FARM CREDIT ADMINISTRATION
United States Department of Agriculture
Washington, D. C.

FRUIT AND VEGETABLE FREEZING COSTS

(PRELIMINARY)

By
Anne L. Gessner

COOPERATIVE RESEARCH AND SERVICE DIVISION

Miscellaneous Report No. 91 October 1945

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM CREDIT ADMINISTRATION
I. W. Duggan, Governor

Cooperative Research and Service Division

Harold Hedges, Chief W. W. Fetrow, Associate Chief

Much published material is now available on methods and techniques in freezing foods. The cost side of the picture, however, is still comparatively obscure due to the newness of the industry.

Because of the scarcity of published cost data on freezing fruits and vegetables and the immediate demand for such information, this preliminary report has been prepared for limited distribution to prospective processors pending the collection of additional statistics for use in a later publication.

- 0 -

NOTE.-Cooperatives contemplating the processing of frozen fruits and vegetables may be interested also in Miscellaneous Report 84, Cooperative Possibilities in Freezing Fruits and Vegetables.

FRUIT AND VEGETABLE FREEZING COSTS

By

Anne L. Gessner
Agricultural Economist

- - - - -

Ranking second only to weather, as a hazard in the life of a fruit and vegetable man, is the yearly uncertainty--cost of production. This is true for the processor as well as the grower.

Costs depend on many variable factors. Therefore, it is impossible to make any positive assumptions. Yet the first question to consider in planning a new business venture is that of costs. It is important that the cooperative packer potentially interested in freezing fruits and vegetables as another outlet for his association's products have at least some general knowledge of the costs involved and the factors affecting those costs.

With a view to assisting those who contemplate quick-freezing of fruits and vegetables, the Cooperative Research and Service Division has assembled and analyzed cost information from such limited data as have been available to it in this field. It is probable that, as the industry progresses, much more cost material will be developed which can be made available to newcomers in the frozen-food field.

In the following material consideration is given to costs as they pertain to certain types of freezing operations. It is recognized that each new freezing plant will be designed for a specific operation and will, therefore, have certain conditions and requirements of its own which will involve other cost items as well as different rates for similar items. It is intended here merely to supply the prospective freezer operator with general information on costs for typical operations.

Cost Analyses of Vegetable Freezing

The following cost analyses developed on vegetable freezing (1939-40 season) show typical costs incurred in the operation of plants of different capacities and initial investments. A study of these analyses may be helpful to the cooperative considering initial investment and operation on a moderate scale.

In schedule A is presented a cost analysis of a plant equipped to freeze 50 tons of finished product per day. The total plant investment of $85,000 consists of electric-driven refrigeration machinery

SCHEDULE A

Operational Cost Analysis for Vegetable Freezing

(Based on annual volume of 2 million pounds; capacity 5,000 pounds of frozen product per hour)

Investment:		
Equipment - Electric-driven refrigerating machinery, complete		$35,000.00
Facilities - Building complete with foundation, wiring, and insulation		50,000.00
Total investment (exclusive of land, processing and packaging machinery)		$85,000.00
	Per ton of frozen product	Per pound of frozen product
Operating costs (storage included):		
Labor		
Engineering (Chief engineer at $185 per month for 12 months and shift engineer at $8.20 per day for 4 months)	$3.20	
Handling (freezing and 6 months' storage--estimated)	4.00	
Power (225,000 k.w. hrs. at 1 cent per k.w.-hr.)	2.25	
Water (well pump)	.10	
Supplies (oil, waste, ammonia)	.25	
Total operating cost	$9.80	$0.0049
Maintenance costs (storage included):		
Machinery (2 percent on $35,000)	.70	
Building (1 percent on $50,000)	.50	
Total maintenance costs	$1.20	0.0006
Fixed charges (storage included):		
Interest - 6 percent on 50 percent of $85,000 (to allow for depreciating values)	2.55	
Depreciation - 5 percent on $85,000	4.25	
Taxes and insurance - 4 percent on $85,000	3.40	
Total fixed charges	$10.20	0.0051
Total cost of freezing and 6 months' storage	$21.20	$0.0106

complete for operation, costing $35,000; and a building complete with foundation, wiring, and insulation, at a cost of $50,000. The investment figure of $85,000 does not include land or preparation and packaging machinery.

Labor costs are based on prewar wage rates. Engineering labor provides for a year-round engineer paid at the rate of $185 per month and for a shift engineer employed for a 4-month period at $8.20 per day. The handling costs for freezing and storage represent an estimate of all handling as computed by the refrigeration engineer making this analysis.

Provision has been made in this analysis for maintenance charges, exclusive of replacement costs, for both equipment and facilities. The equipment maintenance charge provides for regularly recurring costs of cleaning, adjusting, and replacing structural parts. To obtain maximum efficiency of operation and to prevent serious injuries to refrigeration equipment, it is necessary to give careful attention to maintenance.

Depreciation is figured in this analysis on a basis which will provide for complete replacement of facilities and equipment at the end of 20 years.

In schedule B, an analysis is given of vegetable-freezing costs for a plant in which the equipment consists of electric-driven refrigerating machinery complete and ready to operate, with freezing belt and tunnel, at a cost of $32,000. An insulated storage room, at a cost of $10,000, brings the cost of freezing facilities and equipment to $42,000. This figure is exclusive of building, land, and preparation and packaging machinery.

In schedule A facility maintenance and depreciation costs are based on an insulated building, while in schedule B these costs are figured on the basis of an insulated storage room. Fixed charges in schedule A, based on the larger investment in facilities and equipment, amount to 0.51 cent per pound as compared with 0.20 cent per pound in schedule B. Likewise maintenance costs per pound in schedule A are considerably more than in schedule B which covers the smaller investment in facilities and equipment.

The buildings for a quick-freezing plant must be sanitary, but there may be considerable variation in the cost of construction. While the low-temperature storage rooms, engine room, and boiler room must be of good construction, such as concrete, concrete blocks, or brick, with a wooden roof, the preparation of the product may be done in a building of less expensive construction. For sanitation purposes, the entire plant should have concrete floors equipped with ample and properly placed drains.

SCHEDULE B

Operational Cost Analysis for Vegetable Freezing

(Based on annual volume of 2,560,000 pounds; capacity 4,000 pounds of frozen product per hour)

Investment:		
Equipment - Electric-driven refrigerating machinery complete ready to run including freezing belt and tunnel		$32,000.00
Facilities - 25-car storage room complete with refrigerating machinery and insulation		10,000.00
Total investment (exclusive of building, land, and processing and packaging machinery)		$42,000.00
	Per ton of frozen product	Per pound of frozen product
Operating costs:		
Labor		
Engineering (Chief engineer at $165 per month for 6 months and shift engineer at 62½ cents per hour for 4 months)	$1.24	
Tunnel man at 50 cents per hour for 2 months and plant superintendent part time	.34	
Handling (estimated)	3.42	
Power (133,000 k.w.-hrs. at 1 cent per k.w.-hr.)	1.04	
Water (4,000 m.-gal. at 10 cents per m.)	.31	
Supplies (oil, waste, ammonia)	.12	
Storage cost - 6 months	1.94	
Total operating costs	$8.41	$0.0042
Maintenance costs:		
Machinery (2 percent on $32,000)	$0.50	
Storage room (1 percent on $10,000)	.08	
Total maintenance costs	$ .58	0.0003
Fixed charges:		
Interest - 6 percent on 50 percent of $42,000 (to allow for depreciating values)	$0.98	
Depreciation - 5 percent on $42,000	1.64	
Taxes and insurance - 4 percent on $42,000	1.31	
Total fixed charges	$3.93	0.0020
Total cost of freezing and 6 months' storage	$12.92	$0.0065

Many new building materials as yet relatively untried in civilian construction will now become available to postwar builders. While it is indicated that there will probably be no great change in construction practices or structural appearance in the new buildings, there may be important advantages, such as greater convenience and comfort for those who work in them and more economy and durability for those who own them. Some of the new floor materials and floor coverings will be of particular interest to fruit processors who find frequent floor replacements necessary because of the destructive action of fruit acids. A recent publication of the U. S. Department of Commerce on "Building Materials for Post-War Construction" may be helpful to cooperatives contemplating new building construction. 1/ New paints and lacquers, some of which are highly resistant to heat and others to attacks of fungi and insects, are also discussed in this publication.

In comparing the operating costs of the two plants covered in schedules A and B, it will be noted that storage costs in schedule B, including labor and power, are figured separately; whereas, in schedule A the storage costs are included in the operational items of labor and power. Engineering labor in schedule B provides for one chief engineer at $165 per month, employed for 6 months, and for shift labor at 62.5 cents per hour for an 8-hour day over a period of approximately 4 months. A tunnel man is employed at 50 cents per hour for 2 months, and the plant superintendent gives only part time to the operation. Total cost of operation in schedule A is allocated on the basis of an annual volume of 2,000,000 pounds compared with 2,560,000 pounds for schedule B. It is slightly higher than in schedule B--0.49 cent as compared with 0.42 cent per pound.

In the two cost studies shown, only the operating, fixed, and maintenance costs directly attributable to the freezing and storage of the product are included. Raw material, preparation, and administrative costs are not considered.

Freezing Costs

It will be noted from schedules A and B that actual freezing and plant storage costs are small. Certain experimental studies show that cost of the freezing operation alone varies from 0.2 to 0.5 cent per pound, depending on the product, volume, utility cost, and type of equipment used. These figures cover the complete operation of freezing, including power, refrigeration costs, and labor, but excluding preprocessing, packaging, and storing. In the two schedules shown, costs are computed on the basis of actual freezing plus 6 months' storage.

1/ Vallin, Alma H. "New Materials for Plant Construction," (Building Materials for Post-War Construction) Reprint from Domestic Commerce, U. S. Department of Commerce, June 1945, 3 pp.

The major cost items in the production of frozen foods are cost of the raw product, cost of preparing the product for freezing, and cost of packaging the product. In a study of preparation and freezing costs for sweetpotatoes made by Woodroof and Atkinson 2/, costs have been broken down to show cost of the raw product, preparation, packaging, freezing, and storage costs. The breakdown of these costs is given in schedule C. It will be observed that cost of freezing and 1 month's storage accounts for only 7 percent, while cost of the raw product and processing accounts for almost 60 percent of the total cost of the frozen product. An additional 5 months' storage contributes almost a fifth of the total cost.

Costs in Relation to Packer's Price

On the basis of the freezing and storage costs developed in schedule A, and with a comparable volume and investment, the total processing cost for frozen vegetables might be in the neighborhood of 7 cents per pound, exclusive of the cost of the raw product. This processing cost is arrived at as follows:

	Estimated cents per pound
Indirect costs, including salaries and office and general expense	0.55
Processing or prefreezing labor	3.00
Freezing and six months' storage (including fixed, maintenance, operating and labor charged to freezing)	1.06
Container	2.00
Supplies	.28
Total processing cost per pound of frozen vegetable	6.89

The processing cost might be less in an area where labor costs are generally lower. In such an area, the prefreezing labor cost might be about 2.50 cents per pound. Container cost might also be somewhat lower than that given above, perhaps 1.50 cents per pound. Products packed for the industrial and institutional trades would have lower container and packaging costs than those packed for the retail trade. These lower labor and container costs might reduce the total to approximately 5.89 cents per pound.

For frozen fruits, the total processing cost per pound would be somewhat lower because of the smaller amount of labor required in preparation. Sugar, however, would represent a higher cost than the condiments used in vegetable freezing. On the other hand, less water would generally be required in freezing fruits than vegetables.

2/ Woodroof, J. G., and Atkinson, Ida S., "Preserving Sweet Potatoes by Freezing," Georgia Expt. Sta. Bul. 232, March 1944, 26 pp.

SCHEDULE C

Production Costs for 100 Pounds of Frozen Sweetpotatoes

Item	Cost	Percentage of total cost
150 pounds of sweetpotatoes 1/	$1.87	26.6
Processing	2.20	31.4
Containers	1.05	15.0
Incidentals	.15	2.1
Materials and preparation	$5.27	75.1
Freezing and storing - 1 month	.50	7.1
Storing 5 months	1.25	17.8
Cost of 100 lbs. of frozen puree after 6 months f.o.b. packing plant	$7.02	100.0

1/ Amount required for 100 pounds of prepared product. The price of sweetpotatoes varies widely from season to season. The price of jumbo and number three grades, which are entirely satisfactory for frozen puree, ranges from $1.00 to $1.25 per 100 pounds.

If the raw product cost (after allowing for loss in processing) is assumed, in the case of vegetables, to be about 6 cents per frozen pound, the total cost of the frozen product will be about 12.89 cents per pound based on the processing cost above. After allowing a mark-up to the packer of about 20 percent of this cost, and then adding a 4 or 5 percent brokerage fee, the packer could expect to receive a gross price of about 15 to 16 cents per pound. On a similar basis, but assuming a slightly higher cost of raw product and a lower mark-up of about 10 percent, the comparable price per pound of frozen fruit would be about 13 to 14 cents. These figures would, of course, vary with any change of wage rate, container cost, brokerage fee, and similar items. A large packer of frozen peaches in a low-wage area, for example, indicated that his total cost was 11 cents per pound.

Costs for Plant of Recommended Minimum Capacity

One of the first factors to receive consideration by the prospective freezer is the probable volume of product that should be put through the plant to permit efficient operation. It is important that ample volume of the right varieties be available to provide sufficient product so that the plant may operate at capacity. Provided sufficient space, equipment, and labor are available, increased volume usually permits more economical operation. Overhead and general expense, which is fairly constant for all sizes of plants, can be spread over larger volumes as the operations expand, thereby decreasing the unit cost.

The type of operation will, of course, influence the volume required for economical production. Certain persons experienced in the food-freezing industry have indicated that the minimum economical production for a freezing plant is approximately 3 million pounds per year. This would not hold true to the same extent, however, if the cooperative packer were performing dual operations. For example, a cooperative storage plant interested in expanding to quick-freezing would have certain initial advantages which might still permit economical operation with a smaller volume.

These advantages would be represented in most cases by refrigeration equipment, an insulated building, and the employment of a full-time engineer. Therefore, since the plant would already have much of the construction, equipment, and some of the labor necessary for the quick-freezing operation, it could, no doubt, operate economically on a smaller volume than if confined to a single operation. This would also hold true to some extent for the dual operations of canning and freezing where the same preparation equipment and labor could be used for both, and the general overhead spread over a larger volume.

The size of the plant must, of course, be related to the anticipated volume. Estimates made by some frozen-food packers indicate that a plant with a capacity of 3 million pounds per year will require 15,000 to 20,000 square feet for the processing and freezing operations and an additional space of about 40,000 to 50,000 cubic feet for storage of the frozen product, to take care of about a third of the volume of the plant. Total costs of a vegetable-freezing plant of this capacity which freezes peas might be within the following range - cost of processing equipment, about $20,000 to $22,000 (see schedule E); quick-freezing equipment from $25,000 to $45,000; and building approximately $50,000, of which $10,000 to $15,000 would represent cold-storage room cost.

A freezing plant of this size might employ from 50 to 100 people in the processing operation. The number of people employed would, of course, vary considerably with the type of product that is being processed. Any product which lends itself to highly mechanized operations, such as peas, for example, would require less labor than such products as spinach and broccoli. The size of the plant, therefore, will be influenced by the type of commodity to be processed.

Even for the same commodity, the number of workers may vary substantially in different plants according to the sequence of operations or product flow. For example, in peach-processing operations, pitting may be done by workers on one belt and the peeling operation completed by workers on a second belt, or the pitting and peeling operations may be done on the same belt with somewhat reduced output per worker. Likewise the quality of the fruit and the type of initial peeling operation--whether steam or other method is used--will affect labor output. The wide variations possible in different plants make it impractical to give specific figures on the number of employees required. In general, however, if the number of workers required for the prefreezing or preparation work is large, the spacing and amount of equipment will be increased, requiring a larger floor area.

Costs in Relation to Volume

The effect of increased volume on freezing costs for the plant analyzed in schedule A, is reflected in schedule D. The figures given in this schedule are estimates made by a refrigeration engineer and do not represent data developed from a study of actual plant operations. It appears from these estimates that, by increasing the total annual volume of this plant, maintenance and fixed charges can be decreased proportionately. For example, when the volume is doubled, the maintenance and fixed charges are spread over twice the number of units, thus reducing cost per unit by 50 percent.

SCHEDULE D

Effect of Increased Volume on Freezing and Storage Costs

Cost item (freezing and storage)	Cost for annual volume of --							
	1,000 tons		2,000 tons		3,000 tons		4,000 tons	
	Dollars per ton	Cents per lb.	Dollars per ton	Cents per lb.	Dollars per ton	Cents per lb.	Dollars per ton	Cents per lb.
Operation	9.80	0.49	7.78	0.39	6.43	0.32	5.89	0.29
Maintenance	1.20	.06	.60	.03	.40	.02	.30	.02
Fixed charges	10.20	.51	5.10	.25	3.40	.17	2.55	.13
Total - freezing and 6 months' storage	21.20	1.06	13.48	.67	10.23	.51	8.74	.44

Operating costs, however, do not decrease in the same ratio. Each ton of product, for example, requires approximately the same amount of handling labor per ton. Additional volume put through the plant would require additional supplies and power. Therefore, while certain savings per unit will be effected with increased volume, they will not be proportionate to the rate of increase in volume.

Freezing and Canning Costs Compared

Certain cost analyses made several years before the war in a number of canning cooperatives, showed that raw material plus salaries and labor costs for processing accounted for from 66 percent to about 80 percent of the costs of operation of the various cooperatives included in the study. These figures are of interest to prospective freezers since raw product and processing costs for freezing are comparable. The labor in preparing the product for freezing is similar to that required for canning as the products must be washed, graded, peeled, and pitted, or otherwise prepared, just as for canning.

In a study of the frozen-food industry by Carlton 3/ it was indicated that a packer engaged in both quick-freezing and canning peas found the actual cost of the two methods very nearly equal. In the same study another packer of loose-frozen peas was indicated to be of the opinion that the cost of preparing and freezing loose-frozen peas was about the same as that of canning, and that any increased expense would be due to the higher cost of storing and transporting the frozen product.

Carlton indicated in his study that a packer of frozen peas estimated his costs to be 8.37 cents per pound, including raw product, processing, freezing, 1 month's storage and brokerage. This may be compared with the estimate of a large pea canner who, after assuming a price to the grower of 3.25 cents per pound for shelled peas, estimated that his cost in the can, including brokerage, averaged 8.88 cents per pound.

Granting that raw material, labor, and other costs may be higher at the present time, these comparisons do illustrate the similarity in cost factors for freezing and canning. It appears to be the general opinion that the costs of growing, harvesting, and packing-plant operations up to the point of freezing, are very similar for the two methods of packing. The quality specifications and need for more careful grading may increase freezing costs. When dual operations are carried on, the products graded out or discarded for freezing, may provide suitable material for canning. In the opinion of some

---

3/ Carlton, Harry. The Frozen Food Industry, Tenn. Univ. Press, Knoxville, Tenn. 1941, see pp. 145-146.

packers, cost of actual freezing is less than the heating operation for canning, and only the storage and transportation costs for quick-frozen foods amount to more than the same items for canning.

Processing Equipment Costs

Much of the equipment used in processing or preparing fruits and vegetables for freezing is portable. This makes it possible to set up the equipment for handling one product and later to remove it and install the equipment for the next product to be frozen. In this way, equipment and floor space are utilized to the maximum.

However, some processors with ample floor space, and particularly those who have products which are harvested at the same time or which overlap, find it to their advantage to have complete installations for each commodity. Such installations also have the advantage of reducing the amount of labor which is required if shifts are made in the various processing lines. Labor savings would, therefore, need to be measured against the initial costs of equipment for complete preparation lines for each product. In visiting many cooperative processing plants, it is our observation that constant changes and improvements are made in the processing lines from season to season as operations expand.

In schedule E costs are given for the equipment required in a number of vegetable-processing lines.

Refrigeration Machinery and Equipment Costs

As mentioned earlier, the requirements of each plant will vary widely depending on the volume and type of commodity to be frozen. The cost data submitted in the various schedules are those developed for specific plants. It would likewise be impossible to indicate the costs which might occur for refrigeration machinery for all types of operations. Schedule F supplies information on refrigeration machinery needed for a specific plant contemplating a definite annual volume. This is an estimate submitted by an engineer for a new plant which will handle deciduous tree fruits and berries.

It will be noted from schedule F that this plant will provide for a large cooler space in addition to the low-temperature storage for about 4,500 tons of frozen product. Total investment for building with insulation and refrigeration machinery will be somewhat over $170,000.

This plant is equipped with four ammonia compressors arranged to operate as an ammonia booster system. The liquid cooler will permit the liquid ammonia entering the low-temperature space to be thoroughly precooled and the system will be operated flooded through use of an ammonia surge accumulator. Freezing will be done with

SCHEDULE E

List of Preparation Equipment 1/

		Estimated cost (approximate)
Standard one-line pea plant with quality grader:		
1	Sample grader, 4 screens	$225
1	Gooseneck conveyor to feed cleaners, estimated 20 feet long, 12-inch buckets	265
1	Cleaner with variable air regulator	350
1	Separator and washer	560
1	Gooseneck conveyor to feed grader, estimated 20 feet long, 12-inch buckets	265
1	Twin-reel 6-section pea grader	1,885
7	No. 5 pea storage hoppers, each $55	385
1	Gooseneck conveyor, 45 feet long, 12-inch buckets, under grader to blancher	420
1	15-foot blancher without countershaft	1,075
1	Countershaft	125
1	1½-inch self operating temperature control for blancher	84
1	No. 3 shaker washer, standard perforation	285
1	Picking table after blancher, 16 feet long, 30 inches wide	307
1	Gooseneck conveyor to filler, estimated 19 feet long, 12-inch buckets	260
1	Pea filler (carton)	4,750
1	No. 7 double storage hopper with gate for over pea filler	65
	Total	$11,306
Quality grade bypass and second filler:		
2	150-gallon brine tanks, noncorrosive, each $175	$350
1	Gooseneck conveyor, 10 feet long, 12-inch buckets, to quality grader	205
1	Quality grader and brine control and reels	1,475
2	No. 3 shaker washers, each $285	570
1	10-foot picking table	195
1	Gooseneck conveyor to filler, 19 feet long, 12-inch buckets	225
1	No. 7 double storage hopper with gate	65
1	Pea filler (carton)	4,750
	Total	$7,835

1/ As suggested by a large food machinery supply agency.

SCHEDULE E (Cont'd)

		Estimated cost (approximate)
One-line corn plant:		
1	Wagon and truck dump, motor drive, Style B, standard current	$390
6	Huskers, each $895	5,370
1	30-inch wide, 60-foot long, inspection conveyor	980
6	Corn trimmers, each $86	516
2	Corn washers with countershaft, each $600	1,200
7	Cutters (whole grain), each $755	5,285
1	8-inch bucket 12-foot cut corn elevator	245
1	No. 8 silker, for whole grain corn	875
1	Whirlpool washer, complete with 7-foot rod reel washer	1,470
1	10-foot picking table	195
1	Filler (carton)	4,750
	Total	$21,276
One-line string bean plant:		
1	Bean grader, making 2 grades	$875
1	Bean cutter No. 2 with automatic hopper	300
	or	
1	String bean cutter, 1-inch cut	415
1	8-foot bean blancher without countershaft	875
1	Countershaft	115
1	No. 3 shaker washer	285
1	10-foot picking table, 30 inches wide	235
1	No. 3 washer	285
1	Gooseneck conveyor 12 inches wide, 12-foot length	195
4	Automatic bean snippers, 32-inch diameter drum, with elevator and 8-foot picking table	1,750
	Total	$5,330
Miscellaneous equipment (for carrots, etc.):		
1	Topper	$775
1	Grader, six sizes	650
1	Peeler	1,075
1	Slicer	380
1	Cube cutter	1,080
	Total	$3,960
Asparagus and spinach equipment:		
1	String bean and asparagus cutter	$458
1	Drum spinach washer	2,200
	Total	$2,658
Trucks:		
4	Roller-bearing truck, 12-inch wheels, each $32	$128

SCHEDULE F

Refrigeration Machinery and Equipment

		Estimated cost (approximate)
(Requirements based on: 4,500 tons freezer holding space and 45,000 bushels cooler space)		
Investment:		
Building and other construction		$75,000
Refrigeration equipment		53,355
Insulation		45,000
Total		$173,355
	Units	
Equipment:		
Ammonia compressors (standard)	2	$5,000
Electric motors 60 h.p., 3 phases 220 volt, 60 cycle	2	1,100
Electric starters 60 h.p., 3 phases 220 volt, 60 cycle	2	500
Ammonia compressors (Booster)	2	3,800
Electric motors 25 h.p., 3 phases 220 volt, 60 cycle	2	450
Electric starters 25 h.p., 3 phases 220 volt, 60 cycle	2	120
Liquid cooler 20" x 9'3"	1	275
Water intercooler 12" x 8'	1	275
Ammonia condenser 30" x 18'	1	1,950
Ammonia receiver 20" x 16'	1	210
Condenser stand	1	85
Oil trap	1	140
Ammonia surge accumulator	1	210
Miscellaneous controls	17	150
Brine spray units	14	32,000
Automatic water valves	1	90
Thermal valves	14	315
Electric starters 7½ h.p.	14	200
Surge drums	14	1,000
Humidifier units	6	250
Ammonia cut-out valves	2	35
Calcium and regenerator	1	700
Ammonia fittings, valves, etc.		4,500
Total		$53,355

14 brine-spray units, each connected with a surge drum. The volume this plant will handle annually requires a fairly large initial investment in refrigeration equipment.

Various types of freezers set up in more or less complete units are now becoming important in the equipment of food-freezing plants. Some of these operate as truck-and-tray type tunnels and are adapted to both loose and packaged freezing. These freezers are very compact and provide for maximum product capacity per foot of floor space. One such freezer, which can handle about 3,500 pounds per hour, has the advantage of flexibility of arrangement, as the freezer may be enlarged at any time desired by adding an additional unit. The cost of this type of freezer with insulation is approximately $20,000.

For a plant-constructed tunnel it is estimated that the woodwork to be used with shavings insulation might cost somewhere in the neighborhood of $4,000. On the basis of freezing 5 pounds of product per square foot in 20 minutes, the size of the tunnel would normally be about 6 feet wide by 50 feet long to provide a freezing capacity of approximately two tons per hour. Cost of the freezing belt complete for such a tunnel with motor drive for two tons per hour capacity would be about $3,000.

Costs of Converting from Dehydration

Some cooperative processors may be interested in the costs involved in a simple conversion of their dehydration tunnel to freezing operations. The costs of such conversion should be carefully considered, because the expense would probably not be warranted if the present tunnel was improvised for emergency wartime use. In some cases old driers have been brought into service for dehydration operations and are none too efficient. Conversion of such equipment would represent a poor investment.

If conversion is deemed advisable, then careful consideration should be given to the insulation of the tunnel. Transmission of heat into the converted tunnel would generally represent a more serious disadvantage than loss of heat from an inefficient steam-heated dehydration tunnel.

If a temperature of approximately 20° F. below zero is to be maintained and the capacity of the tunnel is to be approximately two tons of finished product per hour, an insulation thickness of 8 to 10 inches, and preferably 10 inches, is recommended. Assuming the size of the reconverted tunnel to be 6 feet wide by 50 feet long, a cork or other good insulation job will cost about $2,000. This is for material only and does not include the labor cost involved in its application.

A new blower for the freezing tunnel capable of circulating 70,000 cubic feet of air per minute would cost approximately $1,800. If brine spray units are purchased for operation in the present tunnel, total cost might be about $10,000, based on an estimated cost of approximately $2,500 per unit. If cooling coils are installed, the required amount of pipe, which should contain about 10,000 square feet of pipe surface, would cost somewhere between $6,000 and $7,000.

In converting from dehydration, the low-temperature storage space required in conjunction with a plant of the above capacity would be about 72,000 cubic feet. Six inches of corkboard or other good insulation material for the storage space would cost approximately $10,000, exclusive of the labor cost in its application.

Commercial Freezing Costs

Some cooperative associations are interested in preparing their products for freezing by a commercial firm. A number of cooperative associations who originally had their products frozen in commercial freezing plants later were in position to construct their own freezing facilities.

In schedule G estimates of commercial freezing rates on fruits and vegetables are given for the benefit of cooperative processors who contemplate commercial freezing of their products.

Commercial Storage Costs

The plans of some associations who intend to do their own freezing may not include construction of sufficient low-temperature storage space to take care of all of their frozen products. Such cooperative freezers will be interested in the estimates of storage costs for frozen fruits and vegetables given in schedule H.

Packaging Costs

Packaging costs show considerable variation, depending upon the type of package in use. In many plants very simple and inexpensive packages are used. Some of the less expensive retail packages are moisture-vapor-proof bags with the brand name imprinted thereon. These bags are used without additional liners or wraps and are heat-sealed to protect the product from loss of moisture and flavor. This type of package is adapted to loose-frozen products such as peas and lima beans.

Laminated glassine and wet-strength kraft bags with heat-sealed bottom and heat-sealing bands at the top have been used for institutional-size frozen-food packs and provide an economical container in this field. Some of these bags are flat and stack well when filled. The wet-strength paper tends to prevent disintegration upon defrosting.

SCHEDULE G

Estimated Minimum Rates on the Freezing of Fruits and Vegetables by A Commercial Cold Storage Warehouse

Commodity	Unit	First month	Monthly thereafter
Fruit, cold pack, fresh to freeze:			
In barrels - 50 gallons each	bbl.	$1.45	$0.40
In barrels - 30 gallons each	bbl.	.80	.25
In barrels - 15 gallons each	bbl.	.45	.15
In barrels - 10 gallons each	bbl.	.35	.10
In kegs - 5 gallons each	keg	.20	.07
(The above rates include freezing, rolling, and turning in storage to insure thorough mixing of the sugar syrup with the fruit and faster freezing.)			
Fruit, cold pack, fresh to freeze:			
In crates, metal cans, wooden containers and cups in cartons:			
10,000 lbs. and over - gross weight	100 lbs.	.45	.15
Less than 10,000 lbs. - gross weight	100 lbs.	.55	.22
Fruit, cold pack, fresh to freeze:			
In special containers	100 lbs.	.80	.15
Fruits and vegetables, fresh for quick-freezing			
Loose freezing - 10,000 lbs. or more gross weight	100 lbs.	1/ .75	.15
Closed packages - 10,000 lbs. or more gross weight	100 lbs.	1/ .80	.15

1/ These rates include receiving commodity at quick freezer, delivery from quick freezer to packing room, and handling from packing room to holding room. All preparation and/or packing labor to be furnished by or for the account of the storer.

SCHEDULE H

Estimated Minimum Rates on the Storage of Frozen Fruits and Vegetables by A Commercial Cold Storage Warehouse

Commodity	Unit	First month	Monthly thereafter
Fruit, cold pack, received frozen:			
In barrels - 50 gallons each	bbl.	$0.70	$0.40
In barrels - 30 gallons each	bbl.	.45	.25
In barrels - 15 gallons each	bbl.	.25	.15
In barrels - 10 gallons each	bbl.	.20	.10
In kegs - 5 gallons each	keg	.15	.07
Fruit, cold pack, received frozen:			
In crates, metal cans, wooden containers, and cups in cartons			
10,000 lbs. and over gross weight	100 lbs.	.35	.15
Less than 10,000 lbs. gross weight	100 lbs.	.45	.22
Fruit, cold pack, received frozen:			
For consolidating loads, not to exceed three days' storage			
50 gallon barrels	ton	1.00	
Cases, cans, and packages	ton	2.00	
Fruits and vegetables received frozen:			
10,000 lbs. or more gross weight	100 lbs.	.35	.15
Less than 10,000 lbs. gross weight	100 lbs.	.45	.22

In schedule I estimated costs per thousand are given for bulk and retail size bags.

There is a wide range in packaging costs from the low-priced moisture-vapor-proof bags just described to the carton complete with a moisture-vapor-proof inner liner, a wax overwrap, and multilithed label on the carton. Some plants use a multilithed label on their frozen-food cartons to correspond to the label on their canned products. These are frequently very colorful and fairly expensive packages.

In schedule J are presented typical costs for three sizes of retail cartons. These are plain, unprinted fiberboard cartons. Costs of the shipping cases for these cartons are also given.

In schedule K costs are estimated for plain and printed one-piece telescope-style cartons made from laminated fiberboard in three standard sizes used by commercial freezers of vegetables. These cartons are made from a bleach filled sulphite board laminated to a wet-strength treated inner lining paper, the laminating agent being of flexible, moistureproof composition.

Costs are also shown for two sizes of snap-end-lock cartons made from bleached sulphite lined manila board in two sizes used by commercial packers of frozen fruits.

Bags frequently used inside these cartons in the packaging of frozen fruit, are made of a special kraft wet-strength treated base stock, coated on one side with a heat-sealing, moistureproof coating composition, providing high protective qualities. Size 4x1-3/4x8-1/4" bags are used inside the 1-3/4x5-1/4x4" snap-end style cartons, and size 5-1/4x2x11-1/4" bags are used with the 2x7½x5¼" cartons. The price on 100,000 bags of the 4x1-3/4x8-1/4" size is about $7.50 per thousand, and for size 5¼x2x11¼", ordered in the same quantity, is approximately $12 per thousand.

Wax paper overwraps, either plain or printed, may be used with the cartons. These wax papers are treated with a special type of wax to allow the wrappers to retain their strong sealing qualities after being subjected to freezing temperatures. The price on one of these, a transparent unprinted wax paper, is about $11.50 per 100 pounds, f.o.b. mill, with freight allowances in certain cases. Prices on printed opaque and special laminated overwraps depend, to some extent, upon the amount of ink coverage, and, therefore, must be figured for each individual plant.

Estimated costs of various sizes of cellophane and laminated bags, are shown in schedule L. These bags are used as liners in paperboard or tin cartons and pails for frozen fruits and vegetables.

SCHEDULE I

Estimated Costs of Moisture-Vapor-Proof Bags for Frozen Fruits and Vegetables

Item:	Per thousand 1/
50-lb. vegetable bag (plain)	$75
2½-lb. vegetable institutional bag (printed label)	17
30-lb. fruit bag (plain)	65
5-lb. fruit bag (plain)	25
1-lb. or 12-oz. fruit bag (plain)	8

1/ These prices would be increased or decreased depending upon the quantities ordered.

SCHEDULE J

Estimated Costs of Frozen Fruit and Vegetable Fiberboard Cartons and Shipping Cases

Size of container (pounds)	Cost per thousand		Number of cartons per shipping case
	Cartons	Shipping cases	
1	$6	$64	24
2½	15	78	12
10	70	78	3

SCHEDULE K

Estimated Costs of Plain and Printed Frozen Fruit and Vegetable Cartons

Size (inches)	Description of carton	Price per thousand ordered in quantities of 100,000			
		Plain	1 color	2 colors	3 colors
1-3/4x5¼x4	Laminated telescope	$10.50	$11.75	$12.00	$12.75
2½x9½x5¼	" "	20.00	21.50	22.25	23.00
3x10x8	" "	33.00	35.00	36.00	37.00
1-3/4x5¼x4	Snap end lock	6.25	7.25	7.75	8.25
2x7½x5¼	" " "	12.00	12.50	13.00	13.75

SCHEDULE L

Estimated Costs of Cellophane and Laminated Liners for Paperboard or Tin Frozen-Fruit and-Vegetable Cartons

Quantity (thousands)	Size of liner	Description 1/	Price per thousand
30-lb. paperboard carton:			
10	18x21"	Laminated flat bags	$110.00
25	"	" " "	106.00
50	"	" " "	103.00
100 and over	"	" " "	101.00
10	"	Cellophane square or flat bags	109.00
25	"	" " " "	101.50
50	"	" " " "	97.00
100 and over	"	" " " "	95.00
30-lb. cylinder metal container:			
10	15-3/4x27"	Laminated flat bags	114.00
25	"	" " "	110.00
50	"	" " "	107.00
100 and over	"	" " "	105.00
10	"	Cellophane square or flat bags	81.00
25	"	" " " "	77.00
50	"	" " " "	75.00
100 and over	"	" " " "	72.00
10-lb. carton:			
10	8x3¼x18"	Laminated flat bags	62.00
25	"	" " "	59.00
50	"	" " "	56.00
100 and over	"	" " "	55.00
10	"	Cellophane flat or square	40.00
25	"	" " "	38.00
50	"	" " "	37.00
100 and over	"	" " "	36.50
5-lb. carton:			
10	6x3x13"	Laminated flat bags	43.00
25	"	" " "	40.00
50	"	" " "	38.00
100 and over	"	" " "	37.00
10	"	Cellophane flat or square bags	23.50
25	"	" " " "	22.00
50	"	" " " "	21.50
100 and over	"	" " " "	21.00
2½-lb. carton:			
10	4x2x12"	Cellophane flat or square bags	15.00
25	"	" " " "	14.00
50	"	" " " "	13.25
100 and over	"	" " " "	12.50

1/ Dimensions are bag size, not carton size. All bags are heat sealed at the bottom and have leak-proof back-seam construction.

The laminated bags are made of two rolls of cellophane using a hot-melt, wax-type adhesive. The resulting lamination provides increased moisture-vapor protection and durability.

A new package for frozen fruits and vegetables which is still in the experimental stage is one developed by a large can company. This oblong container is made of paraffin impregnated fiberboard with lightweight tin-plate ends, and resembles the regular frozen-food carton in shape. It can be filled and capped in the same manner as the conventional type of can used for canned fruits and vegetables, but requires a capping machine specifically designed for the operation. One machine can close 200 containers per minute. The new container will be used without inner liner or overwrap, and the brand name can be printed on the carton at the point of manufacture, eliminating the labeling process. It can be used in all types of freezing equipment now in general use. While the manufacturers are not yet ready to quote prices, it is the opinion of many in the industry that this container may greatly reduce packaging costs.

Packaging Equipment

Frequently, the bottleneck in the production line of frozen-food plants has been the packaging equipment. In some plants in areas where labor rates are comparatively low, large numbers of employees are used in the packaging line. In such plants, however, there are likely to be too many opportunities for delays in the packaging operation.

In the packaging procedure employed in a large number of plants, several operations are involved. Bags are inserted in the cartons, the cartons are filled with the product, frequently by hand, and the bags are then heat sealed. After heat sealing, the cartons are closed and wrappers are applied by means of an overwrapping machine.

Many new packaging machines have been and are being designed to speed up and improve the packaging line. Some of these are still in the experimental stage and will not be available for commercial operations until they have been perfected and the material is available in quantities for production.

One machine now being tried out automatically feeds, opens, fills, and closes a carton and can attain a speed of from 75 to 80 12-ounce vegetable packages a minute. Special telescope cartons have been used with this machine. They are fed from a magazine and ejected into an automatic opener which sets them up. They are then fed along a conveyor into the filling unit. The proper quantity of a free-flowing product, such as peas, cut corn, or lima beans, is

dropped from a hopper into the carton. The carton then goes through a device which automatically closes it and is passed to the over-wrapping machine for wrapping. The machine performs a complete operation of bag opening, filling and wrapping on a conveyor-belt line-up. This machine will be improved to adapt its use to various types of products and various sizes of cartons. Costs for commercial use have not yet been determined.

Wrapping machines adjustable to various sized packages have been widely used by frozen-food packers to wrap cartons in cellophane or wax papers. Some high-speed wrapping machines can wrap up to 70 packages a minute. A newly designed wrapping machine is adapted to wrapping trays or window boxes, which must remain upright during the operation.

Bag making and filling machines are now widely used in frozen-food packaging departments. Some bag-making machines can make various sizes of bags up to 12x3x20 inches at a rate of 2,500 to 4,000 bags per hour. One such machine which makes bags with a size range of 1x2½ to 12x25 inches at speeds varying from 3,000 to 10,000 per hour is priced at about $2,300. It is credited with savings in bag manufacture of from 40 to 70 percent.

Other equipment in the packaging line includes heat sealers which may range all the way from inexpensive hand-sealing equipment at a cost of about $20 to automatic sealers with thermostatically controlled heat, costing about $200 for cellophane and light materials and somewhat more for heavier or foil paper.

Estimates furnished by a large packaging firm indicate that weighing and filling equipment for a plant with a daily volume of 32 tons would cost approximately $12,000 to $15,000. If a tuck-in type of carton is used with an inner liner and an outer wax wrap, the total cost of packaging machinery for a plant of this size would be between $40,000 and $50,000 for new equipment.

In a number of food-freezing plants, packaging, as well as processing equipment, has been improvised by plant engineers. The costs of necessary equipment have thus been greatly reduced. The experience of a freezer of a sizable volume of strawberries, lima beans, and peaches illustrates the possibilities. In this plant, the fruit is packed in 30-pound fiberboard cartons or cans. The lima beans are packed in cellophane bags, which are heat sealed and inserted in 12-ounce and 2½-pound cartons. Because of the difficulty in securing new equipment, the filler and some of the other pieces of packaging equipment were improvised. The packer estimated his packaging equipment cost at less than $1,000. This plant, however, was in a low-cost labor area. Otherwise, the labor used in operating this packaging line would have represented a more

expensive item. The filling machine requires 4 operators; the two sealers, 1 operator each; inserting the cellophane packages in the carton, 16 operators (4 to handle output from each position on the filler); and setting up the cartons, 2 operators.

It can readily be seen from this illustration that the cooperative freezer would need to measure the continuing cost of the labor for such improvised equipment against the large initial investment in the higher-cost, labor-saving equipment.

Raw Product Costs

Raw material costs vary with the type and variety of commodity to be frozen and prices for the same commodity vary for different areas.

The handling of certain raw materials such as peas and lima beans is now highly mechanized, and permits very efficient and economical operations. Peas, for example, are taken to viners and, after vining and shelling, are delivered to the freezing plant. In this way, the cost of handling a large amount of inedible produce is eliminated before the product reaches the freezing plant. It is estimated that the waste in vines and shells amounts to approximately two-thirds of the total raw material bulk of this product.

The prospective cooperative freezer may be able to make some estimates of the quantity of raw product required for a particular volume of finished product from a study of schedule M, which shows losses in weight during processing for various fruits and vegetables of suitable freezing varieties. These percentages were developed in a study made by the Georgia Agricultural Experiment Station. 4/

A detailed analysis of raw material costs would require data by commodity, grade, and area. Because of the wide variations possible, a national average figure can have only limited value.

Prices received by the grower for some of the major vegetables and deciduous tree fruits and berries used for freezing appear in schedules N, O, and P. The data on vegetables are for all processing as no separate breakdown is available for those commodities utilized for freezing only. For deciduous tree fruits, prices are given on those used for cold pack and freezing where obtainable. In the States where freezing is included with other types of processing, the price is given for all types. The 1941 figure was

---

4/ Woodroof, J. G., "Preserving Foods by Freezing," Georgia Expt. Sta. Bul. 233, 1944, 42pp.

SCHEDULE M

Loss in Weight During Processing

Commodity	Form in which frozen	Loss in weight: Minimum	Loss in weight: Maximum
		Percent	Percent
	Vegetables		
Asparagus	Young, green tips	40	65
Beans, lima	Green seed	50	70
Beans, string	Immature green pods	20	40
Beets	Peeled, diced	30	50
Broccoli	Sectioned flower heads	40	60
Brussels sprouts	Axillary buds	30	50
Carrots	Sliced or diced	15	30
Cauliflower	Sectioned heads	30	70
Corn	On cob	10	20
	Whole grain	60	80
Eggplant	Peeled, sectioned	40	60
Kale	Young leaves	15	30
Mustard	Young leaves	30	40
Okra	Young pods	20	60
Parsnip	Sliced or diced	20	40
Peas, green	Green seed	60	65
Peas, field	Tender seed	50	70
Pimiento	Sectioned, peeled, pods	40	60
Pumpkin	Puree	7	16
Rhubarb	Sectioned leaf stalks	20	40
Rutabaga	Puree	20	30
Spinach	Young leaves	30	50
Squash, summer	Peeled, seeded, sliced	30	50
Sweetpotato	Whole, slices, puree	25	35
Tomatoes	Whole	5	25
	Fruits		
Apples	Peeled, cored, sliced, packed in 50 percent sirup, or coated with sugar--4 parts to 1.	50	60
Blackberries	Packed dry, in 50 percent sirup or coated with sugar--4 to 1.	10	25
Blueberries	Packed dry, in 50 percent sirup or coated with sugar--5 to 1.	10	25

Commodity	Form in which frozen	Loss in weight: Minimum	Loss in weight: Maximum
		Percent	Percent
Cherries	Packed in 60 percent sirup or coated with sugar--4 to 1.	30	40
Dewberries	Packed dry, in 60 percent sirup or coated with sugar--4 to 1--or as puree.	10	25
Figs	Packed in 50 percent sirup or coated with sugar--4 to 1.	25	50
Grapes, bunch	Passed through screen as puree.	15	30
Grapes, muscadine	Packed dry, in 50 percent sirup or coated with sugar--5 to 1--or as puree.	15	30
Peaches	Peeled, pitted, sliced, packed in 50 percent sirup or coated with sugar--4 to 1.	45	55
Pears	Peeled, cored, quartered; packed in 50 percent sirup or coated with sugar--5 to 1.	50	60
Persimmon	Sectioned, coated with sugar--5 to 1--or as puree.	10	20
Plums	Coated with sugar--5 to 1--or as puree.	15	40
Raspberries	Packed dry, in 50 percent sirup or coated with sugar--5 to 1.	10	20
Strawberries	Packed in 60 percent sirup or coated with sugar--4 to 1--or as puree.	10	25

SCHEDULE N

Average Prices Received by Growers for Major Vegetables for Processing, 1941 1/

	Price per ton 2/
Asparagus (California)	$106.55
Beans, green lima (shelled)	71.25
Beans, snap	53.40
Beets	13.11
Corn, sweet (in husk)	9.68
Peas, green (shelled)	48.67
Spinach	24.03

1/ Includes commercial truck crops utilized for canning, freezing, or pickling, but not commercially dehydrated.
2/ Average price received by growers for season.

Source: Bureau of Agricultural Economics, U. S. Department of Agriculture.

SCHEDULE O

Average Prices Received by Growers for Major Deciduous Tree Fruits for Processing, 1941

Commodity	Type of processing 1/	State	Price per ton
Apples	Cold pack	Washington	$35.00
Apricots	Freezing	Washington	31.40
Sour cherries	Cold pack	Washington	93.90
	All types	Ohio	80.00
	All types	Michigan	92.00
Sweet cherries	Cold pack	Washington	90.00
	All types	Michigan	102.00
	All types	Oregon	114.00
	All types	California	123.00
Peaches	Freezing	Washington	40.80
Prunes	Freezing	Washington	24.30
	All types	Idaho	21.40

1/ Price is shown for "All types" of processing in those States where freezing is included with other forms of processing and a separate price is not available.

Source: Bureau of Agricultural Economics, U. S. Department of Agriculture.

SCHEDULE P

Average Prices Received by Growers for Berries for Freezing, 1943

State	Black-berries	Boysen-berries	Cur-rants	Goose-berries	Logan-berries	Blackcap rasp-berries	Red rasp-berries	Young-berries	Straw-berries
	Cents per pound								
Washington	12.8	13.2	14.2	8.7	12.6	13.0	16.2	12.0	12.2
Oregon	12.6	12.2	13.5	8.5	12.1	13.2	15.3	12.0	12.9
Two-State average	12.8	12.3	14.2	8.6	12.3	13.2	15.9	12.0	12.7

Source: Bureau of Agricultural Economics, U. S. Department of Agriculture.

selected for vegetables and deciduous tree fruits as a more nearly normal price than prices computed for the later war years. For berries, however, the 1943 figure is used as more complete figures were available for two important berry-freezing States, which permitted use of a two-State average.

Distribution Costs on Frozen Foods

Detailed studies on the costs of distributing frozen foods are not readily available. Some trade estimates indicate that 50 percent of the retail cost represents costs incurred from the time the product leaves the packer's plant until it reaches the consumer.

The Office of Price Administration has established the following wholesale mark-ups for frozen foods 5/:

Type of store:	Wholesale mark-ups on frozen foods (percent)
Retailer owned co-ops	24
Cash and carry wholesalers	24
Service and delivery wholesalers	24
Institutional wholesalers	29

The retail mark-ups permitted by the Office of Price Administration on frozen foods are as follows:

Type of store:	Retail mark-ups on frozen foods (percent)
Independent stores, sales under $50,000	27
Independent stores, sales $50,000-$250,000	27
Chain stores, sales under $250,000	27
All stores with sales of more than $250,000	27

Cost Accounting for A New Freezing Plant

Schedule Q furnishes the prospective freezer with a list of the probable operating accounts required in setting up a cost accounting system for the new freezing plant. In accord with cooperative practice, the entire proceeds of the sales of frozen products will belong to the producer patrons who authorize deductions for necessary operating expense and retains for capital contributions.

5/ Post-war Readjustments in Processing and Marketing Dehydrated Fruits and Vegetables, May 1945. (These mark-ups were still in effect in September 1945.)

SCHEDULE Q

Cost Accounts for Freezing Plant

Account classification number	Account	Description
100	Assembling expense:	
	110 Freight and hauling	Hauling raw products by rail or truck to plant, returning empty boxes.
	120 Receiving and pre-freezing labor	Unloading raw material, transferring product to precooler, handling and washing empty crates or boxes, cleaning up.
	130 Precooling or storage expense	Cooling or storage before preparation
	140 Crate and box expense	Supplies for replacing and repairing crates and boxes.
200	Manufacturing expense:	Preliminary sorting and grading;
	210 Labor	hauling to preparation room;
	211 Preparing labor	operating and servicing preparation equipment; trimming, sorting coring, peeling, cutting, blanching, cleaning up, and waste disposal.
	212 Freezing labor	Loading and stacking trays, moving cars, unloading and cleaning trays; operating conveyor belt; servicing freezing equipment.
	213 Packaging labor	Packaging, sealing, labeling, boxing, transferring to storage; providing empty containers and boxes for filling; unloading packaging supplies from trucks or railroad cars.
	214 Indirect labor	Plant superintendent, foreman, watchman, janitor, general plant help, and plant clerical.

Account classification number	Account	Description
	220 Utilities	Fuel, power, light, and water.
	230 Maintenance and repairs	Records should be kept of each repair job to enable charging to proper operation.
	240 Depreciation	Depreciation of factory building and equipment.
	250 Taxes and insurance	Taxes and insurance on factory building and equipment.
	260 Packing supplies and expenses	Containers, boxes, packaging and crating supplies, sealing equipment, labels, wrappers, liners.
	270 Inspection and control	
	271 Laboratory expenses	Costs of own laboratory, including salaries and expenses.
	272 Inspection and testing fees	Fees paid to outsiders for inspection and testing of the raw material and finished product.
	280 Chemicals - refrigerants	All chemicals used in freezing or in laboratory and all refrigerant used in freezing operation.
	290 Miscellaneous supplies and expenses	All supplies and expenses not included in above items.
300	Automotive expense	This account can be distributed on a mileage basis to accounts 110, 290, 420, 440, 450, 520, and 570.
400	Selling expense	
	410 Salaries	Salaries of employees engaged in selling.

SCHEDULE Q (Cont'd)

Account classification number	Account	Description
	420 Traveling expenses	Traveling expenses incurred in selling.
	430 Brokerage and commissions	All brokerage and commission fees on frozen product sales.
	440 Shipping labor and expenses	Loading trucks and railroad cars, out-freight.
	450 Miscellaneous supplies and expense	Supplies and expenses incurred in selling not allocated to above items.
500	General and administrative expense	
	510 Office salaries and expenses	General office, clerical.
	520 Administrative salaries and expenses	Salaries of administrative officers and personnel.
	530 Utilities	Lights, heat, and telephone for general office.
	540 Interest expense	Interest on money borrowed.
	550 Taxes and insurance	Taxes and insurance on finished goods on hand.
	560 Association dues and assessments	Dues and assessments for memberships in various industry and other associations.
	570 Miscellaneous supplies and expenses	Not included in above items.

SCHEDULE R

Operating Statement for Cooperative Freezing Plant

Sales	$
Plus closing inventories	
Less opening inventories	
Gross returns for products delivered by patrons	
Less operating expenses	
Gross distributable amount	
Less advances made to patrons	
Balance available to distribution	

Cooperatives prepare periodic recapitulations of operations mainly to determine the amounts belonging to patrons. Therefore, they do not have the ordinary profit and loss statements, but instead, may have operating statements similar to the one shown in schedule R. In the operating statement (schedule R) all expenses listed in schedule Q are included in the item "Less operating expenses."

There has been considerable controversy regarding the method of determination of the overhead costs of cold-packing and quick-freezing in a plant which is also engaged in canning. One method which many packers consider practical and equitable is to allocate overhead costs for the canned and frozen products on a value basis. This method of distribution makes the overhead costs chargeable to each product depend upon the sale price.

Any cost accounting system adopted by the cooperative freezer should reflect the basic cooperative principle that, in general, farmers' cooperatives receive products from members and make advances therefor, withholding final payment until final returns are received. Consequently, value of products delivered to the association by patrons does not ordinarily appear on the books as an item of cost.

Summary

Until such time as detailed cost studies in the freezing of fruits and vegetables can be made, it is hoped that the necessarily limited data furnished in this mimeograph may be helpful to prospective cooperative freezers. Wide variations in methods as well as in costs of production make it impossible to set up any hard and fast average costs. The figures contained herein may serve merely as guides when specific size of investment, volume of pack, and type of operation and equipment are considered.