolete.

"PROCESSING", "COOKING" OR "STERILIZING"

A few years ago little skill was required of the man responsible for processing and great latitude was allowed in the operation of the equipment. The processing equipment was comparatively simple and errors due both to faulty equipment and to the human factor were more frequent than they are now. Fish products were too often regarded as "fool–proof." Accurate and detailed processing records were not kept in many instances. As a result the quality of the pack was not uniform and spoilage occurred directly traceable to preventable faulty processing.

It is difficult, if not impossible to eliminate faulty processing and insure against human error if sterilizing equipment is operated manually, with a pressure gauge and indicating mercury thermometer too often untested for accuracy as the only control devices. Retorts should be fitted with at least the following equipment: (1) An automatic control for regulating temperatures. (2) An indicating mercury thermometer of a range from 170 to 270° F., with scale divisions not greater than 2° F. (3) A recording thermometer of a range from 170 to 270° F., with scale divisions not greater than 2° F. (4) A pressure gauge of a range from 0 to 30 pounds with scale divisions not greater than 1 pound. (5) A blow–off vent of at least ¾ inch inside diameter in the top of the retort. (6) Bleeders not less than ⅛ inch diameter. (7) Adequately perforated steam inlet pipe running through the length of the retort. (8) A drainage valve.[5]

Indicating mercury and recording chart thermometers must be installed either within a fitting attached to the shell of the retort, or within the door or shell. If the thermometer is installed within a fitting, the fitting should communicate with the chamber of the retort through an opening at least 1 inch diameter and should be equipped with a bleeder at least ⅛ inch, inside diameter. If the thermometer is installed within the door or shell of the retort, the bulb must project at least two thirds of its length into the principal chamber. The pressure gauge is connected to the chamber of the retort by a short gooseneck tube. The gauge must not be more than 4 inches higher than the gooseneck. The bleeders should be spaced not over 1 foot from each end of the retort and not more than 8 feet apart.

Processing times listed in canning literature do not include the entire period from the time the product is placed in the retort until it is removed but only the length of time after the retort has reached the required temperature and until steam is shut off. The

[5] 1936. Proposed regulations for inspection of canned salmon under section 10-A of the federal food and drug act. Food and Drug Administration, U. S. Dept. of Agric., Washington.

time required for bringing the retort up to processing temperature and for reducing pressure to atmospheric level are in addition to the processing period and it is important that sufficient time should be allowed for each of these steps. If properly processed the product should be neither overcooked nor should it have an "understerilized" flavor, while the texture should be reasonably firm yet not stringy or woody.

COOLING AND WASHING

Since a sudden release of pressure after processing causes severe strains on tin containers, which may result in leakage and spoilage, the pressure should be reduced slowly and gradually. From 5 to 10 minutes should be allowed to bring the retort pressure to atmospheric level and before opening the retort doors. Water cooling in the retort will also cause buckling and distortion, especially of larger sized containers, unless the water is admitted from below. The water should be admitted slowly at first and under air pressure sufficient to maintain a pressure in the retort equal to the steam pressure required for processing.

Most canneries packing fishery products still cool and clean the cans after leaving the retort. The pack should be cooled as rapidly as possible. If cooling is unduly prolonged, especially by stacking cans very shortly after removal from the retort the product will be darkened in color and overcooked in flavor. The necessity for cleaning the cans after processing has been reduced but not entirely eliminated by the general use of can-washing devices previous to processing.

CODING

It should be possible to identify any container as to species, grade, date and place of pack and in some instances the origin of the raw material, or method of catch. This may be accomplished by "coding" or marking by a system of numerals, letters or special symbols, using a simple, carefully worked out system with a minimum of characters. In canning fishery products the codes are marked on the containers by stamping the cover with a die usually operated as an attachment of the closing machine.

As far as possible code lots should be segregated in the warehouse both before and after casing. The cases should also bear the code mark, placed so that it may be readily observed in handling the product. Some packers regard coding merely as a means of avoiding seizure or condemnation of large parcels made up of several code lots when inferiority or spoilage may be confined to a minor fraction. However, the most important function of coding is to enable the packer and distributor to better determine the

grade of the product, and to improve the quality by correcting faults in workmanship and packing.

LACQUERING

For a great many years nearly all cans of fishery products were coated with an asphalt–base brown lacquer as a rust preventative. Cobb (1919) stated that this practice originated through demands of English buyers who constituted the principal market for canned fishery products in the earlier days of the industry. Little attention was paid to conditions of storage at that time. Ship holds were damp and on long voyages there was much variation in temperature and humidity so that cans were often heavily rusted on arrival at destination. Only a minor portion of the pack is lacquered at present, usually for special orders, since it has been found that a well labeled can with enameled ends, has sufficient protection against rusting, under proper conditions of storage and shipment.

WAREHOUSING

Changes in buying methods during recent years have increased the importance to the packer of proper warehousing. The tendency of the distributor and retail trader is to buy for immediate needs only, forcing the packer to warehouse a greater portion of his pack over a longer period of time. The external appearance of the containers deteriorates unless the pack is well housed. Many consumers will not buy cans with stained or rust spotted can surface or label, therefore, a bright attractive appearance of label and can is an important factor in the sale of the product.

The prime essentials for a warehouse are that construction must be of a strength calculated to withstand strains in excess of any loads it may be expected to bear; that it be dry, well lighted and reasonably cool. Canned fishery products will resist a fair degree of heat or cold for short periods, without serious injury, but continued heat or repeated alternate freezing and thawing are injurious to quality. The product becomes flabby in texture and loses its flavor. Chemical changes double in activity with each increase of 18° F. in temperature. Storage in a warm moist place promotes rapid deterioration.

Canned fishery products deteriorate very slowly if well stored. Samples of canned fish ranging from 5 to 12 years old have been examined and were found to be still of satisfactory quality. Most canned fishery products require a few months storage before distribution, as salt and other ingredients are absorbed gradually and therefore the flavor may be uneven and judged unfairly if the

goods are consumed shortly after packing. The "ripening" of sardines is an illustration in point.

However the packer cannot afford to hold his pack in storage over a long period. Goods in storage represent unproductive capital on which interest must be paid, and warehouse charges must be added to the cost of the product. Packs held longer than a few months are often subject to several forms of taxation which might otherwise be avoided.

LABELING

The product may be labeled and packed in cases for shipment immediately on cooling or it may be stacked for labeling and casing later. A portion of the pack may be cased unlabeled for the buyer using his own label. The packer should guard against labeling and casing too soon after packing because labels do not adhere well if applied while containers are still slightly warm and fiber cases insulate the cans unduly prolonging the cooling process.

Hand labeling, except in the case of oval cans and other odd shaped containers has been largely replaced by automatic machines of light construction and simple operation which may be easily transferred from one point to another in the warehouse as needed. A workman places the cans on a conveyor and they roll through the machine by gravity. The cans travel over small rollers which apply a small amount of adhesive, either glue, a casein preparation, dextrine mucilage or other type of label paste. They then roll across a stack of labels, one of which is picked up by the adhesive on the can and is fixed in place automatically by the machine. Finally, adhesive is applied automatically to the end of the label which is then sealed to the can (Cruess, 1938).

The value of a well-designed label and a well known brand is undoubtedly very great. The design should be simple and clear, the brand name easily remembered and pronounced, for customers will not remember or call for a name of difficult pronunciation. Consumers cannot read the label and depend on the picture in a number of markets in the South, or in foreign sections of cities in the United States and in certain export markets. If the picture is misconstrued the sale of the product may be adversely affected. Canned fishery products have been refused in some markets because they showed a fish with the tail not curved upward and the retail buyers therefore claimed that the fish was not fresh when packed. In one instance a good sized shipment of salmon sent to the oriental market had to be relabeled because it bore a picture which led the buyers to believe that the cans contained cat meat.

Brand names are protected by law under the "Trade Mark" Act. For a small fee the records of the U.S. Patent Office at Washing-

ton, D. C., may be searched to determine if a name or brand is registered. Attempts have been made to imitate distinctive designs in order to promote an unknown brand. In other instances the design has led the customer to believe that he was purchasing one species when the container held an entirely different variety. Such labels do the packer more harm than good since the products acquire the reputation of being second-grade imitations.

The label must comply with the regulations of the U.S. Food and Drug Administration. It must bear the net weight of the contents, conspicuously placed, the name of the article, the packers' or distributors' name and address, and the grade. The use of labels which lead the buyer to believe that the species is superior to that contained, or are otherwise deceptive as to quality, is considered as misbranding, when grade is determined by species. The Food and Drug Administration does not approve labels but will advise packers as to labeling regulations with which they must comply. There is one exception to this rule; it must approve all labels under which inspected shrimp are packed.

A digest of the procedures for canning fishery products of various kinds is presented in table 9.

TABLE 9.—*Canning of fishery products, procedures and packing data, condensed*

Product	Season	Cleaning loss	Pre-treatment	Blanch or precook	Total loss	Exhaust	Closing temperature
		Percent			*Percent*		*Deg. F.*
Salmon:							
Chinook	Varies from year to year according to necessity for conservation of supply. See fishery regulations for Alaska, British Columbia, Washington and Oregon. In general, June through September.	30	Wash and cut in container length pieces.	None	30	Vac. seal	Room temp. (60-70)
Red		33	do	do	33	do	do
Coho		33	do	do	33	do	do
Pink		35	do	do	35	do	do
Chum		33	do	do	33	do	do
Sardines:							
California	Northern dist. Aug. 1 to Feb. 15. Southern dist. Nov. 1 to Mar. 30.	No data	Brine 45 to 90 min	1. Raw pack 2. Fry—large, 7 min.; small, 4 to 6 min. 3. Steam exhaust, 25 to 40 min 4. Steam exhaust, 20 to 25 min., then through super-heated steam, 240 to 260° F. 5. Oven cook, steam and gas 20 to 40 min. 6. Oven cook, gas, 45 min. "Ullman" Cooker.	50	Vac. seal 12 to 15 min. ex Sealed hot do do do	70 150 150 150 150 150
Maine	Apr. 1 to Dec. 1, most of canning during period July 1 to Aug. 1.	15 (small fish)	Salted in boat, 280 lb. to hogshead (1200 lb.)	Steam 18 to 20 min., 212-220° F	35 to 41 (small fish), 55 to 60 (large fish).	Cold fill, no exhaust	65
Mackerel:							
Boston	July 15 to Oct. 1	30	Brined 1 hour in 100° brine. (salt mackerel—12 hours in 100° brine).	Raw	50	15 min. at 210° F.	160
California	July 1 to Oct. 1	30	Brine 1 hour in 80 to 90° brine.	Raw	60	20 to 45 min. at 210° F.	180
Tuna:†							
Albacore	July 1 to Aug. 1 (Calif.) Aug. 1 to Oct. 1 (Oregon)	No data	Clean and wash	10 to 14 lb. 3-3½ hrs. 216-220° F 18 to 40 lb. 4-4½ do	60 to 64	3 min. 210° F (some packs vac. seal).	70

Bluefin	June 15 to Nov. 30	do	do	8 to 18 lb. 2 do 18 to 50 lb. 3 do 50 to 60 lb. 4 do 60 to 200 lb. 5–9 do	60 to 64		
Yellowfin	Jan. to Dec. 31 (generally more abundant in summer months).	do	do	8 to 18 lb. 2 do 18 to 50 lb. 3 do 50 to 60 lb. 4 do 60 to 200 lb. 5–9 do	60 to 64		
Striped	Aug. 15 to Nov. 30	do	do	5 to 12 lb. 2–2½ do	60 to 64		
Alewife or river herring.	Apr. 1 to May 15	30	Brined 8 to 12 hours 100° brine.	None	30 to 35	3 min. 210° F. also filled with hot brine or water.	100 (approx.)
Fish flakes (haddock)	Apr. 15 to May 15 or at other times depending on fresh fish market.	40	Brined 10 to 14 hours 100° brine.	Steam 30 min., 240° F	70	Hot fill	150
Finnan haddie	Nov. 1 to Feb. 15	40	Brined 20 to 40 hours 100° brine then smoked 10 to 14 hours.	Fillets steam 15 min., 240° F. (whole fish 30 min.)	70	Hot fill	150
Shad	Calif Apr. 1 to May 15. Columbia River May 1 to July 1.	25	Wash, cut in container length pieces	Raw fill	35	Vacuum seal	60
Clams:							
Razor	Apr. 1 to May 31	65	Wash	Steam	65	Vacuum sea and hot fill.	150
Soft	Oct. 15 to Jan. 1 and Mar. 15 to Apr. 15.	65	Wash	Steam 20 min. 212° F., 15 min. 228° F	75	Hot fill	150
Oysters:							
Atlantic or Gulf	Jan. 1 to May 1	75	Wash	Steam 5 to 8 min. 245° F	93	Hot fill	150
Pacific	Nov. 15 to May 1		Wash	Steam 3.5 to 4 min. 240° F	80	Hot fill	160
Crab, Dungeness	Apr. 1 to Nov. 1 (Alaska—closed season during this time) Jan. 1 to Jan. 1 (Ore. Wash.)	73	Shelled alive, washed	Boiled 20 min	75	Vacuum seal	80
King (Japanese)	May 1 to Aug. 1	No data	Shelled alive, washed	Boiled 15 to 20 min. 25° brine	No data	Heat exhaust 7 to 10 min. 210° F.	165
Shrimp	Apr. 15 to June 30 and Aug. 15 to Mar. 15.	55	Brine soak 30 min. 50°	Wet pack 5 to 7 min Dry pack 7 to 12 min	75	Hot fill Vacuum seal	150 85
Clam chowder	Oct. 15 to Jan. 1 and Mar. 15 to Apr. 15.	75	Solid ingredients diced	Potato 2 to 3 min	75	Hot fill	180
Fish chowder	Apr. 15 to May 15	40 fish, 20 potato	Fish brined 10 to 12 hours 100° brine, potato peeled, washed, diced.	Potato 2 to 3 min., fish, steam 30 min. at 240° F.	70	Hot fill	160

† The season given applies only to California. Tuna of the various species are found on some part of fishing grounds throughout the year.

TABLE 9.—*Canning of fishery products, procedures and packing data, condensed*—Continued.

Product	Season	Cleaning loss	Pre-treatment	Blanch or precook	Total loss	Exhaust	Closing temperature
		Percent			*Percent*		*Deg. F.*
Fish cakes	Aug. 15 to Jan. 15	20 potato	Wash and peel potato. Soak salt cod 10 hours.	200 lb. potato, 100 lb. cod. Boil 30 min. (212° F.)	20	Hot fill	150
Fish roe:							
Alewife (river herring).	Apr. 1 to May 15	5	Rinse	Raw fill	5	Heat exhaust 3 min. 209° F. and hot fill brine.	80
"Deep sea" (Cod & haddock).	Dec. 15 to Apr. 15	None	Ground and mixed with brine.	None	None	15 min. 210° F	180
Shad	California Apr. 1 to May 15. Columbia River May 1 to July 1.	10	Wash, skin and slime	Raw fill	10	8 min. 210° F.	150
						Some use no exhaust	60

Part 2.

Product	Brine or sauce	Fill*		Process		Yield	Remarks
		Weight	Can size	Time	Temperature		
		Ounces		*Minutes*	*Deg. F.*		
Salmon:							
Chinook	¼ oz. salt added to each can. No brine.	16.6	No. 1 tall	90	240 to 245	1 to 5 fish per case	Col. River chinook only part of pack graded for quality and is mostly hand packed.
		16.2	No. 1 flat	do	do		
		8.0	No. ½ flat	80	do		
Red	do	3.9	No. ¼ flat	70	do	12 to 13 fish per case	This species in demand because of deep red color and excellent flavor. Use of lighter colored species has given rise to rumors that some fish are dyed and sold as salmon which is entirely false. It is not permitted by law and technical difficulties of such a process are practically insurmountable.
		16.0	No. 1 oval	90	do		
		7.9	No. ½ oval	80	do		
		3.9	No. ¼ oval	70	do		
		64	(602 x 403)	195	242		
Coho	do					9 to 10 fish per case	Is not very abundant. Forms only 7 percent world's pack canned salmon. More important in fresh, frozen and smoked fish trade.
Pink	do					17 fish per case	Smallest and most numerous of salmon. Forms 41 percent world's pack.

Chum	do					9 to 10 fish per case	Has less color in flesh and lower oil content than other species so is not as popular. Sells at lower price than other species salmon but has very high food value and can be made into palatable and nutritious dishes.
Sardines:							
California	2 oz. tomato or mustard sauce to each 1 lb. oval — 1 oz. to each ½ lb. oval or 8 oz. rect.	16	No. 1 tall	75	240	Average of 13 cases of sardines per ton of fish required by Calif. law. Fish in good canning cond. about 20 cases to ton.	Packing of natura and smoked fillets becoming important feature of pack.
		16	No. 1 oval	65	240		
		9	½ rect.	50	240		
		8	½ oval				
Maine	Cottonseed oil	3½	(quarter oil)	45	240	20 cases per hogshead (large fish); 30 cases per hogshead (small fish).	Maine law requires; use of winterpressed cottonseed oil 4 lb. per case (100 quarter); minimum of 4 fish per can (keyless), 5 (keyopening).
		11	(¾ mustard)	60	240		
Mackerel:							
Boston	3 percent	14	1 lb. oval	75	240	66 percent	Declared net weight on 1 lb. ovals 12 oz. but fill is always heavier. Mackerel must be firm and not over 24 hrs. old.
		14	1 lb. tall				
		16	No. 2 short				
California	3 percent	17⅝	No. 1 tall (301 x 411)	9	240 or 250	No data	Some mackerel packed raw pack without brining, ¼ oz. salt added to can. Not recommended by canning technologists who urge brining be employed.
				75			
		17	No. 1 meat (301 x 407)	75	250		
		11½	No. 1 standard	75	240 or 250		
			(211 x 400)	60			
Tuna:†							
Albacore	oil and salt	9⅛	8 oz (211 x 304)	75	250		Small amounts of tuna packed in glass tumblers, aluminum cans. Number of specialty tuna packs of which "tonno" is probably most important. Other specialty packs "ventresca," creamed tuna, garlic flavored tuna. Bonito also packed tuna style but may not be labeled as tuna yellowtail packed tuna style, but may not be labeled tuna. Some canned tuna imported into U. S. from Europe packed in salt brine without oil must be labeled "Packed without oil and in salt solution."
	oil ¾ oz.; salt 1/14 oz.	3½	No. ¼ tuna	65	240	76 cases; 48/¼s per ton	
	oil 1½ oz.; salt 1/7-3/14 oz.	5½-5¾	No. ½ tuna	75	240	47 cases; 48/½s	
Bluefin	oil 2; salt 9/14	11-11½	No. 1 tuna	95	240	23 cases; 48/1s	
Yellowfin	oil 9; salt 6/7	46	4 lb. tuna	230	240		
Striped							
Alewife or river herring.	3 percent	16	No. 1 tall	50	244	No data	Labeleed "fresh river herring" but is of canned salt fish style. Fish wrapped individually in parchment paper and packed in No. 2 tall cans.
		26	No. 2 tall	60	250		

*The fill given is actual weight filled into container and should not be considered a recommendation for declared weights to be used on the label of the container.
†The season given applies only to California. Tuna of the various species are found on some part of fishing grounds throughout the year.

TABLE 9.—*Canning of fishery products, procedures and packing data, condensed*—Continued.

Product	Brine or sauce	Fill*		Process		Yield	Remarks
		Weight	Can size	Time	Temperature		
		Ounces		*Minutes*	*Deg. F.*		
Fish flakes (haddock)	None	7¼	(211 x 300)	55	240	66 cans per 100 lbs. (211 x 300) size; 40 cans (307 x 208) size per 100 lb.	Fillets sometimes used instead of whole fish. Cod may be mixed with haddock 1 to 3, but is not often packed alone because of its soft texture.
		12	(307 x 208)	75	240		
Finnan haddie	None	4	(211 x 109)	55	240	About same as fish flakes not definitely determined.	Also packed in "nappy" glass tumblers. Imports from England in 1 lb. oval cans.
		12	(307 x 208)	75	240		
		16	(300 x 307)	75	240		
Shad	½ oz. salt	16½	No. 1 tall	90	240	75 lb. round—fish per case 48/1s.	Pack resembles salmon but flesh is rather dark and soft. Some kippered shad also canned.
Clams:							
Razor	Clam juice	5¼	No. ½	45	220	1 bu. clams = 40 No. ½ flat cans; = 20 No. 1 tall.	Sold mostly as "minced sea clams."
		7½	No. 1 picnic	45	220		
		12½	No. 2	60	220		
Soft	3 percent	6	No. 1 picnic	20	240	48 No. 1 picnic cans per bu.	Darkening is principal difficulty in canning. If this occurs blanch in 1.5 percent citric acid and add 0.5 percent citric acid to pack.
		10	No. 1 tall	20	240		
		11	No. 300	20	240		
		12	No. 2	25	240		
Oysters:							
Atlantic or Gulf	4°	3	(211 x 300)	8	250	20 to 25 No. 1 picnic (211 x 400) cans per bbl.	1 bbl.=3 bu. in Miss.; 1 bbl.=4 bu. in La.; Miss. bu.=2826 cu. in.; La. bu. = 2150 cu. in.; Std. U. S. bu. = 2150 cu. in. 9/0 loss = shell, mud, oyster juice (nectar).
		4	(211 x 304)	do	do		
		5	(211 x 400)	9	250		
		8	(307 x 400)	10	250		
		10	(307 x 409)	do	do		
Pacific	3 percent	7 to 9	No. 1 picnic (211 x 400)	29	240		Pacific oysters filled by count as well as weight. Certain number oysters must go into can for each grade size. Count per No. 1 tall can usually 6 to 7 if oysters are large, 8 to 14 if grade is medium, and 15 to 20 if grade is small.
		10 to 13	No. 1 tall	35	240		
		14 to 16	No. 2	42	240		
Crab (Dungeness)	4°	6½	(307 x 202½)	70	228	20 lb. meat or 4 doz. crabs to case 48/½s.	Dry salt may be used instead of brine. Speedy operation without delay, esp. important in this pack.
		13	(401 x 211)	80	228		
		17	(307 x 408)	80	228		
King (Japanese)	See remarks	3½	(211 x 109)	80	220	No data	2 oz. weak buffer sol. of organic acid (lactic or citric) added when discoloration may occur.
		6½	(307 x 202½)	90	220		
		13	(401 x 211)	80	228		

Shrimp	4*	5⅜	No. 1 picnic and squat.	10	250	190 No. 1 picnic cans per bbl. (210 lb.).	Processes for dry pack increase as liner type changes from 3 pc. to 1 pc.
		9¼	No. 1½	12	250		
		5⅜	No. 1 picnic and squat.	70 to 85	240		
		9¼	No. 1½	75 to 90	240		
Clam chowder	Hot soup added	4 solids 6 soup	No. 1 picnic	60	240	550 No. 1 picnic to 168 lb. solid ingredients.	Down East clam chowder similar to Manhattan, except D.E. has whole clams, no tomatoes and flour instead of cracker meal.
		7.5 clam 7.5 potato 11 soup	No. 3	85	240		
Fish chowder	Hot soup added	2 fish 2 potato 6 soup	No. 1 picnic	60	240	550 No. 1 picnic to 168 lb. solids.	Darkening or discoloration principal difficulty to be guarded against.
Fish cakes	Solid pack	10		75	240	460 cans to batch (200 lb. potato, 100 lb. fish).	Green mountain potatoes best variety in fish cakes. Discoloration caused by over-processing.
Fish roe:							
Alewife (river herring).	3 percent (sometimes hot water used).	8	(211 x 300)	50	240	1 case 48/8 oz. cans per 20 lb. bucket "green" roe.	From 13½ to 15 oz. green roe required as fil lin weight to give drained weight 16 oz. Variation depends on condition of roe.
		16	(307 x 400)	60	240		
"Deep sea" (Cod & haddock).	3 percent	14	(300 x 407)	75	240	400 cans to 300 lb. roe	Fill of cans must be watched carefully. Leave ⅛ in. headspace in filling.
Shad	¼ oz. salt	7¾	½ oval	110	230	26; 6 lb. per case 24/½ ovals.	Roe must be fully developed but not over ripe. If roe is too ripe, is watery and lacks flavor. If too green is hard and tough.
				55	240		
				90	240		