HOTEL AND RESTAURANT MEAT PURVEYORS—IMPROVED METHODS AND FACILITIES FOR SUPPLYING FROZEN PORTION-CONTROLLED MEAT

Marketing Research Report No. 904

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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This work was conducted under the general supervision of Tarvin F. Webb, Investigations Leader, Transportation and Facilities Research Division.

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HOTEL AND RESTAURANT MEAT PURVEYORS—IMPROVED METHODS AND FACILITIES FOR SUPPLYING FROZEN PORTION-CONTROLLED MEAT

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SUMMARY

Time and motion studies were used to evaluate the efficiency of various work methods and equipment used in selected meat-supply houses preparing and freezing portion-controlled meat. The more economical methods often used more expensive equipment, but saved money overall by reducing labor costs. In preparation of steaks, chops, ground-meat patties, and breaded-meat patties, the following comparisons were brought out:

In handling large beef cuts, semilive skids with racks were more efficient than meat rails. For transporting separate portions to packagers, belt conveyors were most efficient. Large-capacity carts were more efficient for packages than smaller carts. For handling boxes or cases of meats, pallets and forklift trucks were most efficient.

Using two workers when one could handle an entire operation wasted time transferring the meat from one to the other. This was shown for cutting the large beef cuts into portions, and also for the wrapping and packaging of portions.

Self-feeding machinery was more economical in grinding meat and in forming patties than manual-feed machinery. Dial scales took less time to read than weigh-beam scales. A membrane-removing machine produced better quality tenderloins in less time than a worker removing the silver skin with a knife. Systematic rather than random storage arrangements saved time in filling orders.

After analysis of costs per 1,000 pounds of meat handled, the resulting data were applied to the operation of a house with an annual volume of 3.5 million pounds. In this example, use of the recommended methods showed a savings of over 10 percent of the cost of using the next most economical method for each process. A layout for such a house was designed around the recommended methods, and suggestions were made for expanding this layout to handle an annual volume of 7 million pounds.

BACKGROUND OF THE STUDY

This is the second of two reports based on research in hotel and restaurant meat-supply houses. The first report dealt with custom-service houses, which prepare fresh meat to customer specifications and deliver orders, usually on the same day they are placed.[1]

This second report covers supply houses that prepare and freeze packages of portion-controlled steaks, chops, and meat patties (packages that contain a definite number of uniform pieces that are of the same weight), and usually deliver orders from inventory. The term "house" or "houses," as used here, will refer specifically to such supply houses.

Practically all of the houses in operation today are less than 25 years old. Despite their

[1] BRASINGTON, CLAYTON F., JR., HOTEL AND RESTAURANT MEAT PURVEYORS—IMPROVED METHODS AND FACILITIES FOR CUSTOM SERVICE HOUSES. U.S. Dept. Agr., Mktg. Res. Rpt. No. 747, 45 pp., illus. 1966.

recent entry into the meat-purveying business, these houses are already an important part of the meat industry. Together with custom-service houses, they account for more than two-thirds of the total volume of meat and meat products sold to the food service industry. Much of their success can be attributed to the use of modern mass-production techniques to lower operating costs and, as a result, the selling price of meat portions. The cost of labor and equipment and the time required to perform in-plant operations are important in determining how production can be handled most efficiently.

Beef, veal, lamb, and pork, both fresh and frozen, are used in preparing these meat products. Most of the houses sell them in packages of 5 to 20 pounds to hotel dining rooms, restaurants, hospitals, schools, and other establishments that serve meals. A few houses also sell smaller packages (1 to 5 pounds) to retail stores. While most houses freeze all products after packaging, some houses freeze a few types of steaks or patties before they are packaged. Since there is no consistency as to what products are frozen before packaging, and usually only a small part of the total volume is handled in this manner, this method is not covered in the report. These houses also sell some items that they do not prepare, such as frozen poultry and seafood.

The types of customers served by these houses range from exclusive restaurants to drive-ins. Some houses prepare products from meat of average quality and specialize in selling to commercial feeders, school lunchrooms, hospitals, drive-in restaurants, and retail stores. These are usually the large-volume houses, and they sell to both local and distant customers. Other houses prepare a number of products of different quality and have, as regular customers, all types of public feeders, from exclusive restaurants to lunch counters. These houses usually handle a smaller volume and limit their sales to the local trade area.

The general layout of these houses consists of: A meat cooler for storage of fresh meat; a holding freezer for storage of the frozen products received and for the inventory of frozen products prepared; an overnight freezer for quick-freezing the prepared products; a tempering freezer where frozen meat to be used in the preparation of patties is held for 2 to 7 days; refrigerated fabricating rooms or areas where steaks, chops, and patties are prepared; refrigerated rooms or areas where the prepared portions are packaged; a dry storage room; a machinery room; an equipment washroom; employee locker rooms; offices; and a receiving and loading dock or area.

The workers employed in these houses are production supervisors, a skilled crew of meatcutters and workers who prepare ground meat, and a semiskilled crew of handling and packaging workers. The houses visited employed 12 to 30 in-plant workers.

A few of the houses visited had layouts that permitted efficient operations based on the products then being produced and the volume being handled. However, most of the houses were using remodeled buildings that were originally designed and built for other businesses. In the latter group, one or more of the following conditions were common: Multifloor operations served by a slow, light-duty elevator; low ceilings; closely spaced columns; crowded workrooms with inadequate aisle and work space; storage rooms too small to permit the holding of an adequate inventory; poor product flow causing excessive handling; and no space for expansion.

Both the houses in which the plants were designed and built for this business and those in remodeled plants had substantial investments in high-cost facilities with limited alternate use. About one-half of the total area was divided into specially constructed refrigerated rooms for quick-freezing products, storing frozen products, and holding fresh meat.

To maintain an adequate freezer inventory and to make full use of the workers' time, operators of the houses try to make up production schedules about a week in advance. When production is properly scheduled, long runs of high-volume products can be made, and little time is lost in changing from one product to another or from one type of equipment to another. In many houses, however, inadequate work or storage space prevents efficient production scheduling. Frequent revisions of schedules are necessary; or schedules must be made up daily for short runs of products, resulting

in loss of productive time of work crews. Some of the work methods and equipment used in preparing and handling products, as well as inadequate work and storage space, also affect efficiency, making operating costs higher than necessary in these houses.

The objectives of this research were to evaluate in-plant operations to determine which work methods and types of equipment are the most efficient, and to develop layout principles to be used as guides in the planning of new houses or the expansion of existing ones.

The data collected in this research are presented in two sections. The first compares the labor and equipment requirements and costs per 1,000 pounds of meat or meat products handled when operations are performed with various work methods, crew sizes, or types of equipment.

The second part of the report illustrates how these data may be used in a specific situation. A composition of products is assumed for a house that handles 3,500,000 pounds of meat annually. Alternate work methods, crew sizes, or types of equipment are compared, based on both labor and equipment requirements and costs. The layout designed for this house is based on both the most efficient work methods studied and the layout principles developed during the research. Operators of houses that have annual volumes of about 1 to 5 million pounds can use these data as guidelines to evaluate their operations and to develop more efficient layouts.

GLOSSARY

Operation.—The accomplishment of a sequence of acts or of motions to complete an objective.

Method.—The particular manner in which labor and equipment are combined to perform a specific operation.

Time item.—An easily timed subdivision (element) of an operation.

Base time.—The amount of time required for performing a time item (element) of an operation at a normal pace for a worker skilled in the work.

Fatigue and personal allowances.—The time allowed a worker to compensate for weariness resulting from sustained physical effort and the time allowed a worker to cover his personal needs. The fatigue allowance will vary from 5 percent when little physical effort is required, to 25 percent when a great deal is required. The personal allowance is 5 percent. When workers are given rest periods as a part of their normal workday, the 5 percent personal allowance should not be included.

Productive time.—The time allowed for performing a time item of an operation. It is computed by adding the base time and the fatigue and personal allowances for the time item.

Unproductive time.—The idle time that results from an irregular flow of work to individual workers in a crew during the performance of an operation. Also the idle time that occurs when a machine running at normal capacity cannot keep the operator busy.

Elapsed time.—The total time, both productive and unproductive, that is required from the beginning to the end of an operation.

METHOD OF CONDUCTING THE STUDY

Visits were made to hotel and restaurant meat-supply houses in various locations throughout the country. Detailed studies were made in six houses where frozen portion-controlled products made up either all or a major part of the volume. Studies also were made of specific operations in some of the other houses visited. These houses handled annual volumes of about 1.5 to 5.2 million pounds.

Data were obtained by conducting time and motion studies of work methods and equipment. Flow diagrams charted the movement of

products into, through, and out of the houses. Scale drawings of floor plans showed the location, size, and arrangement of work areas, equipment, storage space, and aisles. Operators and supervisory personnel supplied other data, such as volume handled, product composition, length of storage of products, equipment operating and maintenance costs, and wage rates.

The elapsed time and labor and equipment requirements and costs were computed, per 1,000 pounds of product, for several different methods, procedures, or equipment types used in receiving and storing meat and other products; for fabricating, wrapping, packaging, and freezing portions; and for assembling products and loading delivery trucks. These data also were used to compute the labor and equipment requirements and costs for the two most efficient work methods and equipment combinations for each process if used in a supply house with an annual volume of 3,500,000 pounds, handling a selected composition of products. Operators of supply houses can compute their own costs by substituting their own volume and product composition.

An efficient layout for the house handling 3,500,000 pounds annually was designed. This layout can be expanded to handle 7 million pounds annually at minimum costs and without disruption of basic flow patterns.

METHOD OF COMPUTING LABOR AND EQUIPMENT COSTS

In this report, labor cost estimates are based on the man-hours required for an operation, including both productive and unproductive time. Equipment costs are based on assumed hours of use annually for each item, for all operations. In most cases, annual usage is 2,000 hours. For some items that are also used in product storage, the annual usage may be as small as 50 hours. The most economical equipment for a large-volume operation may not be the most economical for small-volume operations.

The total plant costs are not covered in these data, since overhead costs such as rent, management, buying, selling, and delivery are not included.

The hourly wage rate paid to production workers doing the same type of work varied considerably in the houses studied. The variation was probably due to the scattered locations of the houses and to the availability of labor in each area. Because of this variation in wages, an hourly rate of $4.00 is assumed for meatcutters and workers that prepare ground meat, and $3.25 for handling and packaging workers. These rates include both the basic hourly wages and the fringe benefits such as social security, workmen's compensation, paid vacations, and hospitalization.

Equipment prices, based on average f.o.b. factory prices in 1969–1970 plus estimated delivery and installation costs, were obtained from equipment suppliers and manufacturers. Equipment costs are divided into two parts—owning costs and operating costs (see appendix). Owning costs are considered fixed and are as follows: (1) Depreciation, based on the straight-line method and using life expectancy tables from U. S. Treasury Department Internal Revenue Service Publication No. 456 (9–62); (2) interest, based on 6 percent of the average investment over the depreciable life of the equipment; and (3) taxes and insurance combined, based on a total figure of 4 percent of the initial investment. Operating costs are based on representative costs in this country. Electricity was computed at 2.7 cents per kilowatt hour. Maintenance costs are based on estimates made by operators, an equipment manufacturing representative, and the author.

LABOR, EQUIPMENT, AND COSTS PER 1,000 POUNDS, BY PROCESS

In evaluating labor requirements in the houses covered by this report, all estimates were based on preparation of the following products:

a. Beefsteaks prepared from fresh meat.
b. Pork chops prepared from fresh meat.
c. Ground-meat patties prepared from a mixture of fresh and frozen meat.

d. Breaded ground-meat patties prepared from a mixture of fresh and frozen meat.

The operations that were evaluated were the receiving and storing of fresh and frozen meat and other frozen products; the preparation of steaks, chops, and patties; the wrapping and packaging of these products and their movement to the freezer; and the assembling and loading of the frozen products onto delivery trucks.

A production supervisor usually prepares daily production schedules several days or a week in advance. Using these schedules, a foreman instructs meat handlers to bring fresh meat from the meat cooler to the fabricating area, where meatcutters prepare steaks and chops and place them in large containers. The meat handlers move the filled containers to a packaging area, where packaging workers tenderize the steaks and package the steaks and chops in boxes. Meat handlers then move the filled boxes to an overnight freezer. The next day they move the filled boxes to a holding freezer.

Ground-meat patties may be fabricated at the same time that steaks and chops are being prepared, though in a different work area. The foreman instructs the meat handlers to bring fresh meat from the cooler, and frozen meat from the tempering room, to the area where ground products are prepared.

The ground-products workers prepare batches of ground meat and move the ground meat to machines that form patties. Packaging workers operate the patty machines and the breading equipment and package the patties in boxes. Meat handlers move the filled boxes to the overnight freezer. The following day they move the filled boxes to the holding freezer.

Meat handlers also receive and store fresh and frozen meat and other frozen products; move frozen meat from the holding freezer to the tempering room; and assemble products from the holding freezer and load them into delivery trucks.

The data presented on operations are based on average labor requirements as observed during visits to houses located throughout the country. These data were collected in a manner that made it possible to eliminate unproductive time caused by unnecessary work and avoidable delays. The labor requirements do include unproductive time if applicable. Unproductive time caused by lack of work and the time used by workers to move from one job to another within the house are not included. As a result, labor requirements in this report probably are less than those encountered in actual operations and therefore should be used only as guidelines in evaluating individual facilities, labor requirements, and work methods.

Labor costs different from those used here can be computed by substituting the actual wage rate for that shown, and multiplying it by the man-hours required.

For all operations, labor requirements and costs are based on an in-weight of 1,000 pounds of meat, since this weight provides more meaningful data than 100 pounds or some other smaller weight. In the preparation of meat cuts into steaks and chops, the weight of the total yield is less than 1,000 pounds after the trim loss. The yield assumed in dividing a cut of meat into steaks or chops is based on published data and estimates made by both operators and workers in the meat industry. It is assumed, however, that meat cuts for steaks and chops are purchased to specifications that include a weight range, average fat thickness, and quality (grade) that will minimize the losses that occur when excessive trimming is necessary. This report does not allow for the natural shrinkage that occurs during the handling, storage, and cutting of the meat into portions.

Receiving and Storing

The houses covered by this report receive and store individual cuts of fresh beef; fresh and frozen beef, veal, and pork in boxes; fresh beef, veal, and pork in barrels; and boxes of other frozen products such as poultry and seafood.

Most houses assign only one worker to the job of receiving and storing because the driver of the delivery truck, who unloads the items onto the house equipment or stacks them on the truck tailgate, usually paces the work. The house worker checks receipts against the invoices to see that they meet purchase specifications, weighs fresh meat and records and totals

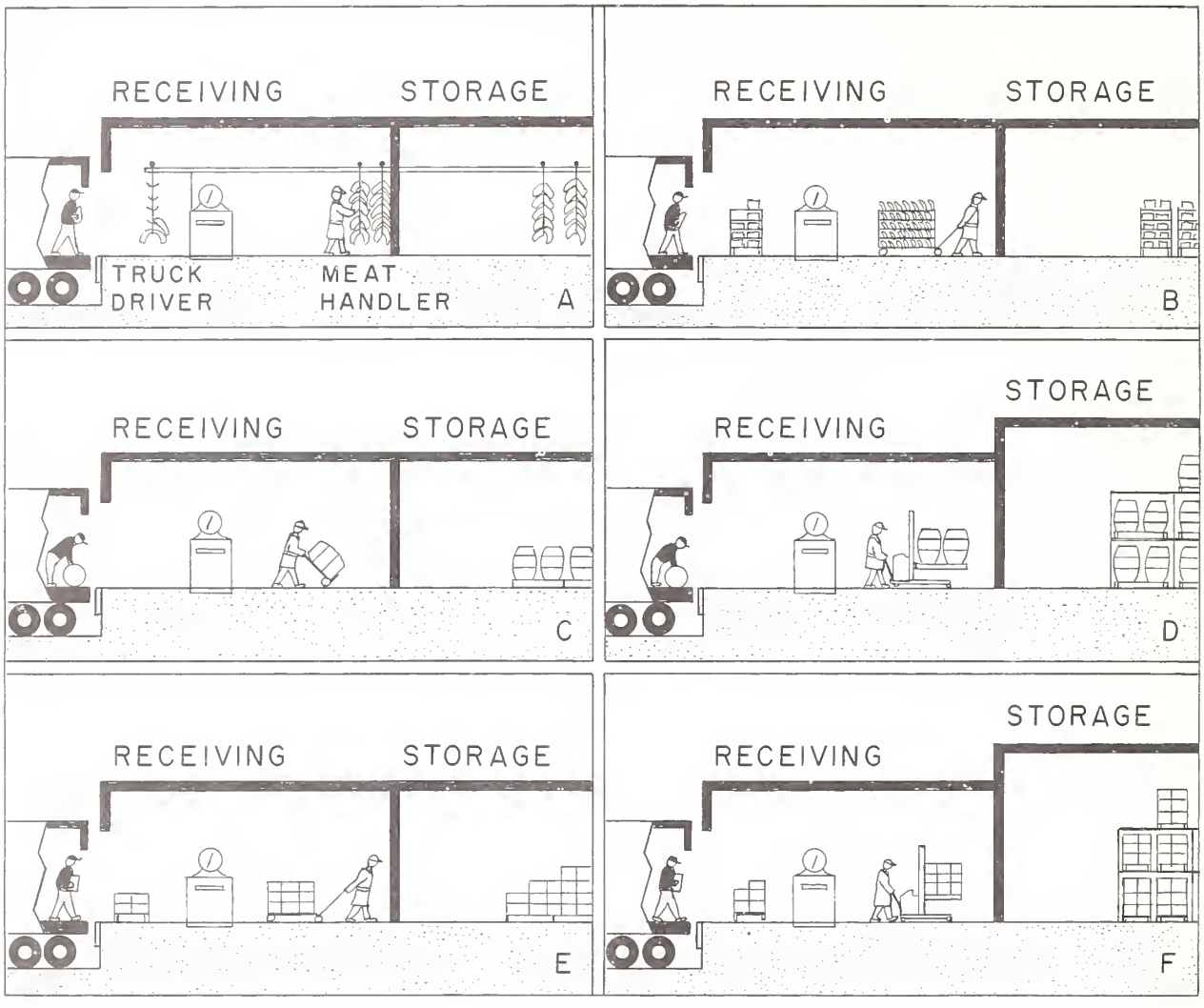

FIGURE 1.—Receiving and storing: Bone-in meat, (A) on overhead rail or (B) on loin truck; barrel meat, (C) on two-wheel barrel truck or (D) on forklift; and box meat, (E) on semilive skid or (F) on forklift.

the weights of each lot, and transports fresh meat to the cooler and frozen items to the holding freezer (fig. 1). Although some frozen items are weighed, most of the weighing is limited to fresh meat.

Fresh beef received as individual cuts is limited in most houses to short loins and bone-in strip loins (to be cut into bone-in steaks), because the operators try to minimize the time that meatcutters spend in breaking, boning, and trimming. Labor requirements are therefore computed only for short loins and bone-in strip loins. Some houses also receive beef loins and ribs as individual cuts.

Beef short loins and bone-in strips are received on trolley trees hung on overhead rails and stored on rails in the meat cooler in some houses. In others, these cuts are received on semilive skids with racks, moved by jacklift, and stored in the cooler on the skids.

Fresh meat received in boxes consists of bone-in cuts, usually pork loins; boned cuts such as beef top sirloin butts, rib-eye rolls, ribs, strip loins, and tenderloins; and boneless meats, either from primal cuts such as the chuck or round or from the entire carcass. Most of the volume of frozen meat received is boneless carcass meat, but some houses receive

some frozen bone-in or boned cuts. Boneless meat is generally used to make ground products.

Fresh and frozen meat and other frozen products in boxes are either transported on semilive skids with jacklifts and hand-stacked in storage; or placed on pallets, transported by forklift truck, and stored on the pallets. Some houses that use pallets have pallet storage racks that are two, three, or four tiers high.

Fresh meat received in barrels is boneless meat of the same type received in boxes. It is also used for making ground products. In houses that use forklift trucks and pallets, barrels are placed on pallets and transported two at a time to storage, and stored on the pallets. In other houses, two-wheel barrel trucks are used to transport one barrel at a time, and the barrels are unloaded onto floor racks in the storage area.

A combination track and platform scale is required for weighing if items are received on both overhead rails and floor equipment. When items are received on floor equipment, only a platform scale is required.

We measured labor requirements for receiving and storing for houses with receiving docks or doorways at or near truckbed level. For these houses, the truckdriver generally places all items except individual meat cuts on the house equipment. Individual cuts are brought to the truck tailgate. The house worker either inserts a California hook in each cut and hangs several cuts on each trolley tree hook for on-the-rail transport, or places each cut on shelf racks for transport on semilive skids.

Table 1 shows the average weight transported, the distance per round trip for each type of product received, and the labor requirements and costs, and equipment costs per 1,000 pounds, by method of transport. Table 20, in the appendix, shows the cost per hour for equipment and what equipment is used in performing each job by various procedures.

TABLE 1.—*Labor requirements and costs and equipment costs for receiving and storing meat, by type of meat cut, container, and method of transport*

Type and weight of meat cut or container, and method of transport	Average per trip		Per 1,000 pounds					
			Labor requirements [1]			Costs		
	Weight transported	Distance (round-trip)	Productive	Unproductive [2]	Total	Labor	Equipment	Total
	Pounds	*Feet*	*Man-hours*	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Fresh beef short loins (18 pounds):								
On-the-rail	792	130	0.26	([3])	0.26	0.85	0.26	1.11
Semilive skid with racks	1,440	130	.18	0.04	.22	.72	.18	.90
Fresh beef bone-in strip loins (12 pounds):								
On-the-rail	528	130	.38	([3])	.38	1.24	.39	1.63
Semilive skid with racks	1,080	130	.27	.06	.33	1.07	.27	1.34
Fresh beef, veal, or pork in boxes (60 pounds):								
Semilive skid	1,200	140	.10	.06	.16	.52	.19	.71
Forklift	1,200	140	.08	.06	.14	.46	.17	.63
Frozen beef, veal, pork, or other products in boxes (60 pounds):								
Semilive skid	1,200	190	.12	.06	.18	.59	.04	.63
Forklift	1,200	190	.10	.06	.16	.52	.07	.59
Fresh beef, veal, or pork in barrels (350 pounds):								
Two-wheel barrel truck	350	140	.10	0	.10	.33	.13	.46
Forklift	700	140	.09	0	.09	.29	.11	.40

[1] Includes weighing of fresh meat only.

[2] Waiting for truck driver to unload.

[3] Less than 0.01 man-hours per 1,000 pounds.

Transporting separate cuts of meat on semilive skids with racks requires less labor and is significantly cheaper than transporting them on overhead rails, because nearly twice as much meat can be transported each trip. Using forklift trucks and pallets to transport and store fresh and frozen meat in boxes and barrels is faster than using semilive skids, because the containers do not have to be removed from the pallets and handstacked in storage.

Transporting Meat to the Fabricating Areas

The same methods of transport used in receiving and storing meat are used in transporting meat to the individual fabricating areas.

Table 2 shows the labor and equipment requirements and costs per 1,000 pounds for transporting meat to the steak and chop fabricating area and to the ground-meat fabricating area, by fabricating area, type of meat cut or container, and method of transport; and the average weight transported and the distance per round trip. The equipment used in performing each job by different procedures is identified in table 20, in the appendix.

Because nearly twice as much product can be handled per trip, labor requirements for transporting separate cuts by semilive skid with racks are less than half of those for transporting on-the-rail. Palletloads of boxes transported by forklift truck require about 25 to 50 percent less labor than boxes transported by semilive skids, because the boxes stored on pallets can be moved directly to the fabricating area without rehandling. Boxes handled on

TABLE 2.—*Labor requirements and costs and equipment costs for transporting meat from the cooler or freezer to the fabricating areas, by fabricating area, type of meat cut or container, and method of transport*

Fabricating area, type and weight of meat cut or container, and method of transport	Average per trip		Per 1,000 pounds				
	Weight transported	Distance (round-trip)	Elapsed time	Labor requirements [1]	Costs		
					Labor	Equipment [2]	Total
	Pounds	*Feet*	*Hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Steak and chop area:							
Fresh beef short loins (18 pounds):							
On-the-rail	792	130	0.05	0.05	0.16	0.01	0.17
Semilive skid with racks	1,440	130	.02	.02	.07	.01	.08
Fresh beef bone-in strip loins (12 pounds):							
On-the-rail	528	130	.07	.08	.26	.01	.27
Semilive skid with racks	1,080	130	.02	.03	.10	.01	.11
Fresh beef boned strip loins, rib-eye rolls, full tenderloins, top sirloin butts, or ribs; or pork loins in boxes (60 pounds):							
Semilive skid	1,200	136	.06	.06	.20	.01	.21
Forklift	1,200	136	.03	.03	.10	.01	.11
Ground meat area:							
Fresh beef, veal, or pork in boxes (60 pounds):							
Semilive skid	1,200	120	.06	.06	.20	.01	.21
Forklift	1,200	120	.02	.03	.10	.01	.11
Frozen beef, veal, or pork in boxes (60 pounds):							
Semilive skid	1,200	60	.07	.07	.23	.02	.25
Forklift	1,200	60	.05	.05	.16	.02	.18
Fresh beef, veal, or pork in barrels (350 pounds):							
Two-wheel barrel truck	350	120	.06	.06	.20	.02	.22
Forklift	700	120	.04	.05	.16	.02	.18

[1] Includes time taken by meatcutter or ground-products worker to inform meat handler as to kind and quantity of meat needed.

[2] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

semilive skids must be moved one at a time from storage and stacked on the skids. The semilive skid with racks and the forklift truck are more costly to own and operate per hour than an on-the-rail system; however, their expense is offset by the smaller time requirements per 1,000 pounds.

Preparation of Steaks and Chops

Fabricating

In the houses studied, seven types of beef cuts are most commonly used to fabricate portion-controlled steaks. These seven cuts and the types of steaks prepared are:

Original cut	*Steak*
Short loins	Club, T-bone, and porterhouse.
Bone-in strip loins	Bone-in strip loin.
Boned strip loins	Boned strip loin.
Rib-eye rolls	Rib-eye roll.
Boned ribs	Boned rib.
Full tenderloins	Filet mignon.
Top sirloin butts	Top sirloin butt.

Pork loins are used to prepare pork chops.

The number and total weight of the steaks or chops prepared from a cut depend on the weight of the cut. For example, a well-trimmed 18-pound beef short loin can yield seven 8-ounce club steaks, six 12-ounce T-bone steaks, and six 16-ounce porterhouse steaks. Management usually designates the number of portions of each weight to be prepared from a particular cut. If the freezer inventory of one portion weight is low, however, several extra portions in that weight can be fabricated from a particular cut without a very noticeable change in portion size.

There are two general methods of preparing portion-controlled steaks and chops. In the first, the specified-weights method, a meatcutter fabricates only one portion weight at a time. For example, he cuts only the 8-ounce club steaks from a short loin. In the second, the all-weights method, a meatcutter fabricates all of the portion weights designated for a particular cut. He uses the entire short loin to prepare the 8-ounce, 12-ounce, and 16-ounce steaks. Layout of the work areas, the types of worktables, and some of the equipment used differ in the various houses studied.

We measured the labor requirements for both the specified-weights method and the all-weights method. The workroom arrangement and equipment for the specified-weights method is as follows: The worktables are against a wall with a bandsaw at the end of each table. A meat rail extends over an aisle behind the worktables. Semilive skids holding boxes of meat are in the aisle near the meatcutters' work areas (fig. 2). Empty containers for each kind and weight of portion are also on skids in the aisle. A portion scale is placed on a worktable when boned cuts are prepared and on a bandsaw when bone-in cuts are prepared.

With this method and work arrangement, the meatcutter obtains a bone-in meat cut from the overhead rail or a boned cut from a box on a skid, then measures and trims it. He uses a bandsaw to cut bone-in steaks and chops, and a knife to cut boned steaks. The meatcutters have a highly developed skill for estimating the thickness of each portion so that when cut, it usually weighs the specified number of ounces. They frequently weigh a steak or chop as a check, and on occasion trim off extra weight. Each portion weight and kind of steak or chop is placed in a separate container.

After the meatcutter prepares the specified number of portions from a meat cut, he places the unused part of the cut back on the overhead rail or puts it aside on his work table. Filled containers (50 pounds average weight) are stacked on the skid.

The equipment and workroom arrangement for the all-weights method is as follows: The worktables and bandsaws are on both sides of a powered conveyor, which is used to transport empty containers to the meatcutters, and filled containers of steaks and chops to the packaging area. A portion scale is on each worktable. Semilive skids with racks holding separate meat cuts are beside the bandsaws, and pallets of boxed meat are beside the worktables. This arrangement provides a more compact work area for each meatcutter than the one used with the specified-weights method.

With the all-weights method, the meatcutter takes two meat cuts from the rack shelf or from a box, trims them, and cuts each one into

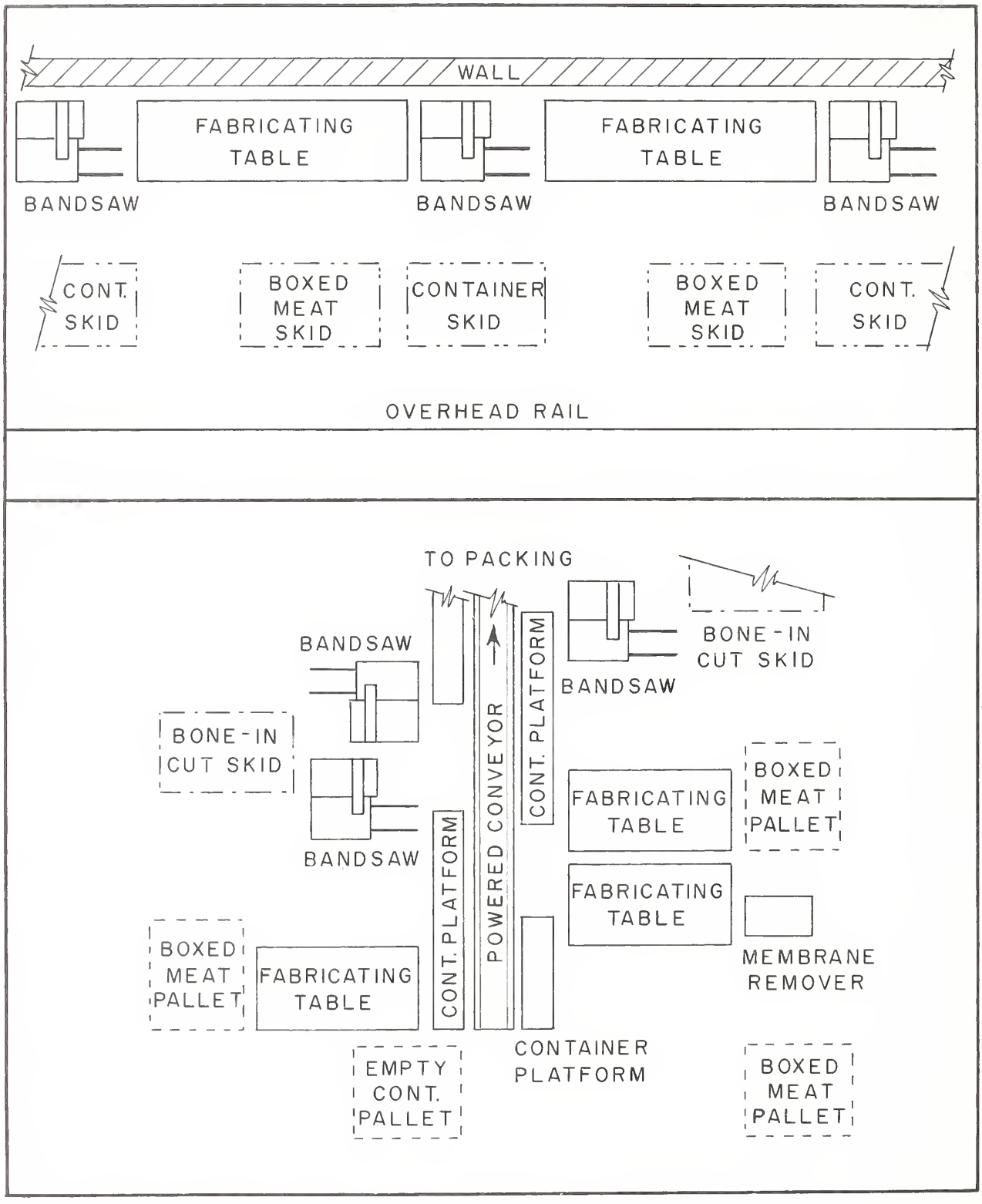

FIGURE 2.—Cutting steaks and chops: The work area arrangement shown at top is for the specified-weights method and that shown at bottom is for the all-weights method.

portions. After he finishes cutting a particular portion weight, he places the portions in the proper container and adjusts the portion-scale poise for the next weight. The containers are on a platform beside the conveyor. The same general work procedures—measuring, cutting, and weighing—are used in both methods. An additional item of equipment—a membrane remover—is used with the all-weights method. A worker using the membrane remover can take the silver skin from three full tenderloins before a worker using a knife can complete one piece. The machine also does a smoother job and leaves more meat on the tenderloin.

Operators of houses employing the specified-weights method say they like the method because the meatcutters do not have to change their portion-scale poise several times while working on one cut, there is less chance for portions to be placed in the wrong container, and workers should be able to cut closer to the actual portion weight needed when they specialize in cutting one size for extended periods.

Operators of houses that employ the all-weights method say that meatcutters devote less time to getting and disposing of meat cuts, and therefore are more productive; and also that workers cutting all the steak and chop portions from one piece can determine the best cutting plan for each piece and obtain a better yield.

Table 3 shows the labor requirements and labor and equipment costs per 1,000 pounds (in-weight) for cutting steaks and chops from eight meat cuts by the two methods described. Table 20 lists the equipment used for both

TABLE 3.—*Labor requirements and costs and equipment costs for fabricating steaks and chops from basic meat cuts, for each of 8 kinds of meat, by 2 methods*

Original meat cut and method [1]	Average weight each cut	Per 1,000 pounds of original meat cuts			
		Estimated yield [2]	Labor requirements	Costs	
				Labor	Equipment	Total
	Pounds	*Pounds*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Beef short loins:	18	778				
Specified weights			5.11	20.44	1.69	22.13
All weights			4.58	18.32	1.57	19.89
Beef bone-in strip loins:	12	750				
Specified weights			5.53	22.12	1.93	24.05
All weights			5.15	20.60	1.86	22.46
Beef boned strip loins:	8	875				
Specified weights			7.43	29.72	.68	30.40
All weights			7.17	28.68	.74	29.42
Beef rib-eye rolls:	7	857				
Specified weights			9.94	39.76	.91	40.67
All weights			9.65	38.60	1.01	39.61
Beef boned ribs:	11	818				
Specified weights			7.16	28.64	.65	29.29
All weights			6.98	27.92	.71	28.63
Beef full tenderloins:	6	667				
Specified weights			9.09	36.36	.79	37.15
All weights			7.78	31.12	1.59	32.71
Beef top sirloin butts:	9	667				
Specified weights			6.65	26.60	.57	27.17
All weights			6.43	25.72	.63	26.35
Pork loins:	10	800				
Specified weights			7.34	29.36	2.25	31.61
All weights			6.98	27.92	2.22	30.14

[1] In the specified-weights method, the meatcutter fabricates only one portion weight at a time. In the all-weights method, all portion weights designated for each cut are fabricated at one stop.

[2] For the weights of the original cuts listed, it is assumed that the following can be prepared from one original cut: Beef short loin, seven 8-ounce, six 12-ounce, and six 16-ounce steaks; beef bone-in strip, nine 8-ounce and six 12-ounce steaks; beef boned strip loin, five 8-ounce and six 12-ounce steaks; beef rib-eye roll, eight 4-ounce and eight 8-ounce steaks; beef boned rib, eight 6-ounce and eight 12-ounce steaks; beef full tenderloin, eight 4-ounce and four 8-ounce steaks; beef top sirloin butt, eight 6-ounce and six 8-ounce steaks; and pork loin, twenty 4-ounce and eight 6-ounce chops.

methods. Most of the reduction in labor requirements when the all-weights method is employed is due to the elimination of the extra handling of meat cuts; to a better work area arrangement that reduces the amount of walking; and to the use of a membrane remover on tenderloins. While equipment costs are higher for five meat cuts with the all-weights method, the savings in labor costs over the specified-weights method make it the most economical method to use for the meat cuts covered in this research.

Moving Steaks and Chops to the Packaging Area

In houses that use a powered belt conveyor in the fabricating area, the conveyor usually extends to the packaging area. As containers are filled with steaks and chops, they can be placed on the belt and moved directly to the packaging area. A worker in either the fabricating or packaging area can operate the conveyor. A gravity conveyor is sometimes attached to the end of the powered conveyor in the packaging area to hold a supply of full containers. While almost any number of containers from one to a full beltload can be transported each time the conveyor is started, we assume the average to be four containers.

Semilive skids holding an average of 10 containers are used to transport steaks and chops to the packaging area in other houses.

The labor requirements and costs and equipment costs per 1,000 pounds are shown in table 4. The equipment used and its cost are shown in table 20. Since the labor required for the conveyor method is limited to starting and stopping the conveyor, it is about one-third the amount required for skids. However, the equipment costs of the conveyor method, depending upon the length used, can range from about the same to more than five times as much per 1,000 pounds as the costs of the several skids and the jacklift needed for the semilive skid method.

Packaging

Steaks are first dipped in a tenderizing solution, then individually wrapped in plastic film and packed in boxes to a specified weight. The boxes are labeled, tied or taped, and placed on four-wheel carts for transport and overnight storage in a low-temperature freezer. Chops are handled in the same manner, except that they are not tenderized.

Most of the houses studied use a machine equipped with a solution tank and a powered conveyor which carries the steaks into, through, and out of the tenderizer. A packaging table, with a powered conveyor down the center and work areas on each side, is generally placed at the "off" end of the tenderizing conveyor. A table with a package scale usually is located at the end of the packaging table.

Some houses use a combination crew, both to wrap individual portions in film and to pack them in boxes. Some houses use separate wrapping and packaging crews.

When a combination wrapping and packaging crew is used to package steaks, one worker obtains the containers from a skid or conveyor and places them at the "on" end of the tenderizer. He then places individual steaks on the conveyor leading to the tenderizing solution. Workers on both sides of the packaging table

TABLE 4.—*Labor requirements and costs and equipment costs for transporting steaks and chops to the packaging area, by method*

Method	Average weight each container	Average per trip		Per 1,000 pounds			
		Weight transported	Distance (one-way)	Labor required	Costs		
					Labor	Equipment[1]	Total
	Pounds	*Pounds*	*Feet*	*Man-Hours*	*Dollars*	*Dollars*	*Dollars*
Powered conveyor	50	200	40	0.01	0.03	0.01	0.04
Semilive skid	50	500	40	.03	.10	.01	.11

[1] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

wrap the tenderized steaks in plastic film, pack them in boxes, and place the boxes on the conveyor. A worker at the end of the table weighs, labels, and tapes or ties the boxes by machine, and places them on a four-wheel cart. This worker also helps to wrap steaks and pack boxes.

When separate wrapping and packaging crews are used, the workers along the packaging table place the wrapped steaks on the conveyor, and a full-time worker at the end of the table packs the steaks in boxes and weighs and labels the boxes. From time to time, one of the wrapping workers tapes or ties the boxes by machine and places them on a four-wheel cart.

When pork chops are packaged, the worker who places steaks on the tenderizing conveyor is normally assigned to other work, and workers along the packaging table bring the containers of pork chops to their work places.

The labor requirements and costs and equipment costs per 1,000 pounds are shown in table 5. Table 20 lists the equipment needed and the owning and operating costs. The savings in time and labor when a combination wrapping-and-packaging crew is used is due primarily to the elimination of one handling (wrapping worker placing wrapped cut on conveyor) of the individual pieces.

TABLE 5.—*Labor requirements and costs and equipment costs for tenderizing steaks and wrapping and packaging steaks and chops, by weight and kind of portion, and by type of work crews*

Kind of meat, portion weight, and method	Package weight	Crew size	Per 1,000 pounds						
			Elapsed time	Labor requirements			Costs		
				Productive	Unproductive	Total	Labor	Equipment	Total
	Pounds	*Number*	*Hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
4-ounce steaks:									
Separate wrapping and packaging crews	10	5	2.98	13.11	[1] 1.79	14.90	48.43	1.54	49.97
One wrapping and packaging crew	10	5	2.62	12.16	[2] .94	13.10	42.58	1.37	43.95
6-ounce steaks:									
Separate wrapping and packaging crews	10.5	5	2.16	9.20	[1] 1.60	10.80	35.10	1.12	36.22
One wrapping and packaging crew	10.5	5	1.84	8.64	[2] .56	9.20	29.90	.96	30.86
8-ounce steaks:									
Separate wrapping and packaging crews	10	5	1.98	7.71	[1] 2.19	9.90	32.18	1.02	33.20
One wrapping and packaging crew	10	5	1.62	7.56	[2] .54	8.10	26.33	.85	27.18
12-ounce steaks:									
Separate wrapping and packaging crews	10.5	4	1.76	6.28	[1] .76	7.04	22.88	.91	23.79
One wrapping and packaging crew	10.5	5	1.31	6.26	[2] .29	6.55	21.29	.68	21.97
16-ounce steaks:									
Separate wrapping and packaging crews	10	4	1.58	5.41	[1] .91	6.32	20.54	.82	21.36
One wrapping and packaging crew	10	5	1.20	5.78	[2] .22	6.00	19.50	.63	20.13
4-ounce chops:									
Separate wrapping and packaging crews	10	4	2.98	11.92	0	11.92	38.74	.92	39.66
One wrapping and packaging crew	10	4	2.76	11.04	0	11.04	35.88	.86	36.74
6-ounce chops:									
Separate wrapping and packaging crews	10.5	4	2.16	8.28	[3] .36	8.64	28.08	.66	28.74
One wrapping and packaging crew	10.5	4	1.94	7.76	0	7.76	25.22	.61	25.83

[1] Worker placing steaks on tenderizing conveyor and workers wrapping steaks in film wait for packaging worker.

[2] Worker placing steaks on tenderizing conveyor waits for other workers.

[3] Workers wrapping chops in film wait for packaging worker.

Preparation of Ground-Meat Patties

Fabricating

Ground-meat patties, with varying amounts of fat and seasonings, are prepared from boneless fresh and frozen meat. Frozen meat generally is allowed to warm up (temper) to 20° to 28° F. before it is used. This tempering makes the meat easier to work. The proportion of frozen meat used in preparing ground-meat patties in the houses visited varied from very little to almost 100 percent. In this study, we assumed that frozen meat made up one-third of the weight of batches of ground meat.

Ground meat.—Blocks of frozen meat are reduced by machine into pieces suitable for coarse chopping or grinding, then the frozen meat and the fresh meat are weighed into batches. The batches are either put through a coarse and a fine plate on a meat grinder, or coarse-chopped and blended by a silent cutter and then put through a grinder with a fine plate for the final run.

Reducing frozen meat.—Blocks of frozen meat can be reduced to small pieces with a number of different machines. Two types are used in the houses studied. One of these, the reciprocating-blade machine, slices a block into rectangular pieces the size of the end of the block as the block is mechanically fed under a powered knife that moves up and down between two guides. The other machine chips pieces from a block that is mechanically pushed against a number of knife-type blades attached to a rotating drum. Each machine can be adjusted to change the thickness of the cut or chipped pieces.

One meat handler is required for operation, regardless of which machine is used. He opens a box of meat and places it on the feed table, starts the machine, and from time to time cleans the cutting area, levels the cut pieces in a tub truck, and exchanges tub trucks as they are filled. Since either machine can reduce a block faster than a worker can get another one ready, some houses, to speed up the operation, use two workers on a machine.

Table 6 shows elapsed time, labor requirements and costs, and equipment costs per 1,000 pounds when one or two meat handlers use the reciprocating-blade machine and the rotating-drum machine. Table 20 shows the cost per hour for the equipment used. If more than one worker operates either machine, the men perform the jobs as needed without any specific assignments. It should be noted that the initial cost of the rotating-drum machine is almost one-third more than that of the reciprocating-blade machine.

Weighing batches.—Fresh and frozen meat is selected from boxes, barrels, and tub trucks and weighed into batches. The batch weight generally is determined by the capacity of the equipment and, as a result, can range from less than 100 pounds to more than 300 pounds. Management normally assigns a skilled worker

TABLE 6.—*Labor requirements and costs and equipment costs for reducing blocks of frozen meat, by number of workers and type of machine*

Number of workers and type of machine	Per 1,000 pounds						
	Elapsed time	Labor requirements			Costs		
		Productive	Unproductive [1]	Total	Labor	Equipment	Total
	Hours	*Man-hours*	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
One worker:							
Reciprocating blade [2]	0.54	0.54	0	0.54	1.76	0.23	1.99
Rotating drum [3]	.52	.52	0	.52	1.69	.33	2.02
Two workers:							
Reciprocating blade [2]	.30	.54	.06	.60	1.95	.13	2.08
Rotating drum [3]	.26	.52	0	.52	1.69	.17	1.86

[1] Workers wait for machine.

[2] A 60-pound block of frozen meat cut into 21 pieces averaging 1 inch in thickness.

[3] A 60-pound block of frozen meat chipped into flakes ¼-inch thick.

to this job, as he must not only follow the specifications for the batch, but also evaluate the fat content of the meat used and then vary the weight of the different kinds of meat to obtain a consistent product.

There is very little variation in the way the ground-products worker performs his job. He normally uses meat hooks, shovels, and forks to transfer the meat to a container or pan on a platform scale. The type of scale used affects the time required to weigh batches.

The labor requirements and costs and equipment costs per 1,000 pounds for weighing batches of meat with two types of platform scales, the weigh-beam and the dial, are shown in table 7. Equipment costs are listed in table 20. A batch weight of 200 pounds is assumed, as this weight is used quite often. The dial scale requires less time than the weigh-beam scale, because the worker reads the weights from a dial and does not have to move a poise to each weight and watch for the beam to balance at the set weight as he must with the weigh-beam scale.

Grinding meat.—The items of equipment most commonly used to prepare ground meat are two manual-feed grinders; two self-feed grinders with a meat mixer, located between them, which elevates and dumps the meat; a silent cutter and manual-feed grinder used in combination, and a silent cutter and self-feed grinder used in combination. A number of arrangements are possible for this equipment, but the four arrangements shown in figure 3 are the only ones covered in this report.

TABLE 7.—*Labor requirements and costs and equipment costs for weighing fresh and frozen meat into batches for ground meat, by type of scale*

(Average batch weight, 200 pounds)

Type of platform scale	Per 1,000 pounds			
	Labor requirements	Costs		
		Labor	Equipment	Total
	Man-Hours	*Dollars*	*Dollars*	*Dollars*
Weigh-beam	0.29	1.16	0.02	1.18
Dial	.25	1.00	.04	1.04

Skilled workers normally operate this equipment. Generally two workers, one per machine, are required to operate the manual-feed grinders, to blend and feed the meat into the machines, and to service them. If, however, there is no need for speed in completing a batch, one worker can handle both machines, operating each one in turn.

When two self-feed grinders and an elevating mixer are used, only one part-time worker is needed to start and stop the grinders and to start, mix, elevate, dump, lower, and stop the mixer.

Usually only one worker operates both the silent cutter and the manual-feed grinder. With the cutter, very little time is required to load and unload a batch of meat, and the running time during coarse-chopping can be automatically controlled.

The silent cutter and self-feed grinder require only a part-time worker to operate both of them, as the two machines perform their work automatically. They need a worker only to start and stop them, to load the cutter, and to transfer the meat from the cutter to the feed hopper of the grinder.

The amount of ground meat produced per hour by an equipment combination can depend on a number of factors. The piece size of meat to be coarse-chopped or ground may affect the time required per batch. Large pieces, especially if frozen, do not feed as readily as small ones. All of the equipment should be capable of holding an entire batch to eliminate the extra time that is required when only part of a batch can be handled by a machine at one time.

An equipment combination in which all machines have about the same production capacity should minimize the idle time that can result from a lack of balance in running time per batch. A good equipment arrangement to minimize walking time between work stations, and the use of automatic timers and machines to replace manual labor can reduce worker fatigue and help maintain maximum production throughout the work day.

Table 8 shows the labor requirements and costs and equipment costs for preparing 1,000 pounds of ground meat using two 10-horsepower manual-feed grinders, mounted piggyback; two 10-horsepower self-feed grinders and

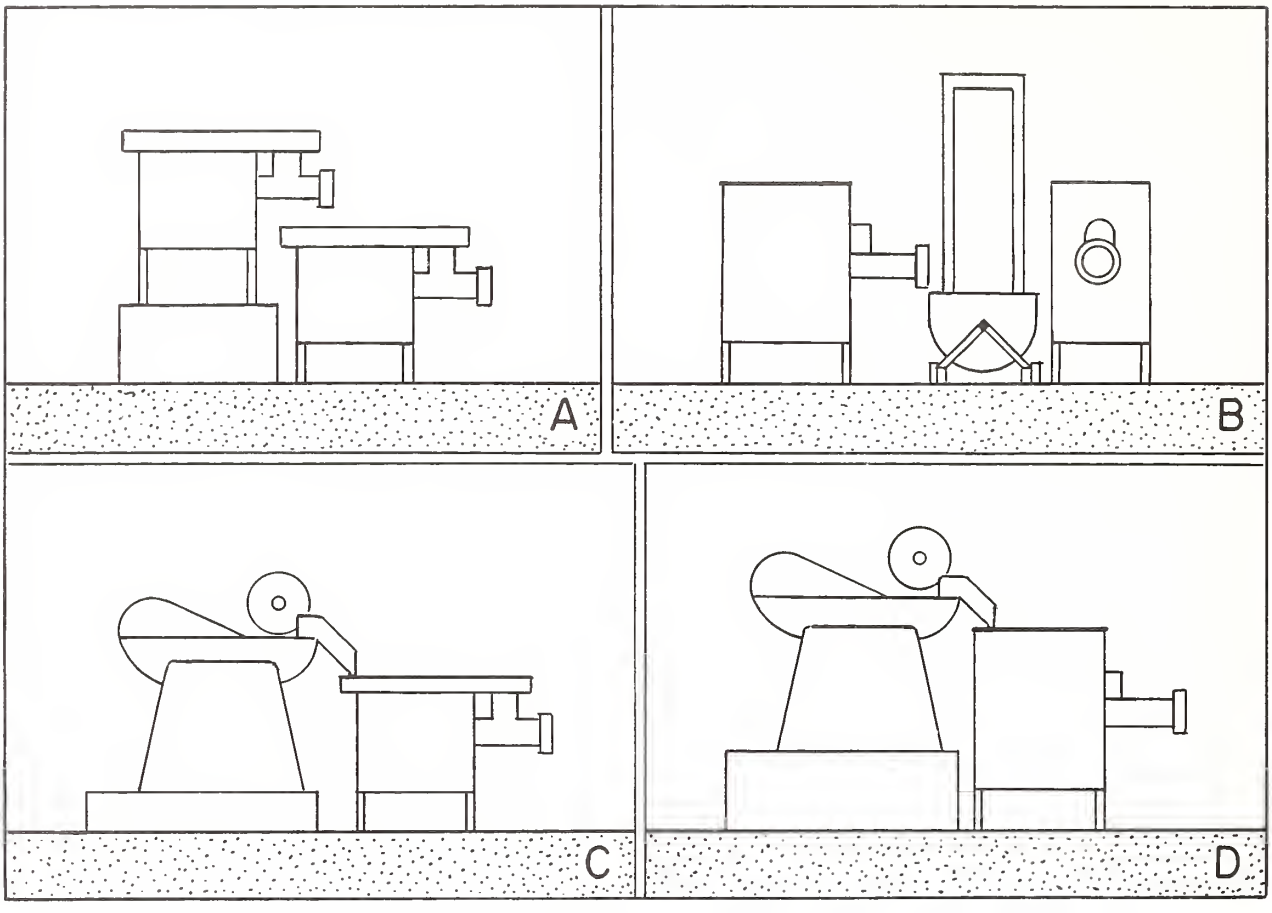

FIGURE 3.—Preparing ground meat: (A) Two manual-feed grinders, piggy-back; (B) two self-feed grinders and mixer; (C) silent cutter and manual-feed grinder; and (D) silent cutter and self-feed grinder.

TABLE 8.—*Labor requirements and costs and equipment costs for coarse chopping and fine grinding fresh and frozen meat for ground meat, by type of equipment and number of workers*
(Average batch weight, 200 pounds)

Type of equipment and number of workers	Per 1,000 pounds						
	Labor requirements				Costs		
	Elapsed time	Productive	Unproductive	Total	Labor	Equipment	Total
	Hours	*Man-hours*	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Two manual-feed grinders piggyback:							
One worker	0.82	0.82	0	0.82	3.28	0.47	3.75
Two workers	.54	.82	[1] .25	1.07	4.28	.31	4.59
Two self-feed grinders and elevating mixer:							
One worker	.42	.18	([2])	.18	.72	.53	1.25
Silent cutter and manual-feed grinder:							
One worker	.45	.45	0	.45	1.80	.63	2.43
Silent cutter and self-feed grinder:							
One worker	.36	.14	([2])	.14	.56	.58	1.14

[1] Worker operating coarse-grinder waits for meat pieces to be placed on feed pan, and worker operating fine-grinder waits for coarse-ground meat.

[2] Worker performs other jobs while machines are in operation and require no attention.

an elevating meat mixer; a 15/30-horsepower silent cutter and a 10-horsepower manual-feed grinder, mounted piggyback; and a 15/30-horsepower silent cutter and a 10-horsepower self-feed grinder, mounted piggyback. Table 20 shows the cost per hour of use for this equipment. In addition to operating the machines, the workers periodically have to stop the equipment and clean the feeding and cutting areas.

When two workers operate the two grinders, as compared with one worker, the actual time per 1,000 pounds is reduced by 34 percent; however, total labor requirements are increased by about the same amount. The silent cutter and self-feed grinder is the most productive combination. It also has the smallest labor requirement. The major reason for this efficiency is that the coarse chopped meat is blended in the cutter bowl, which eliminates the need for a separate mixing cycle.

The comparatively small labor requirement for the silent cutter and self-feed grinder is the result of using built-in devices to reduce worker attention time. While the total costs per 1,000 pounds for the two self-feed grinders and elevating mixer and for the silent cutter and self-feed grinder are about the same, the latter equipment combination can produce about 16 percent more ground meat per hour of operation with about 22 percent less labor.

Transporting Between Work Areas

Fresh and frozen meats normally have to be moved between several equipment locations during the preparation of ground meat. By having separate work stations, workers can be assigned to prepare or accumulate a supply of the product needed in the next step and then can be transferred to other jobs. This procedure minimizes both the time that workers spend waiting on machines and any delay in supplying the proper ground meat to the patty formers.

In most houses three transports are involved in preparing and delivering ground meat: The moving of (1) reduced frozen meat from the block-reduction machine to batch makeup, (2) batches of fresh and frozen meat from the scale to the coarse-chopper, and (3) ground meat from the fine-grinder to the patty-formers.

Four different combinations of transportation equipment and procedures are used in the houses studied. One combination employs only tub trucks; a second, both tub trucks and hand-carried pans; another, tub trucks and dump buckets; and a fourth, tub trucks and belt conveyors. When tub trucks and pans are employed, the handcarried pans are used only to transport meat from the scale at the batch-weighing area to the coarse-chopper. For both the tub-truck and dump-bucket combination and the tub-truck and belt-conveyor combination, tub trucks are used only to transport reduced frozen meat from the frozen-block reduction machine to batch makeup at the scale.

The tub-truck and dump-bucket combination requires an electric hoist attached to double trolleys, a number of bucket dollies, several bucket-lifting yokes, and an overhead rail to transport meat in buckets from the weighing area to coarse-chopping and then to the patty-formers.

The transport of products generally is performed by the same workers who handle the meat preparation at each work area. Meat handlers normally move the frozen reduced meats to batch weighing. All other transports generally are handled by a ground-products worker.

The labor requirements and costs and equipment costs per 1,000 pounds for transporting the products between work areas and from the work areas to the patty-formers are shown in table 9. Table 20 shows the equipment costs per hour. The use of the tub-truck and belt-conveyor combination offers the advantages of being the lowest in total cost, requiring the least labor, and demanding the least worker effort. The major disadvantage is that the distance the ground meat can be moved is limited to the length of the conveyor and the arc through which it can be moved.

Forming and Packaging Patties

Forming and packaging patties includes feeding meat into the forming machine, checking patties for defects and packing them in boxes, closing and labeling boxes, placing boxes on a freezer cart, and servicing the

TABLE 9.—*Labor requirements and costs and equipment costs for transporting meat between work areas during preparation of ground meat and from work areas to patty formers, by type of equipment*

Product work areas and type of transportation equipment	Average per trip		Per 1,000 pounds			
				Costs		
	Weight transported	Distance (one way)	Labor required	Labor	Equipment [1]	Total
	Pounds	*Feet*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Reduced frozen meat to batch makeup:						
Tub truck	300	15	0.02	0.08	0.01	0.09
Batches of fresh and frozen meat to coarse-chopper and grinder: [2]						
Tub truck	200	10	.18	.72	.01	.73
Manual pan	50	6	.12	.48	0	.48
Dump-bucket on-the-rail	200	10	.09	.36	.01	.37
Conveyor	200	10	.03	.12	.01	.13
Ground meat to patty-former: [2]						
Tub truck	200	20	.19	.76	.01	.77
Dump-bucket on-the-rail [3]	200	20	.15	.60	.01	.61
Conveyor	200	20	.04	.16	.01	.17

[1] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

[2] Meat is shoveled into feed area when in tub truck, manually dumped when in pan, dumped by sliding out bottom when in dump-bucket, and deposited by belt when on conveyor.

[3] Dump-bucket is on four-wheel dolly during grinding.

machines. All of the patty machines studied can form regular ground-meat patties or patties to be breaded.

Four types of patty-forming machines are used in the houses studied. These machines operate at a constant speed and form patties at a rate of 2,100, 3,600, or 4,000 per hour. The forming plates on three types have to be changed to produce a different weight, size, or shape of patties. With the fourth machine, the thickness of the patty can be regulated so that a range of weights can be produced with each forming plate. This machine requires a different forming plate for each size or shape of patty.[2]

The patty-forming machines are equipped to insert a sheet of paper between the formed patties so that stacks of patties can be separated easily while frozen. The paper used is made, normally, of double sheets, laminated. Both the 2,100- and 4,000-per-hour patty-forming machines have to be stopped to replenish the paper supply. Paper for the 3,600-per-hour machines can be added while the machines are operating.

Even though patties can be formed in a number of combinations of weights, sizes, or shapes, most houses limit their production to about three or four of the most popular ones for each kind of meat, and package them in only one or two package weights in order to reduce the freezer inventory requirements and to limit the number of box sizes needed.

The productivity of a worker or workers forming and packaging patties depends on the forming rate of the patty machine or machines, the weight of the patty, the number of patties placed in each stack or layer in a box, the box weight when packed, and the amount of machine attention time required. To reduce machine attention time, most houses use patty-forming machines with built-in feed. Other labor-saving items of equipment used are: (1) A special conveyor that can be attached to a patty-forming machine, either to count the patties into stacks and then move the stacks or to move single patties; and (2) a package-tying or -taping machine.

[2] While other machines with faster rates are available for forming patties, they are not discussed here because the evaluation of patty-forming machines and most accessory equipment was limited to equipment now available and observed in operation during the study.

Ground-meat patties.—Six of the more common equipment combinations are discussed in this report as follows: (1) A 2,100-per-hour patty-former that requires the operator to hand-feed ground meat into the forming head; (2) a hand-fed, 4,000-per-hour patty-former with a conveyor-stacker; (3) a built-in feed, 4,000-per-hour patty-former with a conveyor-stacker; (4) two 4,000-per-hour patty-formers with built-in feeds and conveyor-stackers; (5) a 3,600-per-hour patty-former with a built-in feed and a conveyor-stacker; and (6) two 3,600-per-hour patty-formers with built-in feeds and conveyor-stackers. One packaging worker normally operates each combination. All combinations require a packaging table, a package-tying or -taping machine, and a freezer cart for packed boxes.

From studies made of these patty-forming machines, it was determined that about 3 percent of the patties formed were unusable. In most instances, this waste resulted from a shortage of meat in the finished patties and from damage to the patties during packaging.

Table 10 compares the labor requirements and costs and equipment costs per 1,000 pounds to form and package three different patty weights, using the six equipment combinations. All of the equipment used and the cost per hour is shown in table 20. Since two of the four patty-forming machines studied have the same forming rate (number of patties formed per hour) and are manufactured by the same company, only three forming rates (2,100/hr., 3,600/hr., and 4,000/hr.) are covered in the table. It is assumed that the average packed box weight is 10 pounds, eight stacks of patties are placed in each box, and the forming plates are changed after a run of 1,000 pounds.

A 4,000-per-hour patty-former and manual feed combination is the most economical when patties weigh 2 ounces. For 1.6 and 2.67-ounce patties, there is no significant difference between the 3,600 and 4,000-per-hour patty-former combinations.

Breaded patties.—Ground beef, veal, pork, and meat blends are used to form patties for breading. After forming, they are conveyed through a batter solution and dry breading and onto a packaging table conveyor. The patties are packed in layers in boxes, and the filled boxes are placed back onto the conveyor for transport to the packaging table with scale. At this table, boxes are check-weighed to see whether the correct number of patties are packed. Then they are closed, labeled, tied or taped, and placed on a freezer-cart rack.

When ground-meat patties are breaded, a short conveyor is needed to transport single patties from the patty-former to the batter-solution conveyor. Most houses use a conveyor equipped with multitooth rollers to score the top and bottom of the patties to increase the pickup of batter and breading when the 2,100- and 3,600-per-hour patty-formers are used.

The same patty-formers described for ground-meat patties generally are used for breading patties. In addition to the patty machines and related equipment, batter and breading machines are needed, as well as a conveyorized packaging table, a packaging table with scale, a tying or taping machine, and a freezer cart.

Breaded patties are composed of about 70 to 80 percent meat and 30 to 20 percent batter and breading. This means that a 2-ounce ground-meat patty can be used to obtain a 2.67-ounce breaded patty.

The crew size ranges from two to six workers. Crew size generally is determined by the number of patty-formers used to supply patties to each batter and breading machine, their rate, and the equipment used. When patties are produced faster than they can be packed, the patty-former is stopped occasionally for the workers to catch up. About 5 percent of the breaded patties are unusable because of forming or breading defects.

Table 11 compares the labor and equipment requirements and costs per 1,000 pounds to form, bread, and package three patty weights (2, 2.67, and 4 ounces) with five equipment combinations. All equipment costs are shown in table 20. Only one patty-former is used in each combination. Breaded patties generally are packed individually in layers in boxes, and large layer-separation sheets are used instead of patty paper. When 2-ounce breaded patties are packed with the 4,000-per-hour patty-former, the use of a built-in feed permits two workers to do the work of three with only a slight increase in elapsed time. In the compari-

TABLE 10.—*Labor requirements and costs and equipment costs for forming and packaging ground-meat patties, by patty weight and by equipment combination*

Patty weight and equipment combination	Per 1,000 pounds					
	Labor requirements			Costs		
	Productive	Unproductive [1]	Total	Labor	Equipment	Total
	Man-hours	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
1.60-ounce patties (100 per box):						
One 2,100-per-hour patty-former and manual feed	3.37	1.97	5.34	17.36	1.38	18.74
One 4,000-per-hour patty-former and manual feed	2.27	.42	2.69	8.74	1.38	10.12
One 4,000-per-hour patty-former with built-in feed	2.12	.57	2.69	8.74	1.44	10.18
Two 4,000-per-hour patty-formers with built-in feed	[2] 2.15	0	2.15	6.99	2.13	9.12
One 3,600-per-hour patty-former with built-in feed	2.13	.78	2.91	9.46	1.50	10.96
Two 3,600-per-hour patty-formers with built-in feed	[2] 2.16	0	2.16	7.02	2.15	9.17
2-ounce patties (80 per box):						
One 2,100-per-hour patty-former and manual feed	3.15	1.14	4.29	13.94	1.11	15.05
One 4,000-per-hour patty-former and manual feed	2.11	.05	2.16	7.02	1.11	8.13
One 4,000-per-hour patty-former with built-in feed	1.96	.20	2.16	7.02	1.16	8.18
Two 4,000-per-hour patty-formers with built-in feed	[2] 1.99	0	1.99	6.47	1.97	8.44
One 3,600-per-hour patty-former with built-in feed	1.97	.37	2.34	7.61	1.21	8.82
Two 3,600-per-hour patty-formers with built-in feed	[2] 2.00	0	2.00	6.50	1.99	8.49
2.67-ounce patties (60 per box):						
One 2,100-per-hour patty-former and manual feed	3.25	.01	3.26	10.60	8.44	19.04
One 4,000-per-hour patty-former and manual feed	2.24	0	2.24	7.28	1.15	8.43
One 4,000-per-hour patty-former with built-in feed	2.09	0	2.09	6.79	1.12	7.91
Two 4,000-per-hour patty-formers with built-in feed	[2] 2.12	0	2.12	6.89	2.10	8.99
One 3,600-per-hour patty-former with built-in feed	2.11	0	2.11	6.86	1.09	7.95
Two 3,600-per-hour patty-formers with built-in feed	[2] 2.14	0	2.14	6.96	2.13	9.09

[1] Worker waits for patties to pack.

[2] Servicing second patty-former requires 0.03 man-hours additional.

TABLE 11.—*Labor requirements and costs and equipment costs for forming, breading, and packaging patties, by patty weight and by equipment combination*

Patty weight and equipment combination	Crew size	Per 1,000 pounds						
		Elapsed time	Labor requirements			Costs		
			Productive	Unproductive[1]	Total	Labor	Equipment	Total
	Number	*Hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
2-ounce patties (80 per box):								
2,100-per-hour patty-former and manual feed	3	4.13	5.72	6.67	12.39	40.27	3.86	44.13
4,000-per-hour patty-former and manual feed	3	2.34	5.50	1.52	7.02	22.82	2.58	25.40
4,000-per-hour patty-former with built-in feed	2	2.51	5.02	0	5.02	16.32	2.83	19.15
3,600-per-hour patty-former with built-in feed	2	2.62	5.24	0	5.24	17.03	3.18	20.21
3,600-per-hour patty-former with built-in feed[2]	2	2.62	5.24	0	5.24	17.03	2.86	19.89
2.67-ounce patties (60 per box):								
2,100-per-hour patty-former and manual feed	3	3.13	4.85	4.53	9.38	30.49	2.92	33.41
4,000-per-hour patty-former and manual feed	3	1.63	4.62	.27	4.89	15.89	1.80	17.69
4,000-per-hour patty-former with built-in feed	2	2.08	4.16	0	4.16	13.52	2.34	15.86
3,600-per-hour patty-former with built-in feed	2	2.19	4.38	0	4.38	14.24	2.66	16.90
3,600-per-hour patty-former with built-in feed[2]	2	2.19	4.38	0	4.38	14.24	2.39	16.63
4-ounce patties (40 per box):								
2,100-per-hour patty-former and manual feed	3	2.13	3.99	2.40	6.39	20.77	1.99	22.76
4,000-per-hour patty-former and manual feed	3	1.25	3.75	0	3.75	12.19	1.38	13.57
4,000-per-hour patty-former with built-in feed	3	1.10	3.30	0	3.30	10.73	1.24	11.97
3,600-per-hour patty-former with built-in feed	3	1.30	3.53	.37	3.90	12.68	1.58	14.26
3,600-per-hour patty-former with built-in feed[2]	3	1.30	3.53	.37	3.90	12.68	1.42	14.10

[1] Workers wait for patty-forming machine.

[2] It was assumed that the light-duty patty-former was used in this combination.

sons made, the 4,000-per-hour patty-former with a built-in feed is the most economical combination.

Transporting Packages to the Quick-Freezer

Most portion-control houses use four-wheel freezer carts to transport packed boxes to the quick-freezer and to hold the packages overnight in the freezer. The carts are of various sizes, with six to 10 rod- or slat-type shelves spaced so that air will circulate between the layers of boxes. Meat handlers transport the loaded carts to storage in the quick-freezer.

The major difference in the use of the carts is in the weight of packages transported each trip. We measured labor requirements for transporting packages with four-wheel carts having eight shelves of 6 square feet each, and with four-wheel carts having nine shelves of 16 square feet each. The small carts hold twenty-four 10-pound boxes; and the larger carts, eighty-one 10-pound boxes. The larger carts carry more than three times as much as the smaller carts, making labor requirements and total costs per 1,000 pounds less than one-third of those for the small carts (table 12). Small carts probably are used because of crowded aisles and work areas in some houses, or because they are easier to handle than the larger carts.

Storing Packages in the Holding Freezer

The freezer carts loaded with the previous day's production normally are removed from the quick-freezer before any of the current day's production is ready for the freezer. In a few houses, the loaded freezer carts are transported directly to the holding freezer and the packages are stacked for storage according to the kind of product. Other houses remove the packages from the freezer carts and stack them on semilive skids, pallets, or four-wheel platform trucks for transport to storage.

Many houses case the packages, before storing, to: (1) Protect the packages, and hence the product, from damage during handling; (2) insulate the product better to minimize loss of quality from exposure to temperatures above freezing during order assembly and delivery; (3) reduce frost buildup on packages and product during storage; (4) minimize labor requirements during handling; and (5) permit higher stacks in the holding freezer without damaging the product. These cased packages generally are stacked on either semilive skids or pallets for transport to storage. Cases on semilive skids normally are hand-stacked in storage according to the kind of products; those on pallets are stacked in unit loads by using a forklift truck. Since most of the houses studied case packages before storage, this procedure is the only one covered in this report.

The method followed in this operation is quite similar in the several houses. The size of the crew varies from four to about 10 workers, depending upon how much is stored and how soon the freezer carts will be needed for the day's production. Generally one worker transports the loaded freezer carts to the casing area. When he has time, he also helps several workers set up cases and place them on the transport equipment, pack and label cases, and

TABLE 12.—*Labor requirements and costs and equipment costs for transporting packages to the quick-freezer, by size of transport equipment*

Equipment	Average weight per load [1]	Per 1,000 pounds			
		Labor required	Costs		
			Labor	Equipment [2]	Total
	Pounds	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Four-wheel cart with eight shelves of 6 square feet each	240	0.10	0.33	0.01	0.34
Four-wheel cart with nine shelves of 16 square feet each	810	.03	.10	.01	.11

[1] Average round-trip distance, 125 feet.

[2] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

record the number of packages. Another worker transports and places the cases in the holding freezer.

Labor and equipment requirements and costs per 1,000 pounds to case the packages and store the cases in the holding freezer, with four combinations of transportation equipment and three crew sizes, are compared in table 13. Table 20 lists equipment costs per hour of use. The two freezer carts are the same as those described for transporting packages to the quick-freezer. The two types of transport equipment for cases are: A semilive skid and a jacklift, and a pallet and a forklift truck. It is assumed that each case weighs 60 pounds (six 10-pound packages). The reduction in labor as well as total costs when the freezer carts with nine shelves and the pallet and forklift truck are used is due partly to the fewer trips required to transport the larger loads between the quick-freezer and casing area, and partly to the elimination of the time required to hand-stack cases in the storage freezer.

Assembling Products from the Holding Freezer

The time required to assemble products from the holding freezer depends to a great extent on the way products are stored and how they are listed on the invoice. Products are not always stored by kind and type, or according to a plan based on the volume sold. Occasionally the order of the listing of products on the invoice does not conform to the product storage arrangement. A few houses have an excellent product storage arrangement in the holding freezer, and the invoice listing follows the same order as the storage arrangement. In these houses, the assembly of products requires a minimum of travel and time. Usually one worker assembles cases on a four-wheel platform cart that holds about 20 cases (1,200 pounds).

Table 14 shows the labor requirements and costs and equipment costs per 1,000 pounds for assembling cases when they are stored at random and when they are stored by product groups in designated areas. When cases are stored at random, the worker usually has to pick up packages on all aisles in the holding freezer each time he loads a cart. Based on studies in a holding freezer containing about 2,000 square feet, he travels about 300 feet inside the freezer each time he loads a cart with 1,200 pounds of product. When the arrangement of the products in storage is determined by the volume sold, and the order of the invoice listing conforms with the storage arrangement, the assembly worker has to travel only about 135 feet per load and he usually can make fewer stops, pick up more cases at each stop, and limit the distance traveled to only part of the freezer.

Loading of Delivery Trucks

Most houses load several trucks at the same time. The loadout dock usually is about the same height as a delivery truck bed. If there is no rush, the same worker who assembles the products normally loads the trucks. The only equipment involved is the four-wheel platform carts.

Two crew sizes are compared for loading products in delivery trucks. The labor requirements and costs and equipment costs per 1,000 pounds are shown in table 15. The actual time for loading 1,000 pounds is about 40 percent less when two workers are used instead of one. However, the total labor required for the two workers is greater, since the time for manual transfer of the cases between the workers adds to the overall time.

Supporting Operations

Some of the work operations performed in the houses covered by this report are classified as supporting operations, as they are not directly concerned in the handling and preparation of products. A few of the supporting operations have to be performed either before or during production, others are performed when required. The supporting operations are difficult to evaluate, as the procedures followed often are left up to each worker's interpretation of how the job should be done, the number of workers assigned varies from time to time and from house to house, and little or no relationship has been established between the volume handled and the labor requirements. Because of these variations, the major supporting

TABLE 13.—*Labor requirements and costs and equipment costs for transporting meat packages to casing area and cases to holding freezer, by work performed and type and size of transport equipment*

Work performed and type of transport equipment	Average per load		Crew size	Per 1,000 pounds						
				Elapsed time	Labor requirements			Costs		
	Distance (round trip)	Weight			Productive	Unproductive	Total	Labor	Equipment [1]	Total
	Feet	*Pounds*	*Number*	*Hours*	*Man-hours*	*Man-hours*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Transport packages to casing areas on four-wheel cart with eight shelves, and pack cases	100	240	6		0.53	0.07	0.60	1.95	0.01	1.96
Transport cases to holding freezer on semilive skids, and hand stack cases	220	1,200	1		.10	0	.10	.33	.02	.35
Total	---	---	7	0.10	.63	.07	.70	2.28	.03	2.31
Transport packages to casing area on four-wheel cart with eight shelves, and pack cases	100	240	7		.53	.03	.56	1.82	.01	1.83
Transport cases to holding freezer, using pallets and fork-lift truck	220	1,200	1		.07	.01	.08	.26	.04	.30
Total	---	---	8	.08	.60	.04	.64	2.08	.05	2.13
Transport packages to casing area on four-wheel cart with nine shelves, and pack cases	100	810	5		.48	.02	.50	1.63	.01	1.64
Transport cases to holding freezer, using semilive skids, and hand stack cases	220	1,200	1		.10	0	.10	.33	.02	.35
Total	---	---	6	.10	.58	.02	.60	1.96	.03	1.99
Transport packages to casing area on four-wheel cart with nine shelves, and pack cases	100	810	6		.48	0	.48	1.56	.01	1.57
Transport cases to holding freezer, using pallets and fork-lift truck	220	1,200	1		.07	.01	.08	.26	.04	.30
Total	---	---	7	.08	.55	.01	.56	1.82	.05	1.87

[1] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

TABLE 14.—*Labor requirements and costs and equipment costs for assembling cases from holding freezer, by storage system*

Method of storage	Average per assembling trip				Per 1,000 pounds			
						Costs		
	Stops to select cases	Cases selected per stop	Total cases	Total load	Labor required	Labor	Equipment [1]	Total
	Number	*Number*	*Number*	*Pounds*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Cases stored at random	10	2	20	1,200	0.15	0.49	0.01	0.50
Cases stored by product groups at designated areas	4.33	4.62	20	1,200	.13	.42	.01	.43

[1] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

TABLE 15.—*Labor requirements and costs and equipment costs for loading of delivery trucks, by number of workers*

Crew and operations performed	Per 1,000 pounds				
	Elapsed time	Labor required	Costs		
			Labor	Equipment [1]	Total
	Hours	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Two workers:					
Check invoice and pick up and hand cases to loader	---	0.07	0.23	0	0.23
Transport cases and stack in delivery truck	---	.07	.23	0	.23
Totals	0.07	.14	.46	0	.46
One worker:					
Check invoice and pick up, transport, and stack cases in delivery truck	.12	.12	.39	.01	.40

[1] Equipment costs are raised to $0.01 when they are between $0.0010 and $0.0099.

operations are listed but no data or discussion is included. The supporting operations are as follows: (1) Receiving and storing supplies; (2) arranging products and supplies in storage areas; (3) setting up boxes and transporting bones, fat, and trash from work areas; (4) cleaning equipment and facility; (5) preparing additives for steaks and patties; and (6) maintaining equipment and facility.

Discussion of Work Methods and Equipment

Work methods that reduce the number of times products are handled, using equipment that transports larger loads or eliminates work, can save time and lower operating costs.

The time required and the costs of receiving and storing separate meat cuts and moving them to the fabricating area can be decreased by using semilive skids with racks, instead of meat rails, to transport and store the cuts. Larger loads can be transported when separate meat cuts are placed on skids with racks. Receiving and transporting boxes and barrels of meat in palletloads by forklift truck, storing them on pallets, and moving the meats to the fabricating area on pallets requires less time and is cheaper than using semilive skids for boxes and two-wheel trucks for barrels. Use of pallets and forklift trucks eliminates the handling of each container when it is placed in storage or removed to the fabricating area.

When a meatcutter fabricates the entire beef cut into steaks, or pork loin into chops, he eliminates several handlings of the cut that are required when a worker fabricates only one weight of steak or chop at a time. A worker using a membrane remover can take the silver skin off beef tenderloins in less than one-third

the time required for a worker using a knife, and the machine does a better job.

The cost as well as the time and labor required to transport containers of steaks and chops from the fabricating area to the packaging area can be reduced by using powered and gravity conveyors rather than semilive skids. In addition to shortening the transport time, use of the conveyors eliminates manual handling of the full containers of steaks from the skids to the packaging table.

When a combination crew does both the wrapping and the packaging of steaks and chops, both jobs are accomplished faster and with less unproductive time than when separate crews are used.

In preparing ground meat, use of a dial scale, a silent cutter equipped with a timer, and a self-feed grinder can substantially increase the productivity of the workers. Weighing batches with a dial scale is faster than with a weigh-beam scale because the worker does not have to adjust the poise for each type of meat added and wait to see if the beam balances.

The tub truck and belt conveyor for transporting meat between work areas during the preparation of ground meat is the most efficient equipment combination studied. The conveyor also eliminates most of the strenuous labor required to transfer meat between equipment.

By using a built-in feed to put ground meat into the forming head of patty machines, the workers assigned to forming and packaging all types of patties often can perform their work faster, at a lower operating cost, and with less unproductive time.

The labor required to transport and store packages on four-wheel carts in the overnight freezer is directly related to the weight transported, as each load, regardless of its weight, requires about the same amount of time to transport.

The transport of cased frozen products and their storage in the holding freezer can be done more efficiently if the cases are placed on pallets and transported and placed into storage with powered forklift trucks.

When the product storage arrangement in the holding freezer follows the same order as the loading invoice, and the location of products is based on the amount sold, the order fillers need less time to select items because they average traveling a shorter distance in the room per load and normally can select more packages at each stop.

While it takes one worker longer than two to load packages into a delivery truck, one worker is more efficient because no time is lost in transferring packages from one worker to the other.

Adequate and well-planned work space for each employee, with a minimum of interference from other workers, can add to the efficiency of an operation. Unfortunately the difference between a good and a poor work area often cannot be measured accurately enough to give a value.

To reduce the time required to prepare some products, two or more workers are sometimes assigned to a job that can be performed more efficiently by one worker.

The work methods and equipment that can be of the most benefit to an operator in a particular situation depend upon a careful evaluation of the volume to be handled, the space available, the product flow, and the labor and equipment requirements and their costs.

The second part of this report, which follows, compares the labor and equipment requirements and costs of using some of the methods and equipment previously described for a medium-size house, assuming an annual volume of 3,500,000 pounds.

LABOR, EQUIPMENT, AND COSTS FOR 3,500,000 POUNDS ANNUAL VOLUME, BY WORKING AREA

In this part of the report, labor and equipment requirements and costs for a house with an annual volume of 3,500,000 pounds are estimated for the most efficient work methods and equipment types previously covered and for an alternate combination of methods and equipment. A house layout of this size, based on the most efficient methods and equipment studied and the principles of good layout, is suggested. Various work and storage areas are discussed, as well as plans for expanding the layout to handle an increase to 7 million pounds volume.

An assumed composition of fresh and frozen products received by the house is shown in table 16. Fresh meat for steaks and chops makes up about 45 percent of the annual volume of 3,500,000 pounds. Fresh and frozen meat for patties makes up 47 percent. Table 21 lists the assumed annual production by work area and by portion kind, name, and weight. The remaining 8 percent of the total volume handled consists of other frozen products that are not produced at the house. The product movement through the handling and processing operations is illustrated in figure 4.

Labor and equipment requirements were developed for the annual volume that would be handled or prepared in each operation, since the frequency and amount of all items produced in these houses generally are determined by the inventory on hand in the holding freezer rather than on the daily production of a speci-

TABLE 16.—*Assumed composition of meat and other products in an annual volume of 3,500,000 pounds received annually by a house supplying frozen portion-controlled meat*

Type of product and container	Average unit weight	Units [1]	Weight	Percentage of total
	Pounds	*Number*	*Pounds*	*Percent*
Fresh meat cuts–separate pieces:				
Beef short loins	18	26,000	468,000	13.37
Beef bone-in strip loins	12	13,000	156,000	4.46
Total	----	39,000	624,000	17.83
Fresh meat cuts–packed in boxes:				
Beef boned strip loins	60	1,734	104,000	2.97
Beef rib-eye rolls	60	3,034	182,000	5.20
Beef boned ribs	60	2,384	143,000	4.08
Beef full tenderloins	60	2,600	156,000	4.46
Beef top sirloin butts	60	1,950	117,000	3.34
Pork loins	60	3,900	234,000	6.69
Total	----	15,602	936,000	26.74
Fresh boneless beef, veal, and pork–packed in boxes	60	9,750	585,000	16.71
Fresh boneless beef, veal, and pork–packed in barrels	350	1,093	382,500	10.93
Frozen boneless beef, veal, and pork–packed in boxes	60	11,375	682,500	19.50
Other frozen packaged products–packed in boxes	60	4,834	290,000	8.29
Grand total	---	81,654	3,500,000	100.00

[1] The number of units involved has been raised to the next higher whole number.

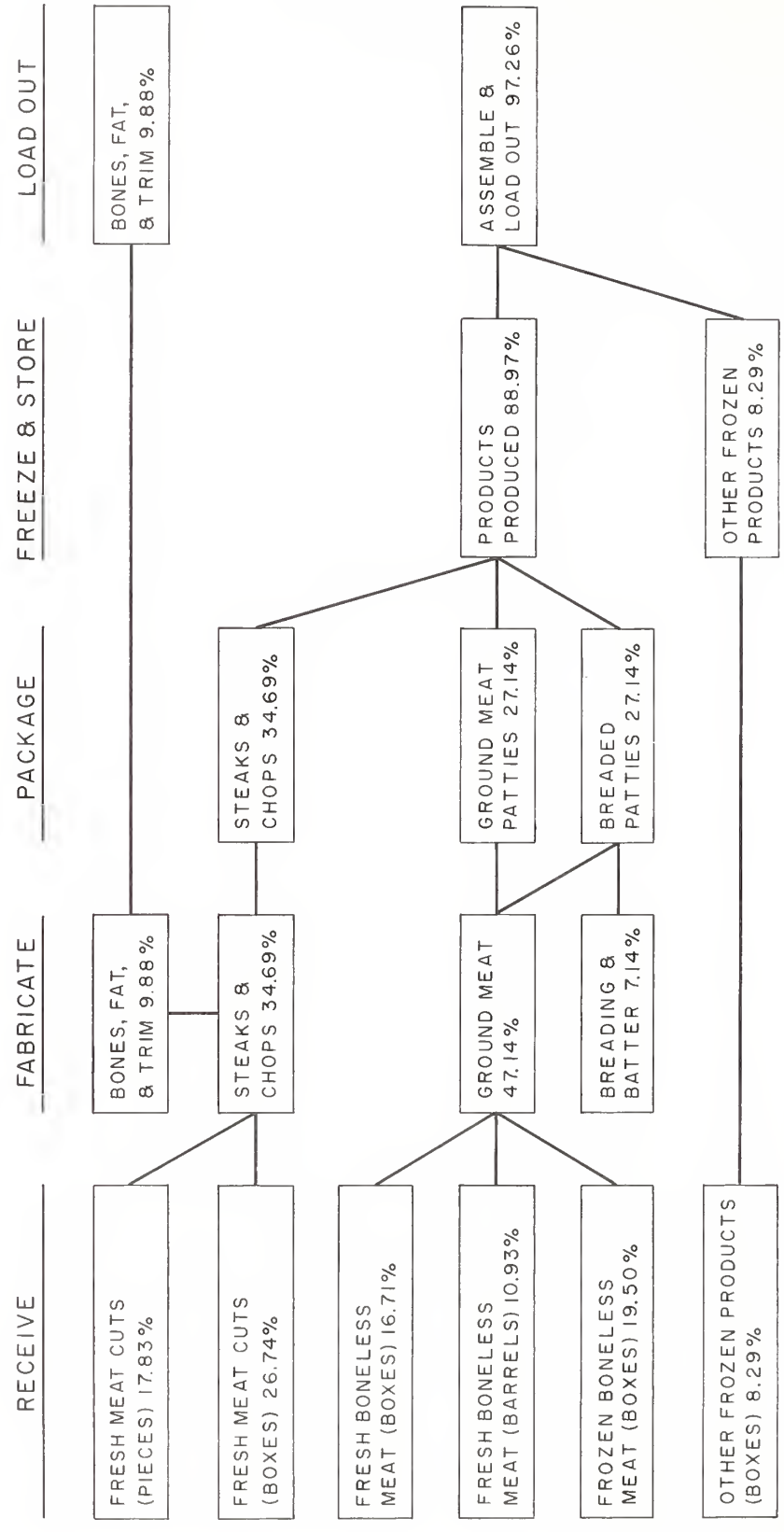

FIGURE 4.—The assumed in-plant distribution for a house handling 3,500,000 pounds annually of frozen portion-controlled meat and other products.

fied volume of each item. Most large-volume items are produced daily or several times each week to maintain the inventory, but for some low-volume items, several hours of production each week is sufficient. Usually a 2-week supply of any product in the holding freezer is considered an adequate inventory. Production runs normally are scheduled for most items when the supply is down to about one week's inventory.

Products are generally received several times each week for fresh meat and about once or twice a week for frozen meat and other frozen products. To have adequate flexibility for fresh-meat storage, many houses have space for a week's supply.

In meat-transportation operations, the same distances are assumed as were described in the first part of the report. The assumed annual composition of products by operations is shown in table 17.

TABLE 17.—*Assumed annual composition of products handled in each operation in a house supplying 3,500,000 pounds annually of frozen portion-controlled meat*

Operations and products	Product		Operation total weight
	Unit handled or prepared	Weight	
		Pounds	*Pounds*
Receiving and storing:[1]			
Fresh beef bone-in meat cuts	Piece	624,000	
Fresh beef boned meat cuts	Box	702,000	
Fresh pork bone-in meat cuts	Box	234,000	
Fresh beef, veal, and pork boneless meats	Box	585,000	
Fresh beef, veal, and pork boneless meats	Barrel	382,500	
Frozen beef, veal, and pork boneless meats	Box	682,500	
Other frozen packaged products	Box	290,000	
Total			3,500,000
Transporting meat to the fabricating areas:			
Steak and chop area:			
Fresh beef short loins	Piece	468,000	
Fresh beef bone-in strip loins	Piece	156,000	
Fresh beef boned meat cuts	Box	702,000	
Fresh pork loins	Box	234,000	
Total for steak and chop area		1,560,000	
Ground-meat area:			
Fresh beef, veal, and pork boneless meats	Box	585,000	
Fresh beef, veal, and pork boneless meats	Barrel	382,500	
Frozen beef, veal, and pork boneless meats	Box	682,500	
Total for ground-meat area		1,650,000	
Total			3,210,000
Preparation of steaks and chops:[2]			
Beef short loins	Steak	364,000	
Beef bone-in strip loins	Steak	117,000	
Beef boned strip loins	Steak	91,000	
Beef rib-eye rolls	Steak	156,000	
Beef boned ribs	Steak	117,000	
Beef full tenderloins	Steak	104,000	
Beef top sirloin butts	Steak	78,000	
Pork loins	Chop	187,200	
Bones, fat, and trim		345,800	
Total			1,560,000

TABLE 17.—*Assumed annual composition of products handled in each operation in a house supplying 3,500,000 pounds annually of frozen portion-controlled meat*—Continued

Operations and products	Product		Operation total weight
	Unit handled or prepared	Weight	
		Pounds	*Pounds*
Moving steaks and chops to packaging area: Beef steaks and pork chops	Container	1,214,200	1,214,200
Tenderizing steaks and wrapping and packaging steaks and chops: [2]			
Steaks (4-ounce)	Box	104,000	
Steaks (6-ounce)	Box	78,000	
Steaks (8-ounce)	Box	377,000	
Steaks (12-ounce)	Box	312,000	
Steaks (16-ounce)	Box	156,000	
Chops (4-ounce)	Box	117,000	
Chops (6-ounce)	Box	70,200	
Total			1,214,200
Preparation of ground meat:			
Reducing frozen meats	Block		682,500
Weighing fresh and frozen meat	Batch		1,650,000
Coarse-chopping and fine-grinding meat	Batch		1,650,000
Transporting between work areas:			
Reduced frozen beef, veal, and pork	Tub truck		682,500
Weighed fresh and frozen meat	Batch		1,650,000
Ground beef, veal, and pork	Batch		1,650,000
Forming and packaging ground-meat patties: [2]			
Beef, veal, and pork patties (1.60-ounce)	Box	316,667	
Beef, veal, and pork patties (2.00-ounce)	Box	316,667	
Beef, veal, and pork patties (2.67-ounce)	Box	316,667	
Total			950,000
Forming, breading, and packaging patties: [2]			
Beef, veal, and pork patties (2.00-ounce)	Box	[3] 316,667	
Beef, veal, and pork patties (2.67-ounce)	Box	[3] 316,667	
Beef, veal, and pork patties (4.00-ounce)	Box	[3] 316,667	
Total			950,000
Transporting packages to quick-freezer:			
Steaks, chops, and patties	Box	3,114,200	3,114,200
Storing packages in holding freezer:			
Steaks, chops, and patties	Case	3,114,200	3,114,200
Assembling cases in holding freezer:			
Steaks, chops, and patties	Case	3,114,200	
Other frozen packaged products	Case	290,000	
Total			3,404,200
Loading delivery trucks: Steaks, chops, patties, and other frozen products	Case	3,404,200	3,404,200

[1] See table 16 for a detailed listing of products received and stored.

[2] See table 21 for product production by portion and total weight.

[3] Breaded patties contain about 26.3 percent by weight of batter and breading (83,283 pounds) and 73.7 percent of meat (233,384 pounds).

Labor and Equipment Requirements and Costs

The annual labor and equipment requirements and costs were determined for the assumed composition of products by comparing the different crew sizes, work procedures, and equipment types used to perform the in-plant operations. The methods and equipment that have the lowest overall costs were designated selected methods and those that were the next to lowest, alternate methods. The methods and the equipment used in each operation are shown in table 18.

The first section of this report described how the operations are performed, and tables 1 through 15 listed the man-hour requirements and labor and equipment costs per 1,000 pounds. The hourly cost for each item of equipment is given in table 20.

The annual labor requirements and labor and equipment costs for handling 3½ million pounds are shown in table 19 for a house that uses the lowest-cost methods in each operation and also for a house that uses the next-to-lowest-cost methods. Costs are not included, for either method, for the extra items of equipment —such as pallets, trolley trees, etc.—that are used to store an inventory of products in the holding cooler and freezer.

When semilive skids with racks and a forklift are used for receiving and storing fresh and frozen meat and other frozen products, savings of more than 12 percent are realized in both labor and total costs. This same equipment, when used for moving meat to the fabricating areas, reduces the man-hours required by more than 42 percent and total costs about 39 percent. All savings are the result of using more efficient handling equipment.

The preparation of steaks and chops is more economical and requires less labor by the all-weights than by the specified-weights method. An annual savings of 727 man-hours and about $2,817 is realized through the use of the selected method.

When a powered conveyor, the selected method, is used to move containers of steaks and chops to packaging, the labor required is about one-third of that needed for semilive skids, the alternate method. Although the equipment cost for the selected method is the same as for the alternate method, the total costs are about 60 percent lower because of the reduction in labor costs.

The tenderizing of steaks and the wrapping and packaging of steaks and chops by a combination wrapping-and-packaging crew is the selected method. It uses about 12 percent less man-hours and total costs than the method of separate crews for each operation. Most of the savings result from a better balanced workload among members of the crew, which practically eliminates unproductive time.

The use of a reciprocating-blade machine to reduce blocks of frozen meat, a dial scale to weigh batches, and a silent cutter and self-feed grinder to prepare ground meat reduces the labor required by almost 11 percent and total costs by about 8 percent when compared with the next best, or alternate method. Equipment costs are higher for the selected method, so all savings are in labor cost.

A tub truck for reduced frozen meat, a belt conveyor for weighed batches of meat, and a belt conveyor for ground meat is the most efficient equipment combination for transporting meat in those operations dealing with ground meat and patty-making. The selected method requires about one-third the man-hours and total costs of the alternate method.

The man-hour requirements and total costs for both the selected and alternate methods are about the same for forming and packaging ground-meat patties.

Forming, breading, and packaging patties using the 4,000-per-hour patty-former with built-in feed requires about 7 percent fewer man-hours and is about 6 percent cheaper than the 3,600-per-hour light-duty patty-former with built-in feed. The faster patty-forming rate of the first machine is the major reason for the reduction in labor and total costs.

Four-wheel carts that hold 810 pounds, as compared with carts that hold only 240 pounds, can reduce both labor requirements and total costs by two-thirds in transporting packages to the overnight freezer. All savings result from a reduction in the number of trips necessary to move the 3,114,200 pounds of products produced annually.

TABLE 18.—*Equipment used for the selected and alternate methods in houses supplying frozen portion-controlled meat, by operation*

Operation	Selected		Alternate	
	Method	Equipment	Method	Equipment
Receiving and storing	Semilive skid with racks and forklift.	Semilive skid with racks, jacklift, platform scale, forklift truck, pallets, and pallet rack.	On-the-rail, semilive skid, and two-wheel barrel truck.	Trolley tree, overhead rail, rail switch, California hook, track and platform scale, semilive skid, jacklift, two-wheel barrel truck, and storage platform.
Transporting meat to fabricating area.	Semilive skid with racks and forklift.	Semilive skid with racks, jacklift, forklift truck, pallet, and pallet rack.	On-the-rail, semilive skid, and two-wheel barrel truck.	Trolley tree, overhead rail, rail switch, California hook, semilive skid, jacklift, two-wheel barrel truck, and storage platform.
Preparation of steaks and chops.	All weights	Fabricating table, bandsaw, over-under scale, membrane remover, lug, lug platform, semilive skid with racks, and pallet.	Specified weights	Fabricating table, bandsaw, over-under scale, lug, trolley tree, overhead rail, California hook, and semilive skid.
Moving steaks and chops to packaging area.	Powered conveyor	Lug, powered conveyor, and gravity conveyor.	Semilive skid	Lug, semilive skid, jacklift.
Tenderizing steaks and wrapping and packaging steaks and chops.	One wrapping-and-packaging crew.	Steak tenderizing conveyor, packaging table with conveyor, packaging table with scale, freezer cart, gravity conveyor, lug, pallet, and package-taping machine.	Separate wrapping and packaging crew.	Steak-tenderizing conveyor, packaging table with conveyor, packaging table with scale, freezer cart, semilive skid, lug, and package-taping machine.
Preparation of ground meat: Reducing blocks of frozen meat.	Reciprocating blade	Tub truck, reciprocating-blade machine, and pallet.	Rotating drum	Tub truck, rotating-drum machine, and semilive skid.
Weighing fresh and frozen meat into batches.	Dial platform scale and conveyor.	Dial platform scale, tub truck, pallet, and conveyor.	Weigh-beam platform scale and dump-bucket.	Weigh-beam platform scale, tub truck, semilive skid, and dump-bucket.
Coarse-chopping and fine-grinding meat.	Silent cutter and self-feed grinder.	Silent cutter, self-feed grinder, and conveyor.	Two self-feed grinders and elevating mixer.	Self-feed grinders, elevating mixer, dump-bucket, and dump-bucket dolly.
Transporting between work areas.	Tub truck and conveyor	Tub truck and two conveyors.	Tub truck and dump-bucket	Tub truck, dump-bucket, hoist, and overhead rail.
Forming and packaging ground-meat patties.	4,000-per-hour patty-former with built-in feed.	Patty-former, packaging table, package-taping machine, and freezer cart.	Two, 3,600-per-hour patty-formers with built-in feed.	Patty-formers, packaging table, package-taping machine, and freezer cart.
Forming, breading, and packaging patties.	4,000-per-hour patty-former with built-in feed.	Patty-former, breading machine, packaging table with conveyor, packaging table with scale, package-taping machine, and freezer cart.	3,600-per-hour patty-former with built-in feed.	Patty-former, scorer-conveyor, breading machine, packaging table with conveyor, packaging table with scale, package-taping machine, and freezer cart.

Transporting packages to quick-freezer.	Four-wheel cart with nine shelves.	Freezer cart		Four-wheel cart with eight shelves.	Freezer cart.
Storing packages in holding freezer.	Four-wheel cart with nine shelves and forklift.	Freezer cart, pallet, forklift truck, and pallet rack.		Four-wheel cart with eight shelves and semilive skid.	Freezer cart, semilive skid, jacklift, and storage platform.
Assembling products in holding freezer.	Assemble cases stored by product groups at designated areas.	Four-wheel platform cart		Assemble cases stored at random.	Four-wheel platform cart.
Loading delivery trucks	One worker	Four-wheel platform cart		Two workers	Four-wheel platform cart.

TABLE 19.—*Annual labor requirements and labor and equipment costs of operations for an annual volume of 3,500,000 pounds by selected and alternate methods in a house supplying frozen portion-controlled meat*

Operations	Selected methods [1]				Alternate methods [1]			
	Labor requirements	Costs			Labor requirements	Costs		
		Labor	Equipment	Total		Labor	Equipment	Total
	Man-hours	*Dollars*	*Dollars*	*Dollars*	*Man-hours*	*Dollars*	*Dollars*	*Dollars*
Receiving and storing	557.41	1,811.58	491.71	2,303.29	637.62	2,072.27	556.55	2,628.82
Transporting meat to the fabricating areas	112.93	367.02	51.26	418.28	197.87	643.08	44.29	687.37
Preparation of steaks and chops	10,046.27	40,185.08	2,230.51	42,415.59	10,773.49	43,093.96	2,139.00	45,232.96
Moving steaks and chops to packaging area	12.14	39.46	12.14	51.60	36.43	118.40	12.14	130.54
Tenderizing steaks and wrapping and packaging steaks and chops	9,949.73	32,336.62	991.28	33,327.90	11,307.87	36,750.58	1,196.26	37,946.84
Preparation of ground meat	1,012.05	3,771.79	1,185.61	4,957.40	1,130.40	4,255.43	1,135.74	5,391.17
Transporting between work areas	129.15	506.36	39.83	546.19	409.65	1,628.36	39.83	1,668.19
Forming and packaging ground-meat patties	2,026.66	6,586.65	1,380.67	7,967.32	2,036.17	6,617.55	1,393.33	8,010.88
Forming, breading, and packaging patties	3,952.00	12,844.00	2,029.84	14,873.84	4,233.84	13,759.98	2,099.50	15,859.48
Transporting packages to quick freezer	93.43	303.65	31.14	334.79	311.42	1,012.12	31.14	1,043.26
Storing packages in holding freezer	1,743.95	5,667.84	155.71	5,823.55	2,179.94	7,084.81	93.43	7,178.24
Assembling products in holding freezer	442.55	1,438.29	34.04	1,472.33	510.63	1,659.55	34.04	1,693.59
Loading delivery trucks	408.50	1,327.63	34.04	1,361.67	476.59	1,548.92	2.38	1,551.30
Total	30,486.77	107,185.97	8,667.78	115,853.75	34,241.92	120,245.01	8,777.63	129,022.64

[1] Selected methods have the lowest cost and alternate methods the next-to-lowest cost.

A saving of about 20 percent in labor requirements and 19 percent in total costs is realized by using the selected method (a forklift and a four-wheel cart with nine shelves and a load capacity of 810 pounds) to store packages in the holding freezer.

When cases are stored in the holding freezer according to product kind and turnover, rather than at random, labor is reduced by about 13 percent when assembling cases for orders, and total costs are reduced by more than 13 percent.

The selected method of using one man to load delivery trucks reduces the labor required by more than 14 percent and total costs by about 12 percent. The savings result from eliminating the unproductive time that occurs when two men are assigned to this job.

For the 13 operations covered in table 19, the use of the selected methods, as compared with use of the alternate methods, saves 3,755 man-hours in labor required (about 11 percent) and $13,168.89 in costs (about 10 percent). Both the labor and dollar savings are generally due to the use of more efficient equipment, which reduces the labor required to do a job; and to better work methods, which eliminate some product handling and minimize idle time of workers.

Layout

The planning of a new house or the expansion of an existing one is a major problem, as many of the decisions made before construction have a lasting effect on cost and efficiency of operations. As a guide in making these decisions, six general factors should be considered: (1) Proposed volume of business to be handled, (2) flow paths of products and supplies, (3) equipment arrangement (4) space requirements, (5) inspection and sanitation requirements, and (6) future expansion.

The annual volume of business to be handled affects the size of building and the kind and type of equipment needed. The anticipated annual volume and composition of products, the average inventory and how it is to be stored, and the handling and production volume for a typical period should be estimated at the outset. From these estimates, the space requirements of the facility and the type, size, and number of pieces of equipment can be roughly established.

The flow of products and supplies should be planned to minimize handling, distance of transport, and congestion. Only by providing enough space and the best possible location for aisles, storage areas, doorways, equipment, and work areas can an efficient layout be developed.

The equipment should be arranged to provide adequate space for the movement of products and supplies between areas with a minimum of handling, the efficient performance of operations, and the servicing and cleaning of the equipment without disrupting other nearby operations.

The space requirements in workrooms should be determined by the number, type, size, and arrangement of the equipment to be used; and by the space needed for workers, aisles, and areas to hold products and supplies. Space also should be provided in some instances to allow for replacing small-capacity machines with larger machines when the volume of products increases. In storage areas, both the floor and vertical space requirements should be based on the quantity of products or supplies to be stored, and the type of equipment to be used to transport and store them.

The inspection and sanitation requirements for these houses are quite rigid, and layouts should comply with these regulations. Before construction, a complete set of drawings and specifications for either the construction of new houses or the remodeling of existing ones should be submitted to proper authorities for approval.

The future expansion of the house should be considered during the planning of the initial facility so that it will not present a major construction problem later. If possible, removable nonbearing walls should be used where expansion is anticipated. The initial construction should allow some growth and flexibility in volume without expanding the facility. However, the extra space should be limited to that needed in the immediate and foreseeable future and not to a volume anticipated 10 or 20 years later.

A layout for a house handling 3,500,000 pounds annually is shown in figure 5.

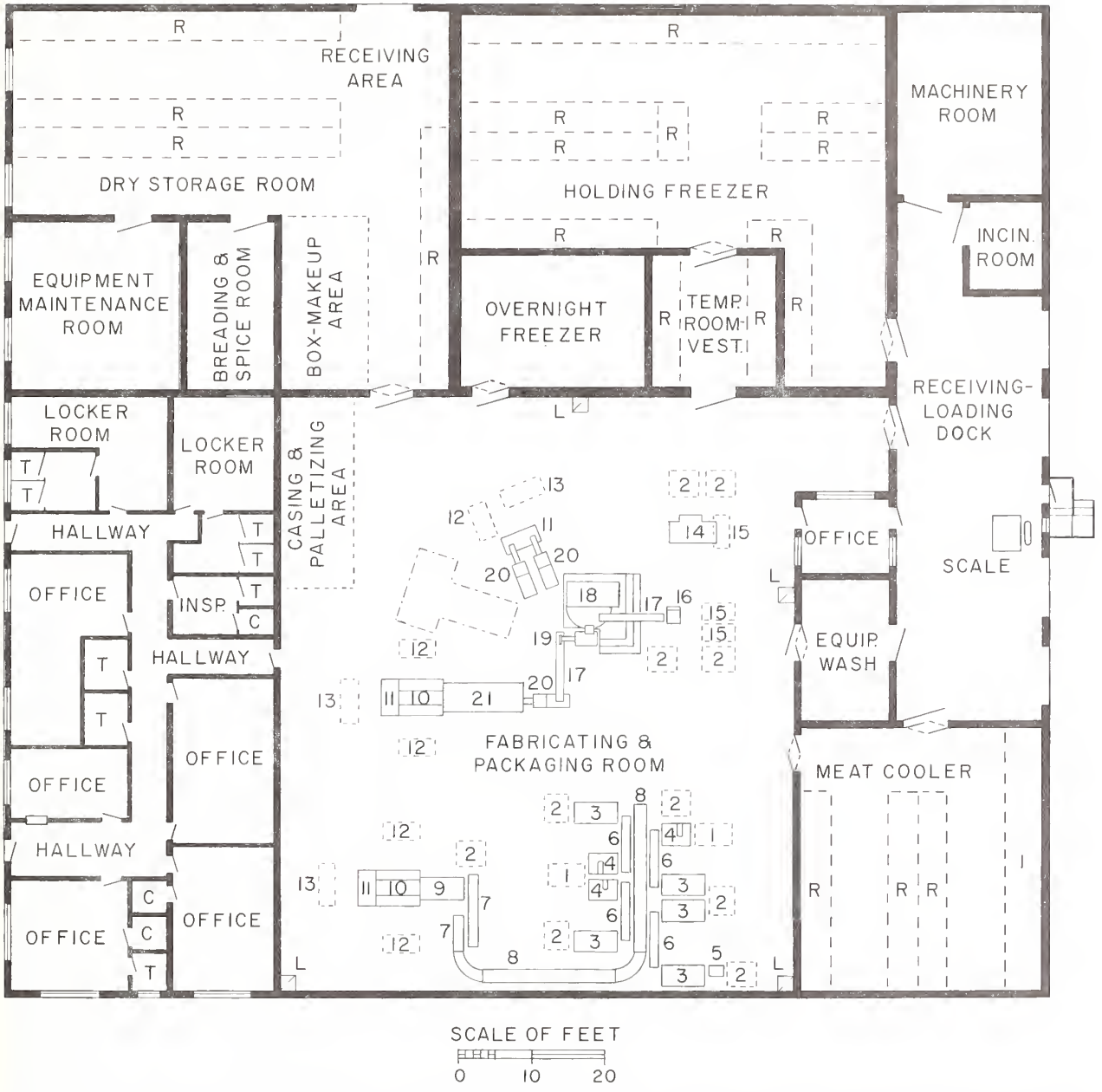

FIGURE 5.—Layout for a house handling 3,500,000 pounds annually of frozen portion-controlled meat and other products. (1) Semilive skid with racks, (2) pallet, (3) fabricating table, (4) bandsaw, (5) membrane remover, (6) lug platform, (7) gravity conveyor, (8) powered conveyor, (9) steak tenderizing conveyor, (10) packaging table with conveyor, (11) packaging table with scale and tape machine, (12) packaging-materials cart, (13) freezer cart, (14) frozen-meat block reducer, (15) tub truck, (16) portable dial scale, (17) portable ground-meat conveyor, (18) silent cutter, (19) self-feed grinder, (20) patty former, (21) patty breader, (T) toilet, (C) closet, (R) pallet storage racks, and (L) lavatory.

Space requirements in storage areas are based primarily on the inventory requirements for the various products. In the work areas, space needs depend on the volume handled or produced in each operation. The components of the house are: Receiving-loading dock, meat cooler, fabricating-and-packaging room, overnight freezer, tempering room-vestibule, holding freezer, dry-storage room, breading-and-spice storage room, equipment-maintenance

room, equipment washroom, incinerator room, machinery room, inspector's office, welfare rooms, and general offices. The overall dimensions of the house are 136 by 143 feet.

Receiving-Loading Dock

The receiving-loading dock contains 1,160 square feet. It is at truckbed level, about 50 inches higher than the street. It is enclosed to protect products from adverse weather, insects, and pilferage. Four 8-foot-wide doorways are provided for unloading meat and other products, loading products into delivery trucks, and loading barrels of bones and fat. Having four separate doorways should minimize both the time that trucks wait their turn to load or unload and a worker's idle time while trucks change places at the dock. In addition, the number of truck spaces and the 20-foot dock width should permit a great deal of flexibility in all operations, both at the present volume and at any reasonably increased volume.

An office of about 120 square feet is provided along the inner dock wall so that all receiving and shipping operations can be coordinated from a central location. This office has a doorway opening onto the dock and a doorway to the fabricating-and-packaging room.

The dock is near the center of one side of the building and adjacent to the areas it serves. It has doorways opening into the meat cooler, workroom (fabricating-and-packaging room), equipment washroom, holding freezer, incinerator room, machinery room, and receiving-and-shipping office. The incinerator and equipment-washroom doorways are 5 feet wide. All doorways for equipment are 6 feet wide to permit 4-foot-wide pallets to be transported through them with ease.

The platform scale for weighing fresh meats (frozen products normally are not weighed) is centrally located in relation to the four doorways, near the outer wall.

The suggested ceiling height for the dock is about 12 feet in the clear to permit empty pallets to be high-stacked at several convenient locations by the lift-truck to minimize floorspace requirements.

Since powered lift-trucks can be purchased with built-in chargers, an electrical outlet should be provided on one wall to recharge the battery.

Meat Cooler

The meat cooler has 1,188 square feet. The ceiling height should be at least 16 feet in the clear to permit pallet racks to be used and the pallets to be stacked three high. These dimensions were determined by evaluating the average length of the storage period for the volume and composition of products handled, best use of the space provided, manner in which the products were stored, and aisle space needed to transport and store products.

Most operators recommend a cooler capacity that will allow the storing of a 3-to 5-day supply of the products to permit some flexibility in storage. Studies made of product storage time in coolers were generally in agreement with their suggestions.

The cooler layout was designed to hold about a 5-day supply of products, or 48,486 pounds, under optimum conditions. However, under normal operating conditions all semilive skids with racks and all pallets are never fully loaded at one time. It is assumed that about a 3-day supply of products, 60 percent of optimum capacity, would be stored in the cooler space.

One hundred and eighty square feet of floor space is provided along one wall for storing beef short loins or beef bone-in strips on semilive skids with racks. Six semilive skids with racks would be needed for storing the short loins, with each semilive skid holding 80 pieces, about 1,440 pounds. Three skids would be needed for storing bone-in strips at 90 pieces each, about 1,080 pounds. Close parking will allow space for storing two additional semilive skids with racks.

Metal pallet racks would occupy the center of the cooler. They would require about 216 square feet of floor space. These racks provide storage for three tiers of 12 pallets each, a total of 36 pallets. Pallet racks permit a loaded pallet to be placed in storage or removed from storage without moving pallets stacked above it. Racks also reduce the direct load on the containers. Each fully loaded pallet of boxed meat would contain twenty 60-pound boxes, a total

of 1,200 pounds. A fully loaded pallet of barrelled meat would contain two barrels weighing 350 pounds each, a total of 700 pounds. The pallet size used in planning the layout is 48 inches wide by 42 inches deep.

Pallet rack space is allocated according to the estimate of volume stored and the composition of the products. Fifteen pallets are provided for boxes of boneless beef cuts and pork loins; 10 for boxes of boneless beef, veal, and pork; and 11 for barrels of boneless beef, veal, and pork. It is assumed that each pallet load would consist entirely of the same type of meat.

In the allocated floor space, measuring 4 x 27 feet, storage can be expanded without increasing the size of the room or changing the number of days' supply held in storage. This space could be used for either four semilive skids with racks or pallet racks for 18 pallets.

The aisles are 8 feet wide between the rows of stored products. This gives plenty of maneuvering room for a forklift straddle truck to place or remove pallets.

The meat cooler is located between the receiving-loading dock and the fabricating room. It has one 6-foot-wide doorway opening onto the dock and one 6-foot-wide doorway opening into the fabricating room. Each doorway is equipped with two double-swing vestibule doors. The doorway opening onto the dock also has a refrigerator door on the dock side. The vestibule doors remain closed except when something is actually passing through the doorway. The outer refrigerator door can be left open during receiving with only a small loss of refrigeration. The set of vestibule doors into the fabricating room would permit a better control of the temperature and humidity in the cooler and reduce moisture penetration into the cooler during cleaning.

Fabricating and Packaging Room

The fabricating and packaging room, also called the workroom, is used for preparing and packaging steak and chop portions and ground and breaded-meat patties.

The room contains 5,839 square feet. The steak-and-chop-fabricating area has about 1,064 square feet of work, equipment, product-holding, and service-aisle space; the ground-meat-fabricating area about 672 square feet; the steak-tenderizing and steak-and-chop-packaging area about 736 square feet; the ground-meat-and-breaded-patty area about 716 square feet; and the casing-and-palletizing area about 260 square feet. In addition, about 220 square feet is provided for a second ground-meat patty-forming and packaging operation to be added when the volume justifies it. The remaining 2,171 square feet provide space for service aisles from 8 to 10 feet wide and space for temporary storage of equipment. A ceiling height of at least 12 feet should be provided to allow adequate clearance for equipment.

The room has four doorways 6 feet wide for forklift truck traffic; two that are 5 feet wide for small, wheeled equipment; and two that are 3 feet wide for the workers. The large doors open onto the receiving-loading dock, the meat cooler, the tempering room-vestibule, and the dry-storage room. Five-foot doors open into the overnight freezer and the equipment washroom. The doorways to the office area and the receiving and shipping office are 3 feet wide. Refrigerator-type doors close the doorway to the dock, equipment washroom, tempering room-vestibule, dry-storage room, receiving-and-shipping office, and general-offices areas. A freezer door is used for the overnight-freezer room, and vestibule doors for the meat-cooler doorway.

The steak-and-chop-fabricating area has an 8-foot wide service aisle along three sides for both pallets and semilive skids with racks to be moved to and from the work areas. Five fabricating tables, three bandsaws, and a membrane remover are the major equipment items for the portion-cutting of steaks and chops. Also needed are five portion over-under scales, eight platforms for holding steak and chop lugs during portion-cutting, and powered belt conveyors to transport filled lugs to the holding area in the packaging area. Floor space is included for four pallets of boxed meat cuts, two semilive skids with racks of bone-in meat cuts, and one pallet for a supply of empty lugs. The containers for bones, fat, and meat scraps would be located under the front edge of the fabricating tables. About 40 square feet of work space is allowed for each of the five meatcutters.

The ground-meat fabricating area has three work areas for preparing boneless fresh and

frozen boxed meat and fresh barrelled meat into various types of ground meat or breaded patties. It also has service aisles and a container-holding area for temporary storage of various products both during and after their preparation. Each area will be described in the general order in which the product flows through during preparation.

In the first work area, frozen blocks of meat are cut into pieces suitable for coarse-chopping. A frozen-meat block-reducing machine is the only stationary equipment. The remaining area is for several tub-trucks, two pallets, and work space needed to operate and service the block-reducing machine.

The second work area, the batch-makeup area, is adjacent to the machine for reducing frozen blocks. Here frozen meat from tub-trucks and fresh meat from boxes and barrels are weighed. Then they are transported on a conveyor to the silent cutter, where the batch is coarse-chopped. Floor space is needed for a work area, a conveyor, a portable platform dial scale, two pallets, and two tub-trucks.

In the third work area, meat batches are coarse-chopped in a silent cutter and fine-ground through a self-feed grinder. The silent cutter is on a raised platform of metal or concrete so the coarse-chopped product can be unloaded directly into the feed hopper of the grinder. The height of this platform depends on the difference in height between the top of the feed hopper on the grinder, and the bottom edge of the discharge chute of the silent cutter. Batches of meat to be ground are transported by belt conveyor and dumped into the silent cutter bowl. The coarse-chopped meat is unloaded into the grinder, and the fine-ground meat is deposited on another conveyor for transport to the patty-formers. This conveyor, 10 feet long, is portable. It would be pivoted through an arc of about 170° to supply meat to each of the patty-formers. The center of the arc is the grinder head.

The steak-tenderizing and steak-and-chop-packaging area has work space for up to six workers. It has several sections of roller conveyor for temporarily holding and for transporting lugs of steaks to the steak tenderizer and chops to the packaging table. The tenderizer machine conveys steaks through a tenderizing solution. A double packaging table has space for two workers on each side and a powered conveyor in the center to transport tenderized steaks to the wrappers and filled boxes of steaks or chops to the packaging table with a scale and a package-taping machine. A freezer cart for packed boxes is nearby. Space is also provided for several packaging supply carts to the rear of the steak-and-chop wrappers, and for a pallet to hold empty steak-and-chop lugs.

The ground-meat patty-forming and packaging area has two self-feed forming machines equipped with patty stacker-conveyors, a packaging table, a package-taping machine, a freezer cart for packed boxes, a packaging-supply cart, and space for one worker.

The patty-forming and breading area has space for five workers. It has a patty-former with built-in feed and a batter-dip and breading machine. A double packaging table has space for four workers and a center conveyor to transport breaded patties to the packers and to transport packed boxes to the packaging table. Here is also a box scale, a package-taping machine, and a freezer cart. Space is provided for two carts of packaging supplies.

The casing-and-palletizing area does not have any permanent equipment, since it would be used for only a short time each day. It has work and aisle space for several workers. There is aisle space for the forklift truck to pick up and move loaded pallets from this area to the holding freezer. Space is also provided for a supply of case flats, for two to four freezer carts at a time that hold boxes of frozen meats from the previous day's production, and for several pallets for cased packages.

Space is provided for a second ground-meat patty-forming and packaging area between the present ground-meat patty-forming area and the breaded-patty area. The two patty-formers would be supplied with ground meat from the same conveyor, since the silent cutter and self-feed grinder shown should be able to supply the ground meat.

Overnight Freezer

The overnight freezer is for the quick-freezing of boxes of products on freezer-cart shelves. It is assumed that the loaded carts are held overnight in the freezer before the packages are placed in cases for storage on pallets in the holding freezer. The floor space provided, 450 square feet, can hold up to 21 freezer carts, at 30 by 77 inches each, with some space between the carts for air circulation. If each cart is fully loaded with 810 pounds of boxed products, the capacity would be 17,010 pounds. The ceiling height should be at least 8 feet in the clear to permit good air circulation throughout the room. A 5-foot doorway, with a freezer door, opens into the fabricating-and-packaging room. Double vestibule doors are suggested on the freezer side of the opening to minimize the temperature change when the outer door is open.

Tempering Room-Vestibule

The tempering room-vestibule area contains 288 square feet. It has two 6-foot-wide doorways. The one opening into the holding freezer is equipped with a freezer door as well as double vestibule doors. The doorway between the tempering room-vestibule and the fabricating-and-packaging room has a refrigerator door.

The tempering room-vestibule would serve a double purpose. First, it would reduce the temperature rise in the holding freezer when the door is opened by providing an air lock between the workroom and the freezer. Second, it would serve as an area to temper boxes of frozen meats. The tempering of frozen meats raises the meat temperature to about 20°–28°F. so they can be more easily fabricated. This tempering normally takes from several days to a week; the time required generally depends upon the temperature setting for the room. Initially provided are pallet racks along one wall with space for 12 pallets or 14,400 pounds of meat. When the volume increases, the holding capacity can be doubled. An aisle 9 feet wide is provided through the center of the room for the holding-freezer traffic as well as for maneuvering space for the forklift truck in placing and removing pallets from the tempering racks. The suggested ceiling height is 16 feet in the clear to permit pallets to be stacked three high.

Holding Freezer

The holding freezer contains 2,122 square feet and has a ceiling height of 16 feet in the clear. The products are stored in three tiers, of 40 pallets each, on metal pallet racks. The pallet racks require 724 square feet of the floor space. The work aisles average 8 feet wide and require 1,290 square feet. The remaining 108 square feet is available for some flexibility in operation. In this extra space, pallet racks for 18 pallets can be constructed. Two 6-foot-wide doorways, each closed by a freezer door, are provided. Each doorway has double vestibule doors on the freezer side.

The pallet racks in the room are arranged to minimize the time required to select cases of products for loading delivery trucks. The lower tier of 40 pallets permits a like number of products to be placed in easy reach of the order selectors. It is assumed that the house will produce at least 29 products (see table 21), and probably no more than a full pallet of each product will be required for loading each day. Eleven lower-tier pallets are available for provisions and other items that are handled but not prepared in the house.

The upper two tiers of pallets are for holding products until they are needed to restock the lower tier, and for holding frozen boneless meat until it is moved to the tempering room-vestibule.

The 120 pallet spaces should permit the house to hold an adequate inventory of all products as well as to maintain some flexibility in the storage. The number of pallet spaces needed in the room was determined by assuming that each pallet is loaded with 1,200 pounds and that a 2-week supply of fabricated products and provisions and a 1-week supply of boneless meat are stored. Thus, the pallets provided would store about 119,776 pounds of steaks, chops, and patties; 11,100 pounds of products not produced in the house; and 13,125 pounds of boneless meat.

Dry-Storage Room

The dry-storage room is next to the fabricating and packaging room. It is used for receiving packaging supplies, meat tenderizing solutions, dry egg, milk, breading, and flavoring ingredients. It contains work space for setting up boxes for products. The ceiling height suggested is 16 feet in the clear. It contains 2,232 square feet of storage, aisle, and work space. The storage space for pallets requires 684 square feet; the work area, 264 square feet; the receiving area for supplies, 240 square feet; and the aisles, 1,044 square feet. The aisles between the pallets are 8 feet wide. It is suggested that all supplies be stored on pallets on racks. If pallet racks are used to stack pallets three high, then 114 pallets can be stored.

This room has four doorways. One doorway, fitted with an 8-foot-wide, overhead-type door, provides access into the room from the outside and would be used for receiving. It is suggested that the truck apron at this opening be about 50 inches below the dock floor to permit supplies to be unloaded at truckbed level. A second doorway, consisting of double vestibule doors and a refrigerator door, opens into the workroom. A conventional 5-foot-wide doorway opens into the equipment maintenance room. The fourth doorway, also a conventional 5-foot width, opens into the breading-and-spice-storage room.

The space for storing supplies should be adequate to hold several weeks' inventory. The number of different types of packaging supplies used and their costs directly affect the inventory held.

Breading-and-Spice-Storage Room

The additives used in tenderizing steaks and in flavoring and breading patties would be stored in the breading-and-spice-storage room. Part of the room could be used to prepare and store additive mixtures until they are needed at the various work stations. The room contains 276 square feet and has one 5-foot-wide door.

Equipment-Maintenance Room

The equipment-maintenance room provides space for equipment repair and spare-parts storage. Supplies such as lubricating grease and oil, tools, and some extra equipment items not needed in the workroom could be kept in this room. It contains 529 square feet and has one doorway 5 feet wide.

Equipment Washroom

Tub-trucks, meat lugs, and other portable equipment are washed during the work day in the equipment washroom. The room, which contains 240 square feet, is large enough to store most of the cleaning equipment needed for the house, plus a few items of both clean and dirty equipment. The room has two 5-foot-wide doorways. The doorway onto the dock is closed by a conventional door. The one into the workroom has double vestibule doors as well as a refrigerator door.

Incinerator Room

An incinerator room containing 120 square feet is suggested for disposal of empty meat boxes and other trash. This space should be large enough for both an incinerator and the storage of a few empty boxes prior to burning. One 5-foot-wide doorway, closed by a fireproof door, is suggested.

Machinery Room

The refrigeration equipment, hot-water heater, and other such equipment are housed in the machinery room. Five hundred square feet of floor space are provided in the room for the equipment and the access aisles. One 6-foot-wide doorway, closed by a conventional door, is provided. This doorway opens onto the receiving-loading dock.

Inspector's Office

The inspector's office is located in the general-offices area. A meat inspector is generally required by city, State, or Federal regulations. This space has a closet and toilet in addition to the office, which contains 72 square feet. A doorway opens into a hallway near the entrance to the workroom.

Welfare Rooms

Two separate welfare rooms in the office area are provided, as it is assumed that about one-half of the plant workers are women. One

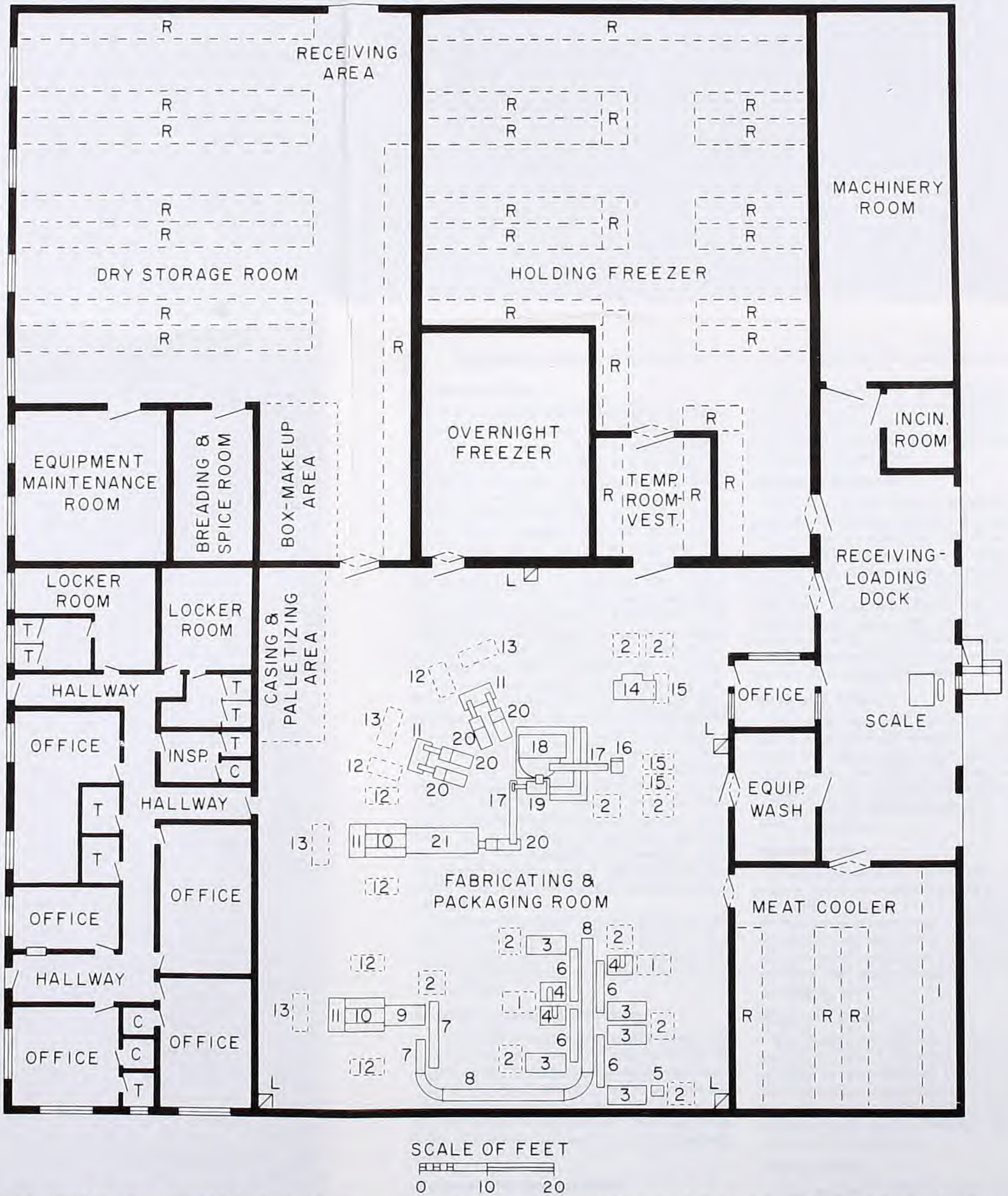

FIGURE 6.—Layout for a house expanded to handle about 7 million pounds annually of frozen portion-controlled meat and other products. (1) Semilive skid with racks, (2) pallet, (3) fabricating table, (4) bandsaw, (5) membrane remover, (6) lug platform, (7) gravity conveyor, (8) powered conveyor, (9) steak tenderizing conveyor, (10) packaging table with conveyor, (11) packaging table with scale and tape machine, (12) packaging-materials cart, (13) freezer cart, (14) frozen-meat block reducer, (15) tub truck, (16) portable dial scale, (17) portable ground-meat conveyor, (18) silent cutter, (19) self-feed grinder, (20) patty former, (21) patty breader, (T) toilet, (C) closet, (R) pallet storage racks, and (L) lavatory.

TABLE 20.—*Estimated cost of owning and operating various types of equipment in a house handling an annual volume of 3,500,000 pounds of frozen portion-controlled meat*

Equipment	Amount, size, or capacity	Estimated installed cost [1]	Expected life [2]	Estimated use per year	Owning costs per year				Operating cost per year			Total annual cost	Cost per hour of use
					Depreciation	Interest [3]	Insurance and taxes [4]	Total	Power [5]	Maintenance [6]	Total		
		Dollars	*Years*	*Hours*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Trolley and tree [7]	12 hooks	14.60	12	500	1.22	0.47	0.58	2.27	0	0.96	0.96	3.23	0.0065
California hook [7]	1	.55	12	500	.05	.02	0.2	.09	0	.04	.04	.13	.0003
Overhead rail [7 8]	⅜″x2½″x20′	54.62	12	2,000	4.55	1.78	2.18	8.51	0	1.32	1.32	9.83	.0049
Overhead rail switch [7]	1	38.48	12	2,000	3.21	1.25	1.54	6.00	0	1.06	1.06	7.06	.0035
Combination track and platform dial scale [9]	1,600 lb.	2,867.30	12	500	238.94	93.19	114.69	446.82	0	30.00	30.00	476.82	.9536
Platform dial scale [10]	1,600 lb.	2,202.59	12	500	183.55	71.58	88.10	343.23	0	25.00	25.00	368.23	.7365
Semilive skid [11]	1	80.80	12	2,000	6.73	2.63	3.23	12.59	0	4.90	4.90	17.49	.0087
Semilive skid with racks [12]	1	176.68	12	500	14.72	5.74	7.07	27.53	0	11.00	11.00	38.53	.0771
Jacklift for skid [13]	1	52.51	12	2,000	4.38	1.71	2.10	8.19	0	2.80	2.80	10.99	.0055
Two-wheel barrel truck [14]	1	66.49	12	2,000	5.54	2.16	2.66	10.36	0	3.50	3.50	13.86	.0069
Box and barrel storage platform [15]	1 load	71.67	12	50	5.97	2.33	2.87	11.17	0	1.00	1.00	12.17	.2434
Pallet [16]	1	4.96	6	50	.83	.17	.20	1.20	0	.43	.43	1.63	.0326
Pallet rack [17]	1 pallet	15.68	12	50	1.31	.51	.63	2.45	0	.14	.14	2.59	.0518
Forklift straddle truck, battery, and charger [18]	2,000 lb.	4,148.29	12	2,000	345.69	134.82	165.93	646.44	43.52	82.97	126.49	772.93	.3865
Fabricating table [19]	3′x3′x6′	196.80	12	2,000	16.40	6.40	7.87	30.67	0	11.62	11.62	42.29	.0211
Bandsaw [19]	1	930.42	12	2,000	77.54	30.24	37.22	145.00	81.00	206.04	287.04	432.04	.2160
Portion over-under scale [19]	5 lb.	264.45	12	2,000	22.04	8.59	10.58	41.21	0	20.00	20.00	61.21	.0306
Membrane remover [20]	1	972.14	12	2,000	81.01	31.59	38.89	151.49	16.20	46.00	62.20	213.69	.1068
Lug [21]	75 lb.	10.35	6	2,000	1.73	.36	.41	2.50	0	0	0	2.50	.0013
Lug platform [20]	16″x2′x4′	24.12	12	2,000	2.01	.78	.96	3.75	0	.25	.25	4.00	.0020
Power conveyor [22]	18″x2′x10′	350.98	12	500	29.25	11.41	14.04	54.70	5.81	32.50	38.31	93.01	.0186
Frozen-meat reduction—reciprocating blade [23]	1	3,179.73	12	2,000	264.98	103.34	127.19	495.51	116.10	75.00	191.10	686.61	.3433
Frozen-meat reduction—rotating drum [24]	1	4,491.98	12	2,000	374.33	145.99	179.68	700.00	270.00	100.00	370.00	1,070.00	.5350
Four-wheel tub-truck [25]	500 lb.	189.80	12	2,000	15.82	6.17	7.59	29.58	0	16.00	16.00	45.58	.0228
Portable platform weigh-beam scale [26]	1,000 lb.	190.66	12	2,000	15.89	6.20	7.63	29.72	0	20.00	20.00	49.72	.0249
Portable platform dial scale [27]	1,000 lb.	1,205.55	12	2,000	100.46	39.18	48.22	187.86	0	25.00	25.00	212.86	.1064
Pan with handles [28]	100 lb.	41.53	12	2,000	3.46	1.35	1.66	6.47	0	0	0	6.47	.0032
Powered belt conveyor [29]	1′x10′	1,418.41	12	2,000	118.20	46.10	56.74	221.04	17.42	40.00	57.42	278.46	.1392
Hoist, double trolley, and bucket-lift yoke [8]	500 lb.	343.37	12	2,000	28.61	11.16	13.73	53.50	17.42	12.00	29.42	82.92	.0415
Dump-bottom bucket [8]	400 lb.	220.00	12	2,000	18.33	7.15	8.80	34.28	0	2.84	2.84	37.12	.0186
Meat grinder [30]	10 hp.	1,429.92	12	2,000	119.16	46.47	57.20	222.83	226.80	118.78	345.58	568.41	.2842
Meat grinder (self-feed) [31]	10 hp.	4,060.75	12	2,000	338.40	131.97	162.43	632.80	226.80	146.75	373.55	1,006.35	.5032
Silent cutter [32]	240 lb.	9,403.87	12	2,000	783.66	305.63	376.15	1,465.44	567.00	196.50	763.50	2,228.94	1.1145
Meat mixer (self-elevating) [33]	250 lb.	2,516.25	12	2,000	209.69	81.78	100.65	392.12	48.60	54.90	103.50	495.62	.2478
Gravity-conveyor [34]	18″x2′x10′	76.22	12	2,000	6.35	2.48	3.05	11.88	0	.80	.80	12.68	.0063
Gravity-conveyor curve [34]	18″x2′x90°	62.19	12	2,000	5.18	2.02	2.49	9.69	0	.66	.66	10.35	.0052
Steak-tenderizing conveyor [35]	1	2,315.63	12	2,000	192.97	75.26	92.63	360.86	11.75	45.13	56.88	417.74	.2089
Packaging table with conveyor [36]	5′x3′x6′	1,274.88	12	2,000	106.24	41.43	50.99	198.66	11.75	33.75	45.50	244.16	.1221
Packaging table [37]	30″x3′x6′	208.78	12	2,000	17.40	6.79	8.35	32.54	0	0	0	32.54	.0163
Package scale [36]	20 lb.	295.86	12	2,000	24.66	9.62	11.83	46.11	0	20.00	20.00	66.11	.0331

Four-wheel cart [38]	8 shelves	243.63	12	2,000	20.30	7.92	9.75	37.97	0	2.50	2.50	40.47	.0202
Four-wheel cart [39]	9 shelves	538.14	12	2,000	44.85	17.49	21.53	83.87	0	5.45	5.45	89.32	.0447
Freezer-tape dispenser [37]	1	49.63	6	2,000	8.27	1.74	1.98	11.99	0	4.90	4.90	16.89	.0084
Patty machine [40]	2,100/hr.	1,435.17	12	2,000	119.60	46.64	57.41	223.65	32.40	44.00	76.40	300.05	.1500
Patty machine (light duty) [41]	3,600/hr.	3,329.14	12	2,000	277.43	108.20	133.17	518.80	72.90	79.13	152.03	670.83	.3354
Patty machine [42]	3,600/hr.	4,741.74	12	2,000	395.15	154.11	189.67	738.93	72.90	103.00	175.90	914.83	.4574
Patty machine [43]	4,000/hr.	4,330.17	12	2,000	360.85	140.73	173.21	674.79	36.45	97.35	133.80	808.59	.4043
Patty machine [44]	4,000/hr.	4,939.33	12	2,000	411.61	160.53	197.57	769.71	36.45	105.35	141.80	911.51	.4558
Patty-stacking conveyor [45]	1	695.44	12	2,000	57.95	22.60	27.82	108.37	4.46	32.53	36.99	145.36	.0727
Patty-scoring conveyor [46]	1	845.74	12	2,000	70.48	27.49	33.83	131.80	4.46	34.20	38.66	170.46	.0852
Patty-breading machine [47]	1	4,394.45	12	2,000	366.20	142.82	175.78	684.80	76.95	107.95	184.90	869.70	.4349
Four-wheel platform cart [48]	1	125.00	12	2,000	10.42	4.06	5.00	19.48	0	3.00	3.00	22.48	.0112

[1] Based on average f.o.b. factory costs, an allowance for shipping the equipment 500 miles, installing it when applicable, and less a trade-in allowance in most cases.

[2] Basis for expected life is U.S. Treasury Department, Internal Revenue Service Publication No. 456 (9–62).

[3] Interest at 6 percent of average investment.

[4] Insurance and taxes at 4 percent of estimated installed cost.

[5] Based on 2.7 cents per kw.-hr. for electricity.

[6] Based on estimates made by operators, equipment manufacturing representatives, and the author.

[7] Used for receiving and storing separate fresh-meat cuts on-the-rail, moving meat to the fabricating areas, and preparing steaks and chops by the specified-weights method.

[8] Used for weighing meat into batches, transporting meat between scale and coarse-chopping and fine-grinding machines, and between fine-grinding machine and patty-formers (the alternate method).

[9] Used for receiving and storing fresh meat on-the-rail, on a semilive skid, and on a two-wheel barrel truck.

[10] Used for receiving and storing fresh meat on a semilive skid with racks and a forklift.

[11] Used for receiving and storing fresh and frozen meat and other products in boxes; moving meat to the fabricating areas; preparing steaks and chops by the specified-weights method; moving steaks and chops to packaging area on a semilive skid; tenderizing steaks and wrapping and packaging steaks and chops with separate wrapping and packaging crews; reducing blocks of frozen meat with a rotating-drum machine; weighing meat into batches with a portable weigh-beam scale; and storing packages in holding freezer on a four-wheel cart with eight shelves and a semilive skid.

[12] Used for receiving and storing separate fresh-meat cuts on a semilive skid with racks, moving these meats to the fabricating areas, and preparing steaks and chops by the all-weights method.

[13] Used for receiving and storing separate fresh-meat cuts on semilive skids with racks and fresh and frozen meat and other products in boxes on semilive skids; moving meat to the fabricating areas when on semilive skids with racks, or in boxes on semilive skids; moving steaks and chops to packaging area with semilive skids; and storing packages in holding-freezer with a four-wheel cart with eight shelves and a semilive skid.

[14] Used for receiving and storing fresh meat in barrels and for moving meat to the fabricating area.

[15] Used for receiving and storing fresh and frozen meat and other products in boxes and barrels with a semilive skid and a two-wheel barrel truck, moving fresh and frozen meat in boxes and barrels to the fabricating areas with a semilive skid and a two-wheel barrel truck, and storing packages in holding-freezer with a four-wheel cart with eight shelves and a semilive skid.

[16] Used for receiving and storing fresh and frozen meat and other products in boxes and barrels with a forklift, moving meat to the fabricating areas, preparing steaks and chops by the all-weights method, tenderizing steaks and wrapping and packaging steaks and chops with combination wrapping-and-packaging crew, reducing blocks of frozen meat with a reciprocating-blade machine, weighing meat into batches with a portable dial scale, and storing packages in holding-freezer with a four-wheel cart with nine shelves and a forklift.

[17] Used for receiving and storing fresh and frozen meat and other products in boxes and barrels with a forklift, moving meat to the fabricating areas, and storing packages in the holding-freezer with a four-wheel cart with nine shelves and a forklift.

[18] Used for receiving and storing fresh and frozen meat and other products in boxes and barrels, moving meat to the fabricating areas, and storing packages in holding-freezer with a four-wheel cart with nine shelves.

[19] Used for preparing steaks and chops.

[20] Used for preparing steaks and chops by the all-weights method.

[21] Used for preparing steaks and chops, moving steaks and chops to packaging area, tenderizing steaks, and wrapping and packaging steaks and chops.

[22] Used for moving steaks and chops to packaging area on a powered conveyor.

[23] Used for reducing blocks of frozen meat (the selected method).

[24] Used for reducing blocks of frozen meat (the alternate method).

[25] Used for reducing blocks of frozen meat; weighing meat into batches; coarse-chopping and fine-grinding meat; and transporting meat between frozen-block reduction and weighing area, between scale and coarse-chopping and fine-grinding machines, and between fine-grinding machines and patty-formers.

[26] Used for weighing meat into batches (the alternate method).

[27] Used for weighing meat into batches (the selected method).

[28] Used for weighing meat into batches and transporting meat between scale and coarse-chopping and fine-grinding machines.

[29] Used for weighing meat into batches, transporting meat between scale and coarse-chopping and fine-grinding machines, and between fine-grinding machine and patty-formers (the selected method).

[30] Used for coarse-chopping and fine-grinding meat, either two manual-feed grinders mounted piggy-back or silent cutter and manual-feed grinder.

[31] Used for coarse-chopping and fine-grinding meat, either two self-feed grinders with elevating mixer or silent cutter and self-feed grinder.

[32] Used for coarse-chopping and fine-grinding meat, with manual-feed grinder or self-feed grinder.

[33] Used for coarse-chopping and fine-grinding meat with two self-feed grinders.

[34] Used for moving steaks and chops to packaging area with powered conveyor, tenderizing steaks, and wrapping and packaging steaks and chops with combination wrapping-and-packaging crew.

[35] Used for tenderizing steaks with separate and combination wrapping and packaging crews.

[36] Used for tenderizing steaks and wrapping and packaging steaks and chops with separate and combination crews; and forming, breading, and packaging patties with all equipment combinations.

[37] Used for tenderizing steaks and wrapping and packaging steaks and chops with separate and combination crews; forming and packaging ground-meat patties with all equipment combinations; and forming, breading, and packaging patties with all equipment combinations.

[38] Used for tenderizing steaks and wrapping and packaging steaks and chops with separate wrapping and packaging crews; forming and packaging ground-meat patties with two 3,600-per-hour patty-formers with built-in feed; forming, breading, and packaging patties with a 3,600-per-hour patty-former with built-in feed (light-duty); transporting packages to overnight-freezer; and storing packages in holding-freezer by all methods.

[39] Used for tenderizing steaks and wrapping and packaging steaks and chops with combination wrapping-and-packaging crew, forming and packaging ground-meat patties with 4,000-per-hour patty-former with built-in feed; forming, breading, and packaging patties with a 4,000-per-hour patty-former with built-in feed; transporting packages to overnight-freezer; and storing packages in holding-freezer with all methods.

[40] Used for forming and packaging ground-meat patties with one patty-former; and forming, breading, and packaging patties with one patty-former.

[41] Used for forming and packaging ground-meat patties with one or two built-in feed patty-formers; and forming, breading, and packaging patties when a light-duty machine is specified.

[42] Used for forming and packaging ground-meat patties with one or two built-in-feed patty-formers; and forming, breading, and packaging patties when a regular machine is specified.

[43] Used for forming and packaging ground-meat patties with one manual-feed patty-former; and forming, breading, and packaging patties.

[44] Used for forming and packaging ground-meat patties with either one or two patty-formers with built-in feed; and forming, breading, and packaging patties.

[45] Used for forming and packaging ground-meat patties when the 2,100-per-hour patty-former is used.

[46] Used for forming, breading, and packaging patties when the 2,100- or 3,600-per-hour patty-formers are used.

[47] Used for forming, breading, and packaging patties with all equipment combinations.

[48] Used for assembling cases in the holding-freezer and loading delivery trucks by all methods.

TABLE 21.—*Assumed annual production, by work area and portion, in a house handling an annual volume of 3,500,000 pounds of frozen portion-controlled meat*

Work area and kind of portion	Annual production								
	Portion weight in ounces								Total weight
	1.60	2.	2.67	4.	6.	8.	12.	16.	
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Steak-and-chop area:									
Beef:									
Club steaks						91,000			91,000
T-bone steaks							117,000		117,000
Porterhouse steaks								156,000	156,000
Bone-in strip loin steaks						58,500			58,500
Bone-in strip loin steaks							58,500		58,500
Boned strip loin steaks						32,500			32,500
Boned strip loin steaks							58,500		58,500
Rib-eye roll steaks				52,000					52,000
Rib-eye roll steaks						104,000			104,000
Boned rib steaks					39,000				39,000
Boned rib steaks							78,000		78,000
Filet mignon steaks				52,000					52,000
Filet mignon steaks						52,000			52,000
Top sirloin butt steaks					39,000				39,000
Top sirloin butt steaks						39,000			39,000
Pork:									
Chop				117,000					117,000
Chop					70,200				70,200
Total				221,000	148,200	377,000	312,000	156,000	1,214,200
Ground-meat patty area:									
Beef:									
Patties	316,667								316,667
Patties		316,667							316,667
Patties			316,666						316,666
Total	316,667	316,667	316,666						950,000
Breaded-patty area:									
Beef:									
Patties		105,555							105,555
Patties			105,555						105,555
Patties				105,556					105,556
Veal:									
Patties		105,557							105,557
Patties			105,555						105,555
Patties				105,555					105,555
Pork:									
Patties		105,555							105,555
Patties			105,557						105,557
Patties				105,555					105,555
Total		316,667	316,667	316,666					950,000
Grand total[1]	316,667	633,334	633,333	537,666	148,200	377,000	312,000	156,000	3,114,200

[1] Not included is 345,800 pounds of bones, fat, and trim.

their expected life. Other equipment items such as semilive skids, jacklifts, trolley trees, forklift trucks, fabricating tables, tub-trucks, and patty machines are expected to be worth at least one-fourth of their purchase price. Items of equipment such as bandsaws, conveyors, meat grinders, and silent cutters are assumed to have a trade-in value equal to 1 year of their expected life. For example, the trade-in value of a forklift truck is estimated to be one-fourth of the purchase price, and of a bandsaw, one-twelfth of the purchase price.

The estimated annual hours of usage for the equipment generally was based on the average number of hours that all of the same items of equipment would be needed in the performance of in-plant operations. No time was allowed for equipment when it was holding stored products for inventory, since there was no "wear and tear" involved. For example, it is estimated that about 10 percent of the pallets at a house would be in actual use on any day; therefore, about an hour's usage for each pallet per week, or 50 hours annually, should be an adequate allowance. For equipment such as fabricating tables, patty machines, bandsaws, and portion scales, all the pieces of equipment would be used a greater part of each workday, or about 2,000 hours annually. The annual usage of the forklift truck was based on 2,000 hours, because it can be used to receive and store packaging supplies, to rearrange palletized products in the holding freezer, and to perform other similar jobs that are not covered in this report.

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