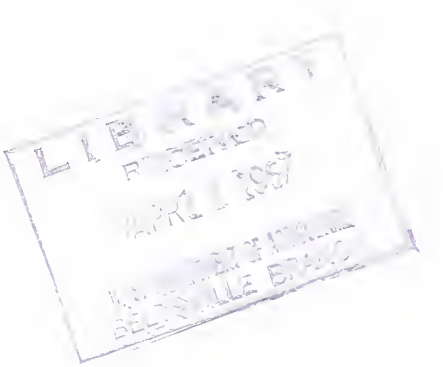
Systems and Equipment for
PACKAGING and PRICE MARKING
MEAT and POULTRY
In Retail Food Stores



Marketing Research Report No. 773

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

PREFACE

Retailers have cooperated in this study by providing their stores to be used as laboratories.

This study was conducted under the general direction of R. W. Hoecker, Chief, Wholesaling and Retailing Research Branch, Transportation and Facilities Research Division, Agricultural Research Service.

The overall study was conducted under the specific direction of Dale L. Anderson, Assistant Branch Chief of the Wholesaling and Retailing Research Branch.

Special credit is due James A. Marsden who was formerly associated with the U.S. Department of Agriculture and who was responsible for major parts of the research.

CONTENTS

Washington, D.C. Issued January 1967

SYSTEMS AND EQUIPMENT FOR PACKAGING AND PRICE MARKING MEAT AND POULTRY IN RETAIL FOOD STORES

Marvin D. Volz, *industrial engineer*
Transportation and Facilities Research Division, Agricultural Research Service

SUMMARY

Substantial savings can be realized in medium and high volume meat departments ($10,000 to $25,000 weekly sales volume) by installing a fully automatic wrapping machine in conjunction with an automatic weighing and pricing operation using a new soft film in rolls instead of the conventional hand wrapping system using sheeted cellophane film. For instance, in a meat department with a total weekly volume of $25,000, costs of labor, equipment, and film could be reduced by as much as $4,000 a year by converting to a fully automatic operation as described above.

In this study five methods of wrapping, weighing, and pricing retail cuts of fresh meat in meat backrooms of food stores were evaluated. The weekly break-even volumes were calculated through the use of a formula which takes into account labor, equipment, and material cost. For example, if 75 percent of the packages wrapped in a meat department can be machine wrapped, the break-even volume for a fully automatic wrapper using soft film in rolls, compared to a hand wrapping operation using sheeted cellophane film, occurs when the total weekly meat sales amount to approximately $7,000. Since approximately 30 percent of the product sold is centrally prepackaged (sliced luncheon meat, etc.), the value of the fresh meat packages actually wrapped in a meat department of this size amounts to approximately $5,000.

Some of the advantages gained by using wrapping machines in place of hand wrapping stations are (1) increased production capacity, (2) reduced labor cost if the volume is sufficient, and (3) better labor scheduling. Moreover, machines tend to pace the worker.

Generally, the disadvantages of the wrapping machines compared to a hand wrapping operation are (1) the wrapping machines usually do a poorer wrapping job, (2) they are expensive, and (3) they have a higher maintenance cost.

During peak sales periods the production rate of a semiautomatic wrapping machine can be increased 50 to 60 percent by using two workers on the machine. This higher production rate is obtained at an increase of 23 percent in labor costs per package.

The quality of the wrap of a semiautomatic machine can be improved by (1) selecting the correct film size, (2) setting the temperature of the heating elements properly, and (3) keeping the surface of the heating elements clean.

Five factors to consider in obtaining the most efficient use of the wrapping machine are as follows: (1) Place equipment to obtain a smooth, continuous flow of product; (2) schedule large amounts of similar size and type of cuts for releasing to the wrapping machine in one batch; (3) use conveyors to feed pans of product directly from the cutting stations to the input end of the wrapping machine; (4) position hand wrapping stations so that all packages go to the wrapping machine first; and (5) position automatic scale and label printer close to the feeding end of the wrapping machine to minimize walking time.

INTRODUCTION

Efficient methods of hand wrapping retail cuts of fresh meat and poultry, developed in U.S. Department of Agriculture research, have increased productivity in the backrooms of retail food stores. Improvements in the design and use of hand wrapping stations were discussed in Marketing Research Reports Nos. 44 and 77.[1]

In the 1950's, automatic and semiautomatic packaging machines appeared on the market. During the early 1960's some stores began to use automatic weighing and pricing equipment in conjunction with packaging machines. Completely or partly automatic systems of wrapping, weighing, and pricing were developed. Some types of meat packages cannot be machine wrapped, so some hand wrapping must still be done when machines are used.[2]

This study was made to evaluate use of automatic and semiautomatic packaging machines, as compared with efficient hand wrapping methods, and to assist the retail trade in determining when it is economically feasible to install a machine wrapping operation in a retail store meat department. Layouts were developed for meat backrooms for efficient use of wrapping machines in conjunction with automatic weighing, pricing, and labeling equipment.

Methods and equipment used in meat backrooms of numerous retail stores were examined, and detailed studies were made in 24 stores in 1962–64. Stores that were using efficient methods and good layout principles were selected for detailed time studies to determine levels of productivity. Fresh meat sales in these stores ranged from $10,000 to $35,000 per week.

Equipment and material costs are based on suggested retail prices, and do not reflect regional price variations. Time standards are used in this report to compare machine and hand wrapping operations. Labor requirements in a given store may differ from those given here because of differences in product mix, skill of the operator, and other factors that may affect the production rate of the wrapping system. The labor requirements given in this report therefore do not necessarily imply labor standards.

OPERATIONAL CHARACTERISTICS OF MACHINE AND HAND WRAPPING SYSTEMS

Description of Systems

Basically, two types of wrapping machines are being used in meat backrooms of modern retail food stores—semiautomatic and automatic. The semiautomatic wrappers were designed specifically for wrapping meat packages, while most of the fully automatic machines were adapted from other industries.

With fully automatic wrapping machines, the operator simply places the tray of meat on the feeding mechanism of the machine. The machines do a complete wrapping and sealing job and, when automatic weighing and labeling devices are placed in the production line (fig. 1), the wrapping machines can be set up to discharge automatically each wrapped package to a conveyor which moves it to the scale. The package is automatically weighed and then moved to the label printer where the label is mechanically applied and the package is discharged to a conveyor or tub.

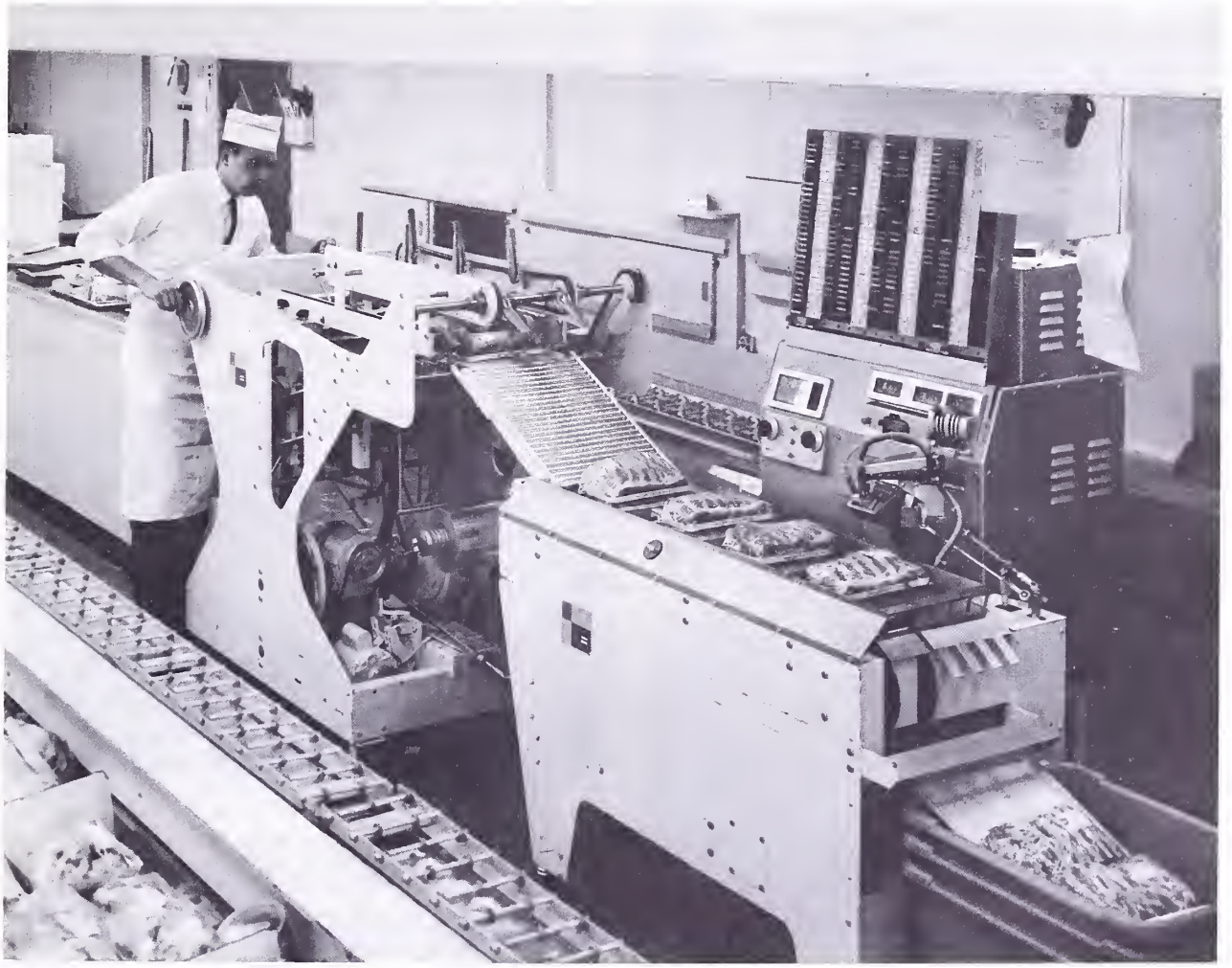
Roll cellophane film is used on most automatic wrapping machines. In a few installations, the new soft film[3] in rolls is used.

[1] HARWELL, EDWARD M., ANDERSON, DALE L., SHAFFER, PAUL F., and KNOWLES, ROBERT H. PACKAGING AND DISPLAYING MEATS IN SELF-SERVICE MEAT DEPARTMENTS. U.S. Dept. Agr. Mktg. Res. Rpt. No. 44, 86 pp., illus., 1953.

ANDERSON, DALE L., and SHAFFER, PAUL F. PRINCIPLES OF LAYOUT FOR SELF-SERVICE MEAT DEPARTMENTS. U.S. Dept. Agr. Mktg. Res. Rpt. No. 77, 33 pp., illus., 1954; reissued 1965.

[2] The term "meat" used throughout this report includes both fresh meat and poultry.

[3] Soft film refers to a polyvinyl chloride type of film. Some of the main characteristics of this film are clarity for display, greater stretch for tighter packages, prevention of cloudy packages, and lessening of rewrap problems.



BN 28434

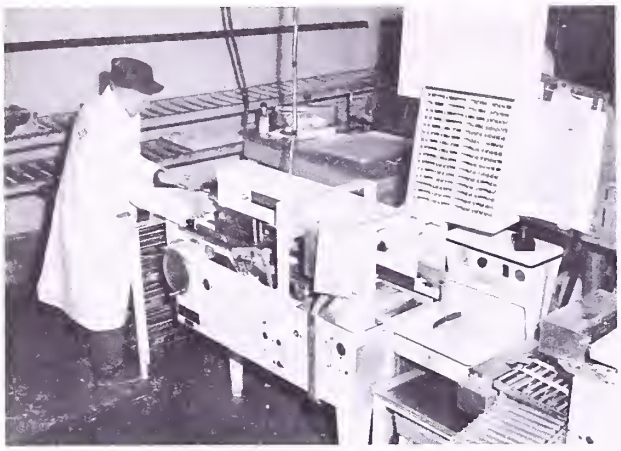
FIGURE 1.—Worker is adjusting fully automatic wrapping machine. A short conveyor delivers packages to the automatic scale and labeling device. Finished packages drop into the tub at right.

Several operations were studied to evaluate use of this film. The machine wrapping procedure is the same as described in the preceding paragraph; the film is positioned on the package with the sides of the film parallel to the sides of the package. Because of the price difference between the two films, however, machine operations using cellophane film and those using soft film are considered separately in this report.

With semiautomatic wrapping machines, an operator positions the film around the tray of meat and manually makes the first seal before placing the package in the machine. The ends of the film are folded under the tray and sealed by the machine. When automatic weighing and labeling devices are attached to the machine (fig. 2), the packages are automatically moved to the scale and label printer in the same manner as in the fully automatic operation. Sheeted film is used with these machines, which allows the operator to select the minimum size film for a particular package.

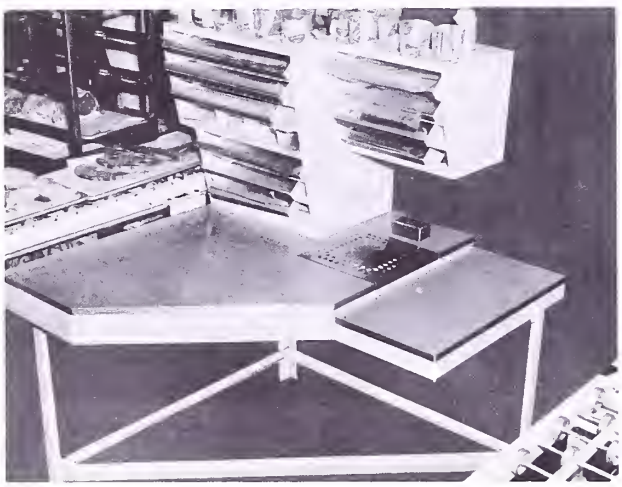
Both the fully automatic and semiautomatic wrapping machines are adjusted for tray size by a handwheel located on the side of the machine.

Two hand wrapping systems are evaluated in this study. Most meat departments hand wrap meat packages with sheeted cellophane film at work stations similar to the one shown in figure 3. In the more efficient layouts, skate-wheel



BN 28435

FIGURE 2.—The worker is manually making the first seal on the package before placing it in the semi-automatic wrapping machine. The package moves onto the scale and then to the label printer and the storage conveyor.



BN 28436

FIGURE 3.—Hand wrapping station using sheeted cellophane film.

conveyors are used to transport pans of trayed meat from the cutting area directly to the wrapping table. The operator positions the trayed meat diagonally on the film, folds over two sides of the film, makes a seal by sliding the package over the seal plate, folds up the third side of the film, makes a seal, and then folds up the fourth side of the film and seals it. The package is placed on a pan and moved on a gravity conveyor to the scale area where the scale operator manually weighs, prices, and labels the package. Figure 4 shows a typical weighing and pricing station. This system of hand wrapping is referred to in this report as "hand wrapping using sheeted cellophane film."

The other hand wrapping system that was evaluated uses soft film in rolls instead of sheeted cellophane film, and is referred to in this report as "hand wrapping using rolled soft film." The roll of film is located at the rear of the wrapping table about 24 inches above the table (fig. 5). A worker unrolls the amount of film needed, cuts it on an electrically heated wire located below the roll, wraps the package,

BN 28437

FIGURE 4.—Typical weighing and pricing station when all packages are hand wrapped.

BN 28438

FIGURE 5.—Hand wrapping station using rolled soft film.

and places it on a heated power belt conveyor which seals the package. The package is transported on the conveyor to a holding table located at the scale. A worker at the scale then weighs, prices, and labels the package as shown in figure 4.

Size of Meat Cuts That Can Be Wrapped by Machine

Studies conducted in several stores showed that 60 to 90 percent of all fresh meat items processed in a supermarket can be wrapped effectively by machines. The percentage varies according to the product mix of a particular store.

To set up an efficient wrapping machine operation, one of the first requirements is to standardize, as much as possible, all the packages which are to be machine wrapped. High volume items should be considered first and a concentrated effort should be made to place these items in trays of the same size and type. To reduce the number of wrapping machine and scale adjustments to the absolute minimum, large batches of like product should be run through the machine at one time.

The height of the product ultimately determines whether or not it can be wrapped by machine. The semiautomatic machines handled packages up to 4½ inches high, and the fully automatic machines handled packages up to 5½ inches high. Items that lie flat in the tray and are 1 to 2½ inches high are the ones that can be most successfully machine wrapped.

Meatcutters can help to increase the production capacity of a wrapping machine by using proper traying practices. The machines jam more frequently if meat is not cut and trimmed properly and if it is allowed to overhang the tray.

Backroom layout also influences the percentage of packages that are machine wrapped. It is important that the wrapping machine be placed in the production line so that all packages go to the wrapping machine operator first. The machine operator can then pass on to the hand wrapping line those items that cannot be machine wrapped. There is a tendency to wrap more packages by machine in this type of layout.

Quality of Machine and Hand Wrapped Packages

Generally, a skilled hand wrapper should be able to wrap packages that have an appearance superior to those wrapped on either semiautomatic or fully automatic machines.

The general appearance of packages wrapped by the semiautomatic wrapper is good. The quality of the end seals is excellent, especially if the proper size of film sheet is selected by the machine operator. Tests conducted in several supermarkets show that as much as 5 percent of all packages wrapped on a semiautomatic machine were improperly sealed. The figure can be reduced by training the operator to (1) select the right film size, (2) set the temperature of the heating elements correctly, and (3) keep the surface of the heating element clean.

Several manufacturers have on the market fully automatic machines specifically designed for wrapping meat packages. A study made of one fully automatic wrapping machine that was designed for wrapping meat showed that less than 1 percent of the packages were improperly sealed.

Packages wrapped on fully automatic machines not specifically designed for wrapping meat packages were not wrapped as well as those packages that were hand wrapped or wrapped on semiautomatic machines. It was found that 10 to 35 percent of the total packages wrapped on these fully automatic wrapping machines were not properly sealed. These machines did a good job on the center seals; the difficulty was in getting a good seal on the ends.

Advantages and Disadvantages

Some of the advantages of wrapping machines over hand wrapping systems are that they—

1. Increase production capacity, which is especially helpful during the preparation for peak sales periods.
2. Reduce labor cost in high-volume operations.
3. Allow for better labor scheduling.
4. Tend to set the pace for the worker.

Some of the disadvantages of automatic or semiautomatic wrapping machines compared to

hand wrapping methods are that they—

1. Usually do a poorer wrapping job.
2. Have a higher maintenance cost.
3. Have greater initial expense.
4. Usually require more film.

Because of the time required for the operator to make the first wrap and seal on a package, the production rate of a semiautomatic wrapper is substantially less than that of a fully automatic wrapper. However, the production rate of semiautomatic wrapping machines can be increased by having two persons operate the machine. One person can wrap up to 462 packages per hour at a labor cost [4] of 0.44 cent per package on a semiautomatic wrapping machine. A two-person team can wrap up to 750 packages per hour at a labor cost of 0.54 cent per package. This is an increase in production of 62.3 percent at an increase in labor cost of 23 percent per package.

COST EVALUATION OF WRAPPING SYSTEMS

Costs of labor, equipment, and film for the three machine wrapping and two hand wrapping systems were analyzed, and a formula was developed to determine the volume at which costs for any two systems are equal. Since costs of labor, equipment, and film will vary, a formula was developed so any firm can use its particular costs to determine the break-even volume between any two wrapping systems. (See Break-Even Formula, appendix.)

Labor

A $2.04 hourly wage rate was used in calculating the labor costs for wrapping, weighing, and pricing meat packages. A different wage rate can readily be substituted into the formula for the break-even volume shown in the appendix.

Time standards were used to determine the production rate in minutes per package. The standards were developed from studies made at retail stores of several food chains located in various parts of the country. Because of differences in backroom layouts and work methods, along with the continuous development of new materials and equipment, production rates and cost data will constantly be changing. Individual firms are therefore encouraged to apply these new costs and their own production rates in determining the break-even volumes. Production times and labor costs for the five systems are shown in table 1.

TABLE 1.—*Standard time and labor cost per package to wrap meat packages in retail food stores, by wrapping system*

Wrapping system[1]	Standard time[2]	Labor cost[3]
	Minutes	*Cents*
Hand wrapping using sheeted cellophane film (one worker)	0.401	1.36
Hand wrapping using roll soft film (one worker)	.296	1.00
Semiautomatic wrapping using sheeted cellophane film	.140	.48
Fully automatic wrapping using rolled cellophane film	.082	.28
Fully automatic wrapping using rolled soft film	.082	.28

[1] Also includes weighing, pricing, and labeling.
[2] Based on appendix tables 6-9.
[3] Based on a $2.04 hourly wage rate.

Equipment

Equipment ownership and maintenance costs for the five wrapping systems, per year and per week, are given in table 2. Because machines may become obsolete quickly due to advances in technology, depreciation was written off over a 5-year period. The capital recovery method [5] was used to calculate the annual depreciation charges on the equipment.

Materials

Although material costs are a basic cost consideration in a wrapping operation, they were not used (except for film costs) to determine the volume at which it was economically feasible to install a wrapping machine in a meat department. For instance, the cost of trays is

[4] Using a wage rate of $2.04 per hour.

[5] A method that will give the uniform annual end-of-year payment necessary to repay the initial cost in a specified number of years at a given interest rate.

TABLE 2.—*Equipment ownership and maintenance cost per year and per week to wrap meat packages in retail food stores, by wrapping system*

Wrapping system[1]	Initial cost of equipment	Cost per year			Ownership and maintenance cost per week
		Ownership[2]	Maintenance	Total	
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Hand wrapping using sheeted cellophane film (one work station)	375	98.92	10.00	108.92	2.09
Hand wrapping using rolled soft film (one work station)	175	46.16	10.00	56.16	1.08
Semiautomatic wrapping using sheeted cellophane film	[3]5,600	1,477.28	75.00	1,552.28	29.85
Fully automatic wrapping using rolled cellophane film or rolled soft film	[3]8,900	2,347.82	75.00	2,422.82	46.59

[1] Cost of scale and labeling devices are not included because the same pricing equipment is used in all five wrapping systems and therefore will not affect the break-even analysis.
[2] Computed on a 5-year depreciation period, with a capital recovery factor of 0.26380 and a 10-percent annual interest rate.
[3] Includes cost of mechanism which automatically feeds the packages to the scale and labeler.

not included in the development of the break-even points because there is a definite trend to use the same type of tray in all wrapping systems. Pricing labels are used on all packages regardless of the pricing system, so they cannot be considered an added cost.

Some of the newly developed fully automatic machines use either rolled cellophane or the new soft film on rolls and handle any width of film up to 18 inches. Most meat departments use two and sometimes three roll sizes. Each firm using a fully automatic machine will have to decide, on the basis of product mix and type of trays used, what film widths would be most economical for them to use. Researchers found that although fully automatic wrapping machines used more film on most items than either the semiautomatic machine or hand wrapping systems using sheeted film, the total film cost for automatic machines was usually lower because of the lower cost of roll film. At least one fully automatic machine on the market automatically cuts the length of film needed to wrap a particular package with only a 1- to 2-inch overlap on the first seal. Table 3 shows the film cost per week for the five systems of wrapping packages over a range of 2,400 to 14,400 packages per week. A more detailed breakdown of film costs can be found in the appendix (tables 10 and 11). Film costs for the machine wrapping systems also include the cost of film used at the hand wrapping station.

The difference in film cost between a semiautomatic or a hand wrapping operation using sheeted cellophane film and an automatic wrapping machine using rolled cellophane film is negligible. The automatic machine uses about 10 to 12 percent more film, but rolled cellophane film is approximately 11 percent cheaper than sheeted cellophane film. However, there is a significant difference in film cost between wrapping operations using cellophane film and those using rolled soft film. For instance, a store wrapping 14,400 packages a week can save approximately $1,300 a year by using soft film rather than cellophane film with an automatic machine.[6] The difference is due to the lower

[6] Referring to table 3:

	Film cost
Automatic wrapper using rolled cellophane film	$ 106.92
Automatic wrapper using rolled soft film	80.28
Weekly savings	26.64
Yearly savings	1,385.28

TABLE 3.—*Film cost per week to wrap packages of meat in retail food stores, by wrapping system and number of packages wrapped per week*

Wrapping system	Average film cost per package [1]	Number of packages wrapped per week					
		2,400	4,800	7,200	9,600	12,000	14,400
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Hand wrapping or semiautomatic machine using sheeted cellophane film	0.0075	18.00	36.00	54.00	72.00	90.00	108.00
Hand wrapping using rolled soft film	.0049	11.76	23.52	35.28	47.04	58.80	70.56
Fully automatic wrapping using rolled cellophane film [2]	.0074	17.82	35.64	53.46	71.28	89.10	106.92
Fully automatic wrapping using rolled soft film [2]	.0058	13.38	26.76	40.14	53.52	66.90	80.28

[1] See table 11, appendix.
[2] It is assumed that 25 percent of the packages are wrapped at a hand wrapping station.

price of soft film; the amount of film used to wrap a package was assumed to be the same in both cases.

The use of soft film for wrapping meat packages is relatively new. The effect this film has on shrinkage and shelf life of packaged retail cuts of meat has not been determined, but research is being conducted on these points.

Combined Labor, Equipment, and Material Costs

Shown in table 4 are labor, equipment, and film costs for five methods of wrapping meat in retail meat departments when total weekly meat sales range from $4,286 to $25,714.

Table 5 shows the size of the operation at which total costs of labor, equipment, and film are equal for hand wrapping systems, when 75, 85, 90 and 95 percent of the packages are machine wrapped. For example, costs for wrapping 3,990 packages are equal for the fully automatic system using rolled soft film and the hand wrapping system using cellophane sheets, when 75 percent of the packages are machine wrapped. The break-even volume drops to 3,579 packages when 95 percent of the packages are machine wrapped. Therefore, a concentrated effort should be made to machine wrap as many packages as possible in order to obtain the maximum savings from a machine wrapping installation.

Figures 6 through 9 are graphic representations of the costs shown in table 5 and can be used to more easily compare hand wrapping systems and machine wrapping systems, using different films, at weekly volume levels ranging from 2,400 to 14,400 packages when 75 percent of the packages are machine wrapped. The horizontal axis represents the number of packages wrapped per week, the dollar value of the packages wrapped, and the total meat department sales per week. The vertical axis represents the total weekly costs in dollars.

TABLE 4.—*Weekly costs of five meat wrapping systems in retail food stores, by volume of sales and packages wrapped*

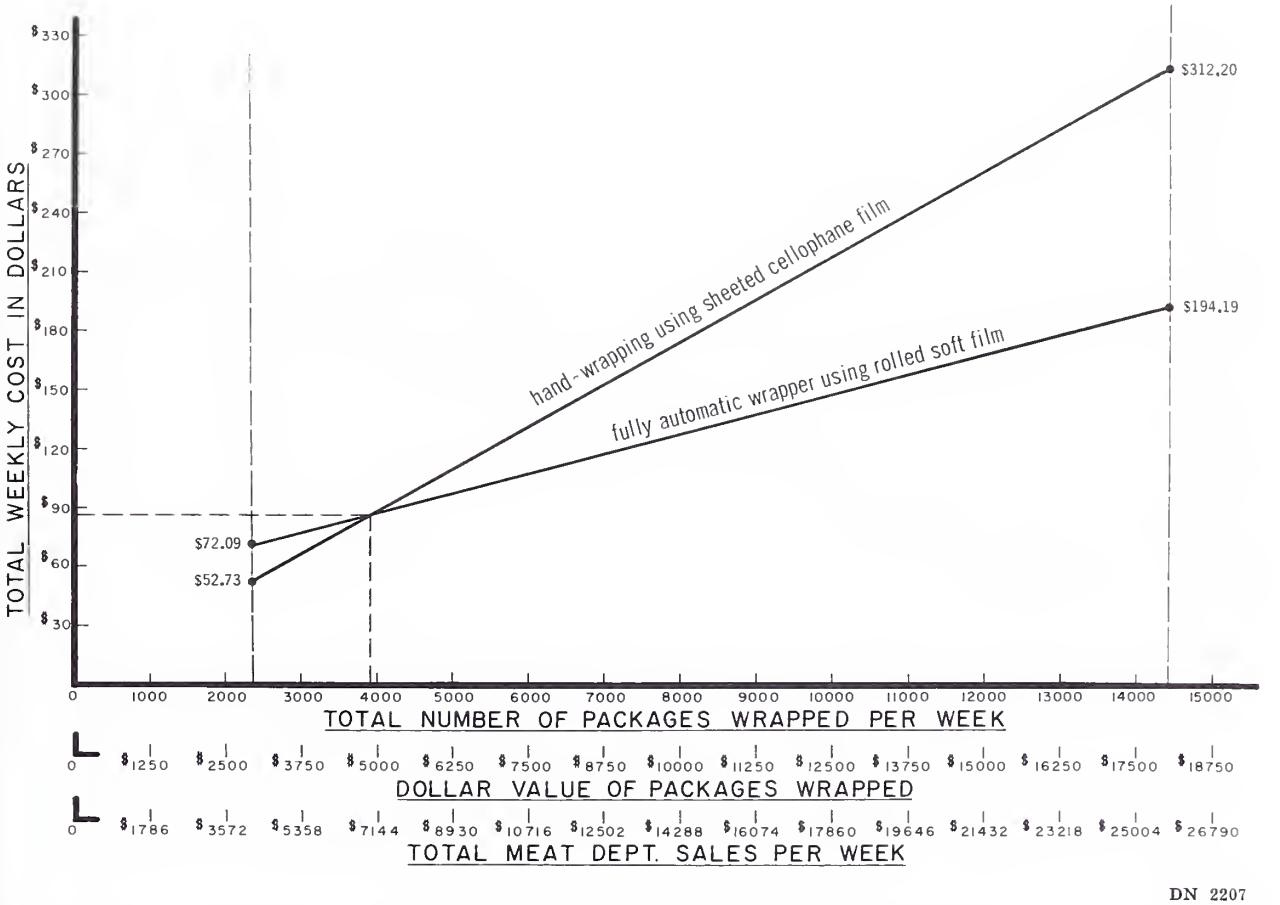
Wrapping system, total meat department sales, and packages wrapped[1]	Labor[2]	Equipment[3]	Film[4]	Total
	Dollars	*Dollars*	*Dollars*	*Dollars*
Hand wrapping using sheeted cellophane film:				
$4,286— 2,400 packages	32.64	2.09	18.00	52.73
8,571— 4,800 packages	65.28	4.18	36.00	105.46
12,857— 7,200 packages	97.92	4.18	54.00	156.10
17,143— 9,600 packages	130.56	6.27	72.00	208.83
21,429—12,000 packages	163.20	8.36	90.00	261.56
25,714—14,400 packages	195.84	8.36	108.00	312.20
Hand wrapping using rolled soft film:				
$4,286— 2,400 packages	24.00	1.08	11.76	36.84
8,571— 4,800 packages	48.00	1.08	23.52	72.60
12,857— 7,200 packages	72.00	2.16	35.28	109.44
17,143— 9,600 packages	96.00	2.16	47.04	145.20
21,429—12,000 packages	120.00	3.24	58.80	182.04
25,714—14,400 packages	144.00	3.24	70.56	217.80
Semiautomatic machines using sheeted cellophane film:				
$4,286— 2,400 packages	16.80	[5]31.94	18.00	66.74
8,571— 4,800 packages	33.34	[5]31.94	36.00	101.28
12,857— 7,200 packages	50.40	[5]31.94	54.00	136.34
17,143— 9,600 packages	67.20	[5]31.94	72.00	171.14
21,429—12,000 packages	84.00	[5]31.94	90.00	205.94
25,714—14,400 packages	87.84	[5]31.94	108.00	227.78
Fully automatic machine using rolled cellophane film:				
$4,286— 2,400 packages	13.20	[5]48.68	17.82	79.70
8,571— 4,800 packages	26.08	[5]48.68	35.64	110.40
12,857— 7,200 packages	39.60	[5]48.68	53.46	141.74
17,143— 9,600 packages	52.80	[5]48.68	71.28	172.76
21,429—12,000 packages	66.00	[5]48.68	89.10	203.78
25,714—14,400 packages	79.20	[5]48.68	106.92	234.80
Fully automatic machine using rolled soft film:				
$4,286— 2,400 packages	11.04	[6]47.67	13.38	72.09
8,571— 4,800 packages	21.87	[6]47.67	26.76	96.30
12,857— 7,200 packages	33.12	[6]47.67	40.14	120.93
17,143— 9,600 packages	44.16	[6]47.67	53.52	145.35
21,429—12,000 packages	55.20	[6]47.67	66.90	169.77
25,714—14,400 packages	66.24	[6]47.67	80.28	194.19

[1] Fresh meat sales are assumed to be 70 percent of total meat sales and 75 percent of the packages wrapped are assumed to be machine wrapped.
[2] Table 1.
[3] Table 2 shows the weekly depreciated costs of hand wrapping and machine wrapping equipment. Only one machine wrapper is required in a meat department; however, in a hand wrapping operation, as the volume increases additional hand wrapping stations will be required.
[4] Table 3.
[5] Includes the cost of one hand wrapping station using sheeted cellophane film.
[6] Includes the cost of one hand wrapping station using rolled soft film.

TABLE 5.—*Weekly break-even points (in quantity and value) for machine vs. hand systems of wrapping meat packages in retail food stores, by percentage of packages machine wrapped* [1]

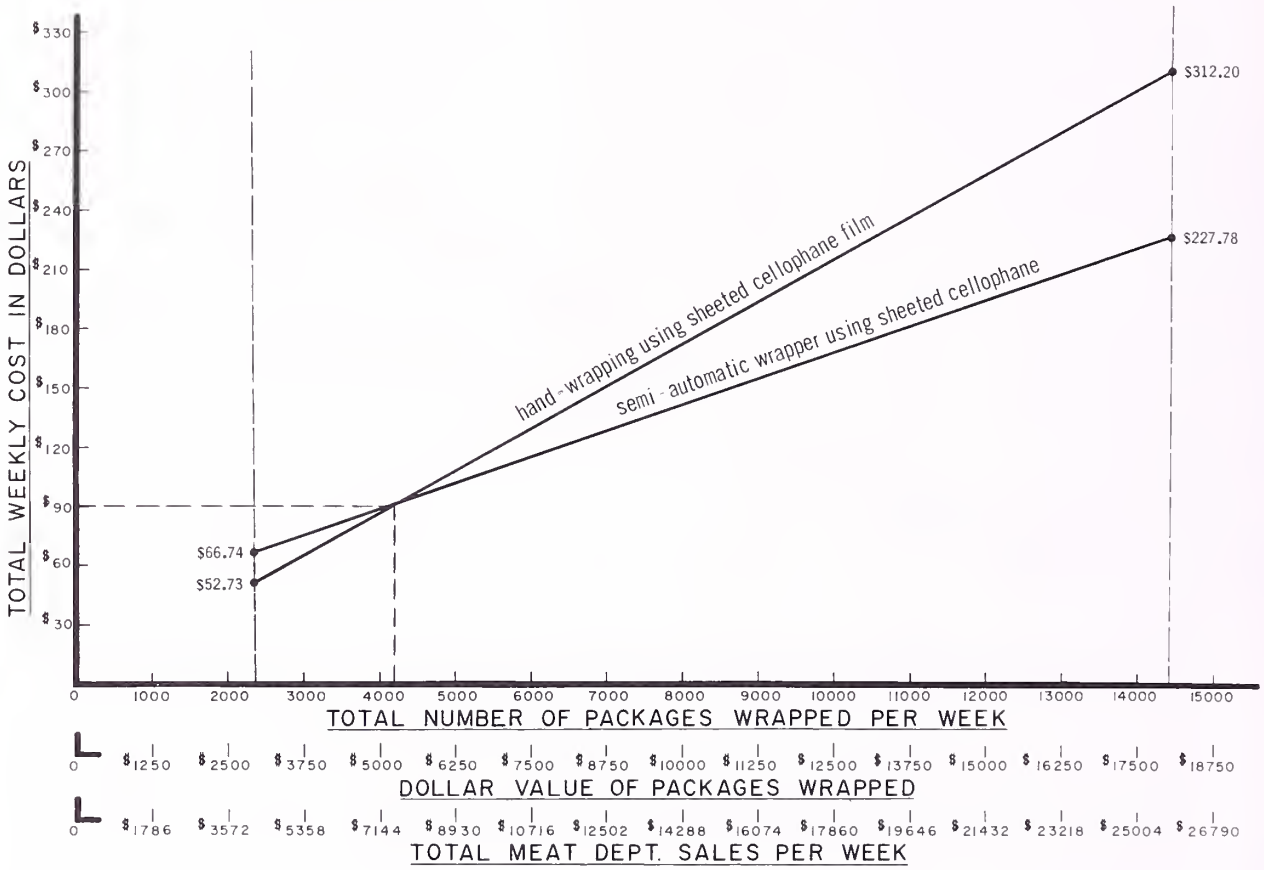
Wrapping systems compared	75 percent			85 percent			90 percent			95 percent		
	Total wrapped	Value of total packages wrapped	Total meat sales	Total wrapped	Value of total packages wrapped	Total meat sales	Total wrapped	Value of total packages wrapped	Total meat sales	Total wrapped	Value of total packages wrapped	Total meat sales
	Packages	*Dollars*	*Dollars*	*Packages*	*Dollars*	*Dollars*	*Packages*	*Dollars*	*Dollars*	*Packages*	*Dollars*	*Dollars*
Fully automatic wrapping using rolled soft film vs. Hand wrapping using sheeted cellophane film	3,990	4,988	7,126	3,749	4,686	6,694	3,655	4,569	6,527	3,579	4,474	6,391
Semiautomatic wrapping using sheeted cellophane film vs. Hand wrapping using sheeted cellophane film	4,187	5,234	7,477	3,701	4,626	6,609	3,559	4,449	6,356	3,345	4,181	5,973
Fully automatic wrapping using rolled cellophane film vs. Hand wrapping using sheeted cellophane film	5,440	6,800	9,714	4,785	5,981	8,544	4,588	5,735	8,193	4,320	5,400	7,714
Fully automatic wrapping using rolled soft film vs. Hand wrapping using rolled soft film	9,632	12,040	17,200	8,499	10,624	15,177	8,026	10,033	14,333	7,604	9,505	13,579

[1] Value of total packages wrapped is based on an average selling price of $1.25 per package. Value of total meat sales is based on the assumption that fresh meat sales (total packages wrapped) make up 70 percent of total meat sales.



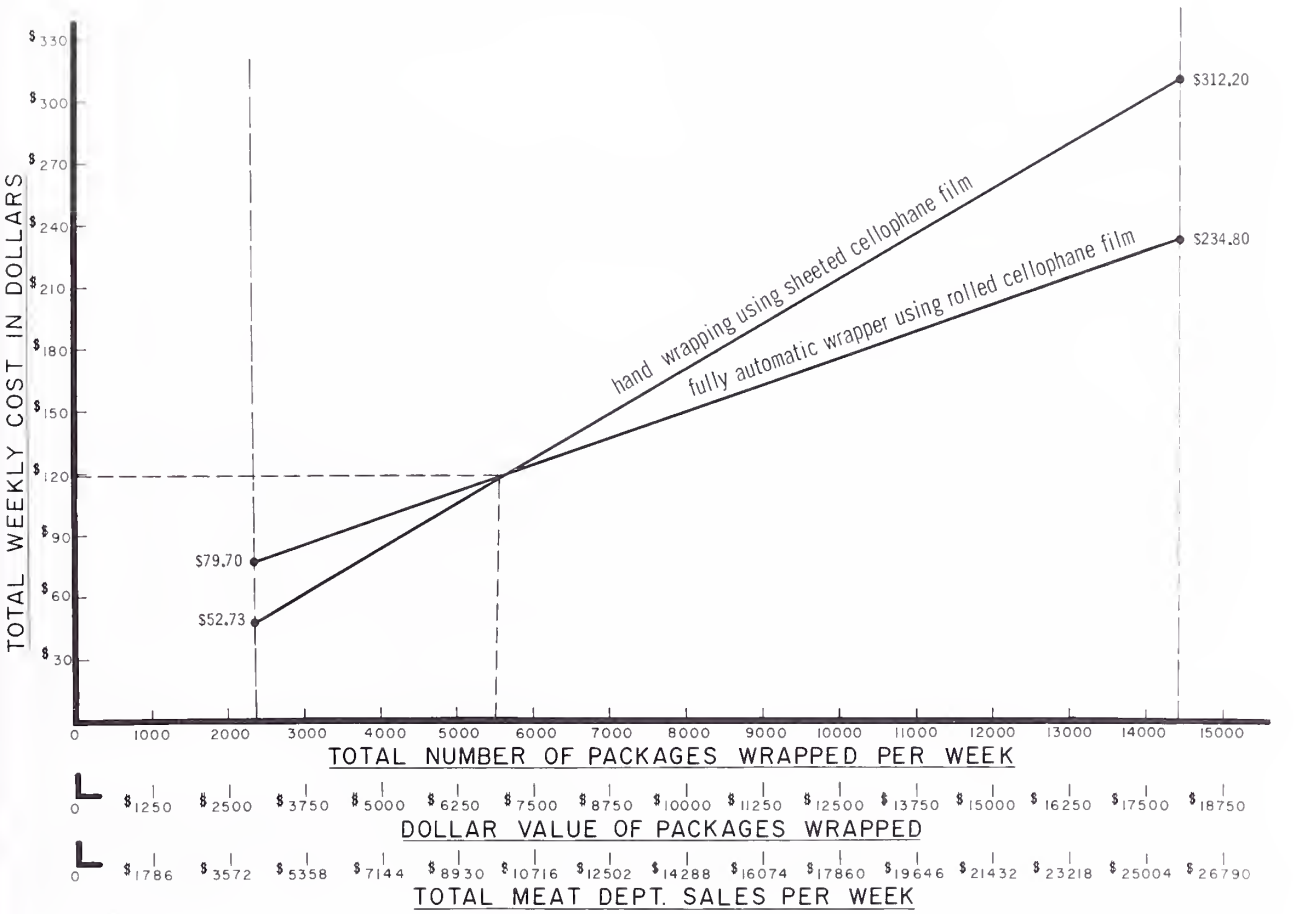
DN 2207

FIGURE 6.—Cost comparison of a hand wrapping operation using sheeted cellophane film and a fully automatic wrapping machine using rolled soft film when 75 percent of the packages are machine wrapped.



DN 2205

FIGURE 7.—Cost comparison of a hand wrapping operation using sheeted cellophane film and a semiautomatic wrapping machine using sheeted cellophane film when 75 percent of the packages are machine wrapped.



DN 2208

FIGURE 8.—Cost comparison of a hand wrapping operation using sheeted cellophane film and a fully automatic wrapping machine using rolled cellophane film when 75 percent of the packages are machine wrapped.

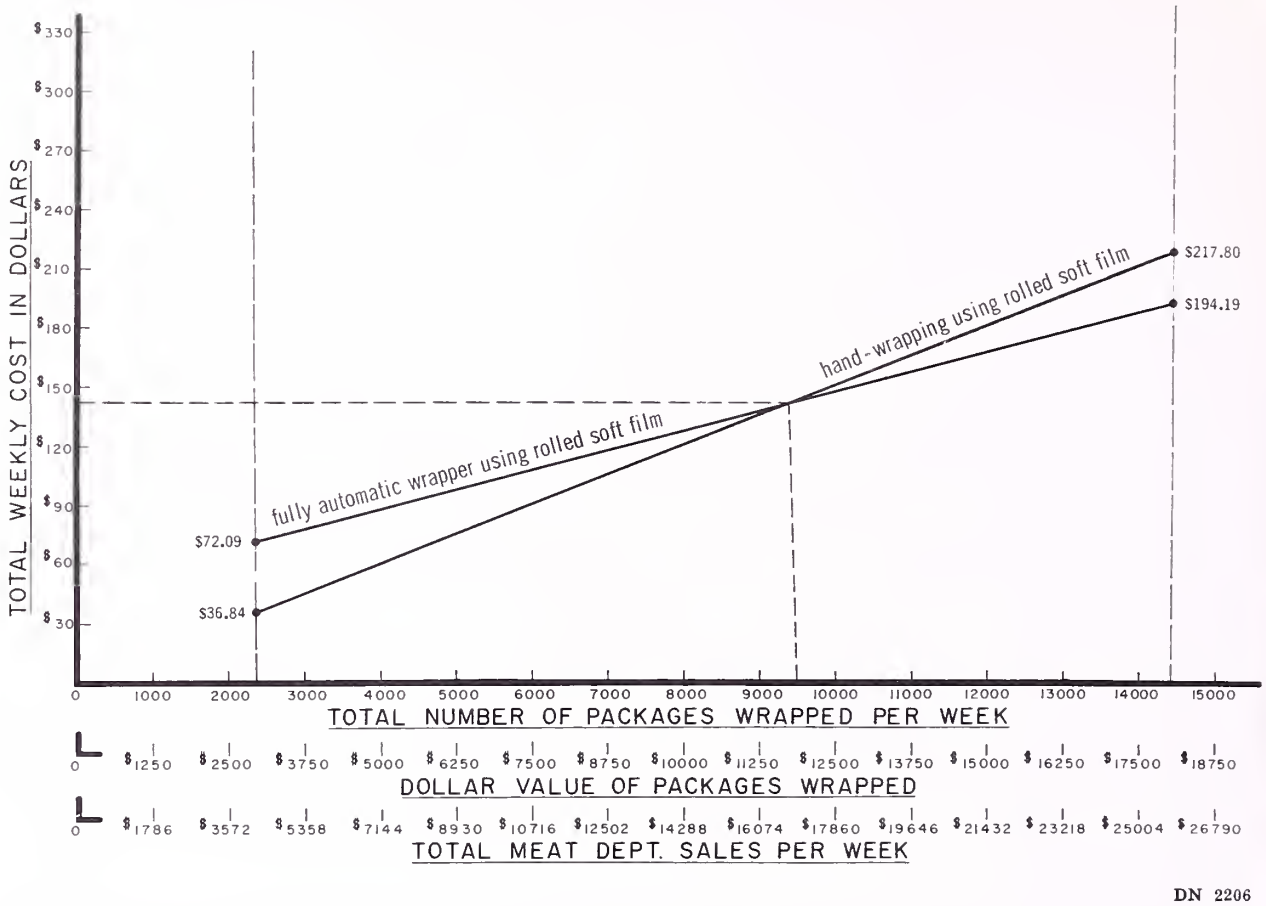


FIGURE 9.—Cost comparison of fully automatic wrapping machine using rolled soft film and a hand wrapping operation using rolled soft film when 75 percent of the packages are machine wrapped.

Other Factors to Consider

There are factors other than cost that should be considered before buying a wrapping machine.

Because machine wrapping is faster than hand wrapping, a wrapping machine can definitely help a meat department keep display cases well stocked during peak sales periods. A properly installed machine also makes it easier for the meat manager to schedule labor and production more efficiently. Since approximately 60 percent of sales occur on the last 3 days of the week, it may be advantageous to install a wrapping machine even when the weekly volume level is below the break-even point.

USE OF WRAPPING MACHINE

Principles of meat backroom layout are presented in a previous report.[7] Much time and effort can be lost if wrapping machines are not properly incorporated into the overall system. Smooth, continuous product flow is necessary to prevent bottlenecks and backtracking.

Cutting Area

In a medium or large volume meat department, as shown in figure 10, the primal cuts are brought by rail directly to the power saws. The cutting and traying tables are placed at right angles to the conveyors feeding the wrapping machine. This placement of cutting tables provides working space for 2- to 5-man crews; hence scheduling of work is more flexible and larger crews can be used for high volume items and during peak sales periods.

A good scheduling system is needed to obtain the maximum production capacity of a wrapping machine. Similar primal cuts (all loins, for example) should be scheduled for processing into retail cuts during a given time period and at a designated cutting station. This allows similar retail cuts of meat to be cut, packaged, and sent to the wrapping machine by conveyor in a group. Wrapping similar packages on the machine at one time reduces the number of times (1) the pricing is adjusted, (2) the slugs are changed, (3) the scale tare is reset, and (4) the wrapping machine is adjusted.

Feeding and Discharging Systems

It is poor policy to invest large sums of money for specialized equipment and then not utilize it to its maximum capacity. In most stores it was found that very little attention was given to developing efficient layouts which would utilize the wrapping machine to its maximum capacity. A backlog of packages should be accumulated at the feeding end of the machine. This accumulation of packages insures the minimum of machine down time due to sporadic feeding. Conveyors are an effective means of connecting the cutting and traying operation to the wrapping machine, and furnish the storage area needed for an ample backlog of packages (fig. 11).

Items that come down the main conveyor from the cutting stations but that cannot be machine wrapped are returned by the machine operator to the hand wrapping station by a gravity conveyor. This procedure helps in realizing maximum utilization of the wrapping machine.

The discharge area of the wrapping line is at present the main bottleneck in processing and packaging fresh meat. Since packages are discharged to a pan or into a tub they must be occasionally stacked and arranged and either put in the display case or stored in bunkers under the case. Some stores have a holding cooler where pans of meat are stored in racks and then are placed in the display case as needed. If the product is discharged onto a conveyor it still has to be placed in some type of container before going to the display case or into storage. Some firms have tried using tubs that fit directly into the case bunkers; however, this involves placing only like items in each tub and is also rather costly due to the large number of tubs needed. Only a limited number of packages can be put in each tub or it becomes too heavy and cumbersome for easy handling; therefore, most firms store the product on pans.

A distinct advantage of the layouts shown in figures 10 and 11 is that the machine operator spends very little time walking compared to a straight line layout as shown in figure 1. Since the operator must change the label-printer slugs for each item and stack the packages at the discharge end, it is important to design a backroom layout that will minimize the distance between the feed and discharge ends of the wrapping machine.

Factors which should be considered in obtaining the most efficient use of the wrapping machine are as follows:

1. Place equipment to obtain smooth, continuous flow of product.

[7] ANDERSON, DALE L., and SHAFFER, PAUL F. PRINCIPLES OF LAYOUT FOR SELF-SERVICE MEAT DEPARTMENTS. U.S. Dept. Agr. Mktg. Res. Rpt. No. 77, 37 pp, illus., 1954, reissued 1965.

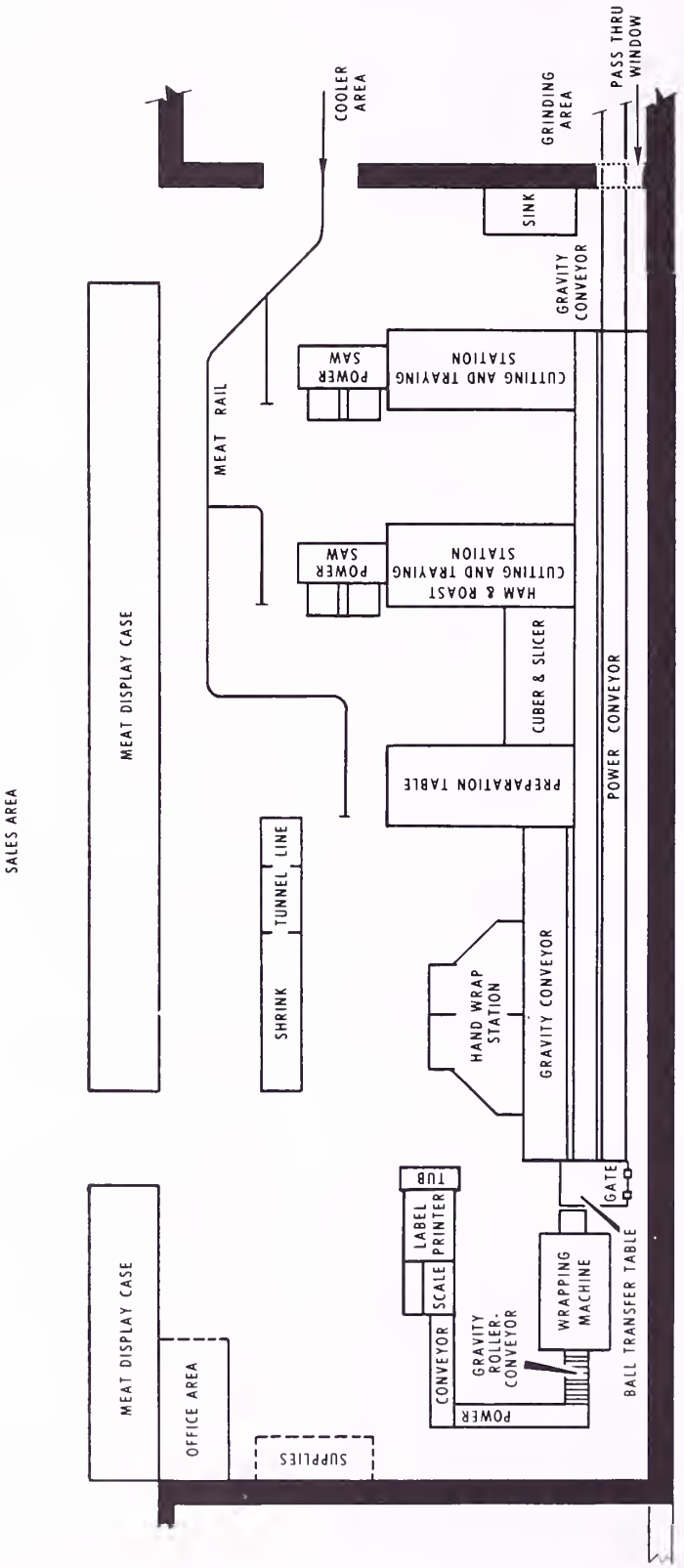
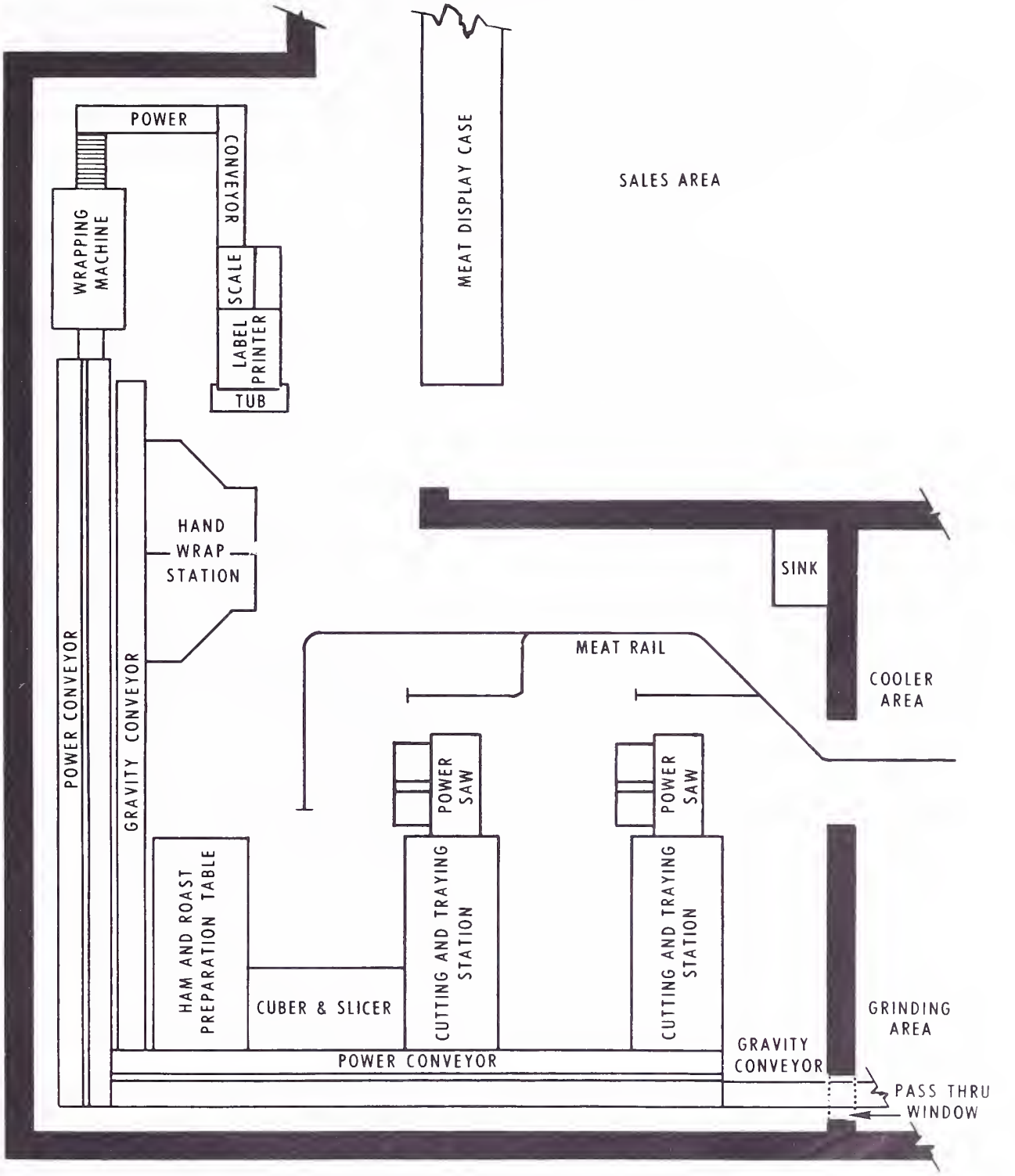


FIGURE 10.—Layout for a medium or high volume meat department in a rectangular meat backroom.



DN 2227

FIGURE 11.—Layout for a medium or high volume meat department in an L-shaped backroom.

2. Schedule large amounts of similar size and type of cuts for releasing to the wrapping machine in one batch.
3. Use conveyors to feed pans of product directly from the cutting stations to the input end of the wrapping machine.
4. Position hand wrapping stations so that all packages go to the wrapping machine first.
5. Position automatic scale and label printer close to feeding end of the machine wrapper to minimize walking time.

APPENDIX

Tables

TABLE 6.—*Standard labor time per package, hand wrapping meat using sheeted cellophane film*

Job element	Time per package
	Minutes
Wrapping:	
Regular elements: Obtain and position meat; wrap, seal, and dispose of package	0.206
Irregular elements:	
Clean seal plate	.0015
Obtain film from storage	.0005
Clean and arrange work place	.0009
Pick up package from floor	.0001
Push pans on conveyor	.0028
Obtain film from table shelves	.0192
Replace film on table shelf	.0034
Obtain full pan and position	.0075
Position empty pan at work place	.0060
Place full pan on conveyor	.0072
Total irregular elements	.049
Total regular and irregular wrapping elements	.255
Weighing and pricing:	
Regular elements	.064
Irregular elements	.030
Total wrapping, weighing, and pricing time	.349
Plus 15 percent for personal and fatigue time	.052
Total standard time	.401

TABLE 7.—*Standard labor time per package, hand wrapping meat using soft rolled film*

Job element	Time per package
	Minutes
Wrapping:	
Regular elements: Obtain and position meat; wrap, and place package on heat seal conveyor	0.126
Irregular elements:	
Position full pans of unwrapped meat at wrapping table	.0030
Position empty pan at scale	.0024
Dispose of empty pan	.0033
Change to different roll size	.0094
Clean wire	.0034
Dispose of divider paper	.0035
Put grade label on packages	.0104
Clean belt:	.0008
Remove package holder	.0006
Position package holder at wrapping table	.0007
Total irregular elements	.027
Total regular and irregular wrapping elements	.163
Weighing and pricing:	
Regular elements	.064
Irregular elements	.030
Total wrapping, weighing, and pricing time	.257
Plus 15 percent for personal and fatigue time	.039
Total standard time	.296

TABLE 8.—*Standard labor time per package, semiautomatic wrapping of meat using sheeted cellophane film*

Job element	Time per package
	Minutes
Wrapping:	
Regular elements: Obtain and position meat; make first seal and place package in machine	0.071
Irregular elements:	
Obtain full pan from conveyor and position	.0059
Dispose of empty pan	.0012
Place pan with wrapped package on dolly	.0069
Adjust wrapping machine	.0017
Clear machine of jammed package	.0002
Turn machine on and off	.0001
Stack package on pans at discharge table	.0262
Obtain or replace film in table racks	.0028
Obtain supplies	.0006
Clean work area	.0001
Change slug and adjust price	.0044
Clear stuck labels	.0003
Rerun package	.0006
Check price	.0002
Relabel package	.0002
Total irregular elements	.0514
Total wrapping, weighing, and pricing time	.122
Plus 15 percent for personal and fatigue time	.018
Total standard time	.140

TABLE 9.—*Standard labor time per package, fully automatic wrapping of meat using rolled film*

Job element	Time per package
	Minutes
Wrapping:	
Regular elements: Obtain and position meat on feeding conveyor	0.040
Irregular elements:	
Obtain full pan from conveyor and position	.0059
Dispose of empty pan	.0012
Place pan with wrapped packages on dolly	.0069
Adjust wrapping machine	.0017
Clear machine of jammed package	.0001
Stack packages on pan at discharge table	.0104
Turn machine on and off	.0001
Change film size	.0001
Obtain supplies	.0001
Clean area	.0001
Change slugs and adjust price	.0044
Check price	.0002
Total irregular elements	.031
Total wrapping, weighing, and pricing time	.071
Plus 15 percent for personal and fatigue time	.011
Total standard time	.082

TABLE 10.—*Film costs per package for wrapping meat, by size of retail package and wrapping system*

Tray size	Height of product	Sheeted cellophane film[1]		Rolled cellophane film[2]		Rolled soft film[3]			
		Semiautomatic and conventional hand wrapping		Fully automatic wrapper		Hand wrapping		Fully automatic wrapper	
		Size of film	Cost of film	Size of film	Cost of film	Size of film	Cost of film	Size of film	Cost of film
	Inches	*Inches*	*Cents*	*Inches*	*Cents*	*Inches*	*Cents*	*Inches*	*Cents*
1	1.00	12x12	0.54	15x13.75	0.69	12x14.00	0.44	15x13.75	0.54
1	2.50	12x12	.54	15x14.50	.73	12x15.25	.48	15x14.50	.57
17 S	.69	12x12	.54	15x11.25	.56	12x11.50	.36	15x11.25	.44
17 S	.75	12x12	.54	15x11.25	.56	12x11.50	.36	15x11.25	.44
17 S	1.15	12x12	.54	15x11.50	.58	12x11.50	.36	15x11.50	.50
17 S	2.80	13x13	.63	15x13.50	.68	12x15.25	.48	15x13.50	.53
2 S	.50	13x13	.63	15x13.25	.66	12x11.50	.36	15x13.25	.52
2 S	.58	13x13	.63	15x13.50	.68	12x11.50	.36	15x13.50	.53
2 S	.75	13x13	.63	15x13.50	.68	12x11.50	.36	15x13.50	.53
2 S	.81	13x13	.63	15x13.50	.68	12x11.50	.36	15x13.50	.53
2 S	1.05	13x13	.63	15x13.50	.68	12x11.50	.36	15x13.50	.53
2 S	1.12	13x13	.63	15x13.50	.68	12x11.50	.36	15x13.50	.53
2 S	1.25	13x13	.63	15x14.75	.74	12x11.50	.36	15x14.75	.57
2 S	1.38	13x13	.63	15x14.75	.74	12x12.50	.39	15x14.75	.54
2 S	1.50	13x13	.63	15x14.75	.74	12x14.00	.44	15x14.75	.55
2 S	2.91	15x15	.84	15x15.75	.79	15x15.50	.61	15x15.75	.61
2 S	3.17	15x15	.84	15x15.75	.79	15x15.50	.61	15x15.75	.61
2	1.42	14x14	.73	15x14.75	.74	12x14.00	.44	15x14.75	.57
2	1.66	14x14	.73	15x14.75	.74	12x14.00	.44	15x14.75	.57
2	1.81	14x14	.73	15x14.75	.74	12x14.00	.44	15x14.75	.57
2	2.08	14x14	.73	15x15.75	.79	15x15.25	.59	15x15.75	.61
2	2.19	14x14	.73	15x15.75	.79	15x15.25	.59	15x15.75	.61
20 S	.85	14x14	.73	15x15.50	.78	15x11.50	.45	15x15.50	.61
20 S	.95	14x14	.73	15x15.50	.78	15x11.50	.45	15x15.50	.61
20 S	1.00	14x14	.73	15x15.50	.78	15x11.50	.45	15x15.50	.61
20 S	1.81	14x14	.73	15x16.00	.80	15x13.00	.51	15x16.00	.62
5 S	.50	14x14	.73	15x13.00	.65	15x13.00	.51	15x13.00	.51
5 S	1.17	14x14	.73	15x13.00	.65	15x13.00	.51	15x13.00	.51
5 S	1.54	14x14	.73	15x13.25	.66	15x13.50	.53	15x13.25	.52
5 S	2.50	14x14	.73	15x15.25	.66	15x15.50	.53	15x15.25	.52
4 S	1.06	15x15	.84	15x16.00	.80	15x17.00	.66	15x16.00	.62
10 S	.75	15x15	.84	15x14.25	.71	15x13.00	.51	15x14.25	.56
10 S	.87	15x15	.84	15x14.25	.71	15x13.00	.51	15x14.25	.56
10 S	.88	15x15	.84	15x14.25	.71	15x13.00	.51	15x14.25	.56
10 S	1.20	15x15	.84	15x14.50	.73	15x13.00	.51	15x14.50	.57
10 S	1.38	15x15	.84	15x15.50	.78	15x13.00	.51	15x15.50	.61
10 S	1.45	15x15	.84	15x15.50	.78	15x13.00	.51	15x15.50	.61

TABLE 10.—*Film costs per package for wrapping meat, by size of retail package and wrapping systems—Continued*

Tray size	Height of product	Sheeted cellophane film[1]		Rolled cellophane film[2]		Rolled soft film[3]			
		Semiautomatic and conventional hand wrapping		Fully automatic wrapper		Hand wrapping		Fully automatic wrapper	
		Size of film	Cost of film	Size of film	Cost of film	Size of film	Cost of film	Size of film	Cost of film
	Inches	*Inches*	*Cents*	*Inches*	*Cents*	*Inches*	*Cents*	*Inches*	*Cents*
10 S.....	3.17	16x16	0.95	18x18.50	1.11	17x18.00	0.80	18x18.50	0.87
8 S.....	2.56	18x18	1.20	18x21.50	1.29	17x18.25	.81	18x21.50	1.01
12 S.....	.75	18x18	1.20	18x17.15	1.03	17x15.00	.66	18x17.15	.80
12 S.....	.90	18x18	1.20	18x17.50	1.05	17x15.00	.66	18x17.50	.82
12 S.....	1.00	18x18	1.20	18x18.25	1.10	17x15.00	.66	18x18.25	.85
12 S.....	1.46	18x18	1.20	18x19.75	1.18	17x15.00	.66	18x19.75	.93
32 S.....	2.50	14x14	.73	15x16.50	.83	15x16.75	.65	15x16.50	.64

[1] $0.0372 per 1,000 square inches.
[2] $0.0333 per 1,000 square inches.
[3] $0.0260 per 1,000 square inches.

TABLE 11.—*Film cost for five meat wrapping methods using a given product mix*

Tray size	Product	Product height	Product movement per week	Cost of cellophane film				Cost of soft film			
				Per package		Per week		Per package		Per week	
				Semiautomatic and hand wrap	Fully automatic	Semiautomatic and hand wrap	Fully automatic	Hand wrap	Fully automatic	Hand wrap	Fully automatic
		Inches	*Packages*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
1	Pork sausage	1.00	84	0.54	0.69	45.36	57.96	0.44	0.54	36.96	45.36
1	Hamburger	2.50	150	.54	.73	81.00	109.50	.48	.57	72.00	85.50
17 S	Loin veal chops	.69	14	.54	.56	7.56	7.84	.36	.44	5.04	5.72
17 S	Meat loaf	.75	88	.54	.56	47.52	49.28	.36	.44	31.68	38.72
17 S	Delmonico steak	1.15	31	.54	.58	16.74	17.98	.36	.50	11.52	15.50
17 S	New York strips	2.80	28	.63	.68	17.64	17.68	.48	.53	13.44	14.84
2 S	Veal steak	.50	64	.63	.66	40.32	42.24	.36	.52	23.04	33.28
2 S	Rib veal chops	.58	17	.63	.68	10.71	11.56	.36	.53	6.12	9.01
2 S	Rib bone veal chops	.75	28	.63	.68	17.64	19.04	.36	.53	10.08	14.84
2 S	Shoulder veal chops	.75	19	.63	.68	11.97	12.92	.36	.53	6.84	10.07
2 S	Spare ribs	.81	123	.63	.68	77.49	83.64	.36	.53	44.28	65.19
2 S	Hamburger patties	1.05	258	.63	.68	162.54	175.44	.36	.53	92.88	136.74
2 S	Boneless sirloin	1.12	10	.63	.68	6.30	6.80	.36	.53	3.60	5.30
2 S	T-bone steak	1.25	104	.63	.74	65.52	76.96	.36	.57	37.44	59.28
2 S	Pork chops, center cuts	1.38	296	.63	.74	186.48	219.04	.39	.54	115.44	159.84
2 S	Shoulder lamb chops	1.50	12	.63	.74	7.56	8.88	.44	.55	5.28	6.60
2 S	Rib lamb chops	2.91	15	.84	.79	12.60	11.85	.61	.61	9.15	9.15
2	Stewing lamb	1.42	8	.73	.74	5.84	5.92	1.44	.57	3.52	4.56
2	Hamburger	1.66	635	.73	.74	463.55	469.90	1.44	.57	279.40	361.95
2	Stewing beef	2.08	323	.73	.74	235.79	239.02	1.44	.57	142.12	184.11
2	Chicken breasts	2.19	176	.73	.79	128.48	139.04	.59	.61	103.84	107.36
20 S	Porterhouse steak	.85	87	.73	.78	63.51	67.86	.45	.61	39.15	53.07
20 S	Rib lamb chops	.95	8	.73	.78	5.84	6.24	.45	.61	3.60	4.88
20 S	Sirloin tip	1.00	158	.73	.78	115.34	123.24	.45	.61	71.10	96.38
20 S	Boneless chuck roast	1.81	34	.73	.80	24.82	27.20	.51	.62	17.34	21.08

5 S.	Rib pork chops	.50	300	.73	.65	219.00	195.00	.51	.51	153.00	153.00
5 S.	Hamburger	.50	466	.73	.65	340.18	302.90	.51	.51	237.66	237.66
5 S.	Boneless round steak	1.17	109	.73	.65	79.57	70.85	51	.51	55.59	55.59
5 S.	Rib steak	1.54	265	.73	.66	193.45	174.90	.53	.52	140.45	137.80
4 S.	Chuck blade steak	1.06	95	.84	.80	79.80	76.00	.66	.62	62.70	58.90
10 S.	Rib steak	.75	117	.84	.71	98.28	83.07	.51	.56	59.67	65.52
10 S.	Veal cutlets	.75	30	.84	.71	25.20	21.30	.51	.56	15.30	16.80
10 S.	Flank steak	.87	11	.84	.71	9.24	7.81	.51	.56	5.61	6.16
10 S.	Pork chops	.88	507	.84	.71	425.88	359.97	.51	.56	258.57	283.92
10 S.	Hamburger	1.20	150	.84	.73	126.00	109.50	.51	.57	76.50	85.50
10 S.	Sirloin steak	1.38	30	.84	.78	25.20	23.40	.51	.61	15.30	18.30
10 S.	Shoulder roast	1.45	61	.95	1.11	57.95	67.71	.80	.87	48.80	53.07
8 S.	Chuck blade roast	2.56	164	1.20	1.29	196.80	211.56	.81	1.01	132.84	165.64
12 S.	Chuck arm steak	.75	163	1.20	1.03	195.60	167.89	.66	.80	107.58	130.40
12 S.	Sirloin steak	.90	2	1.20	1.05	2.40	2.10	.66	.82	1.32	1.64
12 S.	Shoulder roast	1.00	23	1.20	1.10	27.60	25.30	.66	.85	15.18	19.55
12 S.	Steak roll	1.46	13	1.20	1.18	15.60	15.34	.66	.93	8.58	12.09
32 S.	Veal shank	2.50	2	.73	.83	1.46	1.66	.65	.64	1.30	1.28
						Dollars	*Dollars*			*Dollars*	*Dollars*
	Total or average	....	5,278	.75	.74	39.77	39.23	.49	.58	25.81	30.51
						Per year				Per year	
	Total	....	....	....	....	2,068.04	2,039.96	....	....	1,342.12	1,586.52

Break-Even Formula

The formula developed for determining the break-even volume between hand wrapping operations and machine wrapping operations is as follows:

$$LHW(X) + fHW(X) + FHW = PMW[LMW(X) + fMW(X)] + FMW + FHW + PHW[LHW(X) + fHW(X)]$$

Where

X=Number of packages required per week to reach the break-even volume.

LHW=Labor cost in dollars to hand wrap a package. This also includes the labor cost of weighing and pricing the package.

fHW=Film cost per package in dollars for the hand wrapping method.

FHW=The weekly depreciated equipment cost plus the maintenance cost on the hand wrapping station.

PMW=The percent of packages in a meat department which are wrapped on wrapping machines.

LMW=Labor cost in dollars to machine wrap a package. This also includes the labor cost of weighing and pricing the package.

fMW=Film cost per package in dollars when wrapping by machine.

FMW=The weekly depreciated equipment plus maintenance cost on the wrapping machine.

PHW=The percent of packages in a meat department that have to be hand wrapped because they are too large for the wrapping machine.

Sample calculation:

To find the break-even volume when 75 percent of the packages are wrapped on a fully automatic wrapper using rolled cellophane film compared to a hand wrapping operation using sheeted cellophane film, substitute figures from tables 1–4 into the formula:

$$LHW(X) + fHW(X) + FHW = PMW[LMW(X) + fMW(X)] + FMW + FHW + PHW[LHW(X) + fHW(X)]$$

$$0.0136X + 0.0075X + 4.18 = 0.75(0.0028X + 0.0074X) + 46.59 + 2.09 + 0.25(0.0136X + 0.0075X)$$

$$0.0136X + 0.0075X + 4.18 = 0.00210X + 0.00555X + 46.59 + 2.09 + 0.00340X + 0.00187X$$

$$0.0211X - 0.01292X = 44.50$$

$$0.00818X = 44.50$$

$$X = 5{,}440 \text{ packages per week}$$

☆ U.S. GOVERNMENT PRINTING OFFICE: 1967—O 233-033