Marketing Research Report No. 549

Methods and Equipment for EVISCERATING CHICKENS

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
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PREFACE

This report on improved methods and equipment for processing chickens into ready-to-cook condition is based on one of several studies in this area of work. Field studies were conducted in more than 30 poultry processing plants in Georgia, Alabama, Maryland, Delaware, and Maine. In addition, several plants in Mississippi, Arkansas, and Texas were visited to verify eviscerating methodology studied in other parts of the United States.

The work was conducted under the supervision of John A. Hamann, marketing research analyst, Handling and Facilities Research Branch, Transportation and Facilities Research Division, Agricultural Marketing Service, and Harold D. White, agricultural engineer, College Experiment Station, University of Georgia College of Agriculture Experiment Stations, Athens, Ga. Wholehearted cooperation was given by the management and employees of the plants studied, and by inspection personnel of the Poultry Division, AMS. Dr. K. N. May, Market Quality Research Division, AMS, who is also assistant professor in the Poultry Division, University of Georgia, assisted as consultant on bacteriological problems. Frederick E. Henry, industrial engineer, conducted many of the field studies and contributed greatly in analyzing and compiling the data for the report before he left the Department of Agriculture.

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SUMMARY

Poultry processors can reduce costs below the usual levels at practically every work station in the eviscerating area, by reducing labor requirements, decreasing the amount of edible product thrown away, or more effective maintenance of product quality.

Where processing methods offer a choice, shanks can be removed about 50 percent faster if the chickens are suspended by the neck and the removal cut is by knife, than when shears are used and the birds are suspended by the feet. About one dollar's worth of edible product per thousand birds processed can be saved by removing the oil gland with the bird suspended by the hocks, rather than by the neck. Weight loss can be reduced considerably, too, if abdominal fat is left attached to the bird carcass rather than being drawn with the viscera.

The best method for transferring dressed birds from the defeathering line to the eviscerating line depends on the type of picking equipment, the methods of performing other operations near the transfer points, and the type of eviscerating conveyor used . In most cases, it is more economical to transfer birds directly from neck suspension on the defeathering line to hock suspension on the eviscerating line.

Federal inspectors can inspect poultry more effectively if plant management provides an adequate inspection station, presents the bird in the proper position for inspection, and sees that all operations before inspection are performed properly.

In high-volume processing plants (3,000 or more chickens per hour), hearts and livers can be removed and trimmed with about 25 percent less labor if both parts are handled by the same operator. Even though high maintenance cost is involved and some additional labor is required for peeling, gizzards can be split and washed cheaper by automatic splitter than by hand splitting and washing. Of four methods observed, a mechanical splitter with a manual ejection peeler resulted in the lowest processing cost, 23.2 cents per 100 gizzards, compared to the highest cost of 29.0 cents per 100.

Lungs and reproductive organs can be removed more efficiently with vacuum equipment than with a hand rake. A vacuum system with a shut-off-type nozzle, used properly, enables an operator to remove lungs and reproductive organs from 3.4 more birds per minute than he can with an open-flow nozzle.

The crop and windpipe can be removed about 50 percent faster (from 21.1 birds compared to 14.4 per minute) if the vertebrae are severed first, rather than making a horizontal slit in the neck skin for an opening.

Giblets can be wrapped and stuffed into warm carcasses at a rate one bird per minute faster than when stuffed into chilled carcasses.

Costs of performing each of the eviscerating operations can vary significantly between the most and least efficient methods in use. For example, assuming a plant processes an average of 30,000 birds per day, the daily cost variations for some operations, as observed in this study, approximate the following:

Operation	Least efficient method	Most efficient method
Shank removal	$20. 00	$10. 00
Oil gland removal	47. 00	[1] 15. 00
Heart and liver harvest	40. 00	30. 00
Gizzard split and peel	30. 00	23. 20
Lung removal	[2] 30. 00	20. 00
Crop and windpipe removal	50. 00	30. 00
Wrap and stuff giblets	40. 00	30. 00
Total	257. 00	158. 20

[1] Low cost due mainly to saving of edible product.
[2] One worker not fully utilized.

This shows potential savings of almost $100 a day, which would amount to more than $2 million annually during high activity in about 100 U. S. plants at this production level.

In addition to these savings on specific operations, the combinations of methods, equipment, and crew developed in this study can yield further reductions in costs amounting to as much as $15,000 per year per individual plant.

Methods and Equipment for Eviscerating Chickens

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BACKGROUND OF THE STUDY

The commercial broiler industry in the United States has experienced both rapid expansion and severe growing pains. Only 143 million commercial broilers were produced in 1940. By 1955, production had reached 1 billion birds, and preliminary figures for 1961 indicate an annual total of about 2 billion birds. To handle the processing operation involved in marketing this quantity of chickens, many new poultry processing plants have been erected, many plants enlarged, and new methods and equipment devised.

Since the relatively complex eviscerating operation has a high labor requirement, it follows that there developed many "best" ways for performing the various steps in this processing operation. The passage of the Poultry Inspection Act[2] and the regulations in connection with it brought about a greater uniformity of operating procedures in this processing area, and thereby minimized the number of "best methods." However, since the criteria for operating procedures acceptable under the inspection act are related directly to its effect on product wholesomeness, a wide range of efficiency of workers and equipment persisted. Little precise information on methodology or labor and equipment requirements was available, and criteria for crew size and balance in relation to line speed and operating volume were nonexistent.

To develop sound criteria for solving some of these problems, studies employing industrial engineering techniques were conducted in a large number of processing plants in four major broiler-producing areas. These "case-study" plants provided information on variations in methods and equipment used in the numerous processing steps in chicken evisceration. By selecting average workers[3] as study subjects and then screening the most efficient from many good methods, and by improving work station layouts and equipment and labor utilization for various production levels, guidelines for improved methods and equipment for eviscerating chickens were developed.

DESCRIPTION OF EVISCERATING OPERATIONS

Removal of the viscera from the dressed chicken carcass can be accomplished in two or three operations. However, in preparing the chicken carcass in ready-to-cook form, many other operations are thought of in the industry as a part of the evisceration process (fig. 1).

Shank removal is normally considered the first eviscerating operation, since it is usually the first one performed after defeathering, and sometimes is done in the eviscerating room. Removal of the oil gland follows in the sequence illustrated, but does not have to be done before Federal inspection. Three-pointing of the carcass (hanging it by hocks and neck) is preferred by some processors, but the trend is toward processing birds on two-point suspension (hanging by hocks only).

The body cavity is always opened and the viscera drawn just before Federal inspection. After inspection, the giblet harvesting and processing operations begin, followed by removal of inedible products, including the lungs, head, crop, and windpipe. After a final inside-and-outside wash of the bird, and a quick chill, the carcass is considered to be in ready-to-cook form.

[1] Formerly a staff member of the Agricultural Engineering Department, College Experiment Station, University of Georgia, Athens, Ga.

[2] Effective January 1, 1959.

[3] An individual capable of performing acceptable workmanship at a normal rate for an extended period of time.

PROCESS CHART

CHICKEN EVISCERATING OPERATIONS

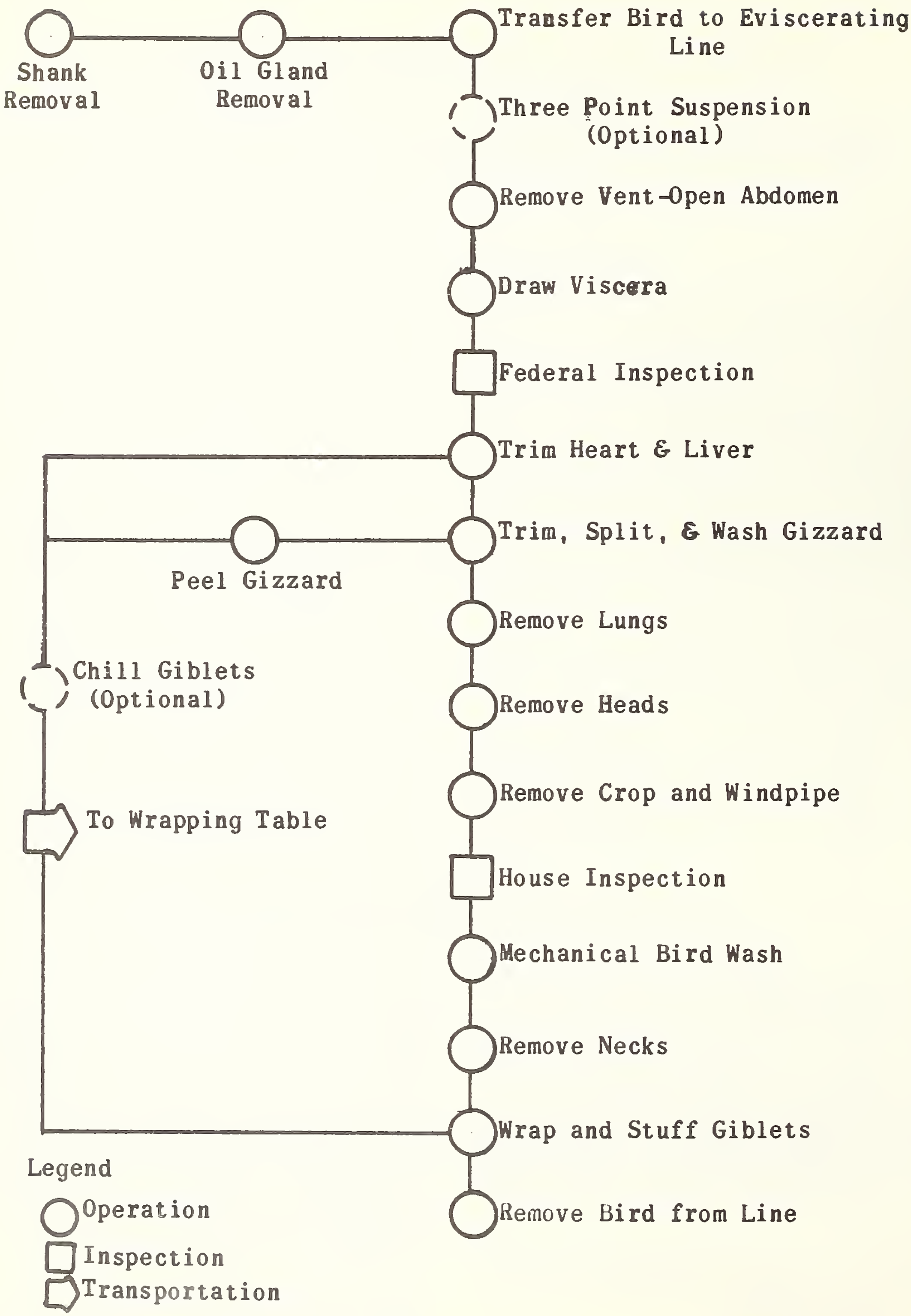

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FIGURE 1

METHODS OF REMOVING SHANKS

Removal of the shanks is required in preparing poultry for Federal inspection. The shanks are usually removed from the dressed bird after the mechanical washing of the bird that completes the defeathering operation. In all case-study plants, shanks were removed at a point on the processing line prior to the place where the body incision was made. Where the layout permitted, shanks were removed while the birds were still on the defeathering line. Crew balance could usually be attained more readily by cutting off shanks on the fast defeathering line rather than after birds were transferred to the slower-moving eviscerating line. This depended, however, on production line speeds.

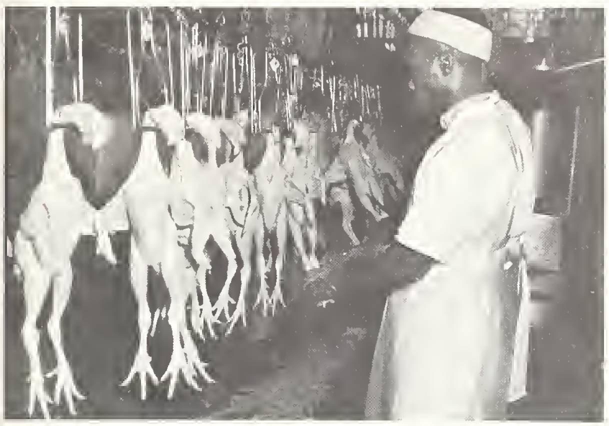

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FIGURE 2.—Removing shanks from poultry suspended by the neck.

As the bird, usually suspended by its neck, passed the operator, the shanks were removed from the legs at the hock joints (fig. 2) and tossed in a waste container or an open gutter drain. The latter was the most common practice. It was often necessary to pump waste water into the drain at high velocity to convey the shanks. If barrels were used as offal receptacles, full barrels had to be emptied periodically.

In the geographic area of this study, three types of tools were employed to remove shanks: A knife with an average blade length of 5 to 6 inches, a pair of hand-operated pruning shears, and an air-actuated hock cutter. In case-study plants, there was a general preference for the knife.

Shank Removal by Knife

A knife was used effectively for removing shanks (fig. 3), but considerable care was required to avoid injury to the operator and to execute the cut properly. Even though a knife of good quality was used, the cutting edge soon became dull, so that a reserve of one or two knives had to be kept within easy reach. Knife design did not appear to be an influencing factor.

The main disadvantage in using a knife was the continuous hazard of injury to the operator, especially when operating speed was high. One precaution used to avoid this danger was to wear a wire mesh glove on the hand that held the shanks during the cutting.

In all case-study plants where shanks were removed by knife, both shanks were severed at one time while the bird was suspended by the neck. The operator carefully alined both hock joints so as not to chip either leg bone. The hock joints were entered from either the side (fig. 3) or front (fig. 4). When the cut was made from the side, it was sometimes necessary to reposition the knife blade before severing the second shank. However, there was no measurable time loss due to this rapid extra movement.

The height of the bird in relation to the operator is important in this operation. The bird

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FIGURE 3.—Removing shanks by cutting from the side with a knife.

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Figure 4.—Removing shanks by knife, cutting from the front.

should be high enough so that the cut is made with a natural, horizontal hand motion by the operator. If the bird is too low, the knife exits from the leg below the joint, as a result of the downward path of the operator's hand.

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Figure 5.—Removing chicken shanks with manual shears.

Shank Removal by Manually Operated Shears

Manually operated shears used for cutting the hock joints have one cutting blade which closes against a narrow anvil when the shears are activated. When the shears are positioned at the hock joint, the anvil slips into the joint recess, helping the operator aline the shears and make a uniformly accurate cut at the joint.

Usually birds were suspended by the feet for this operation, and only one shank was removed at a time (fig. 5). When birds were suspended by the neck, both legs were grasped at once and the shanks snipped off (one at a time) in rapid succession. However, when the shanks were removed in this manner and the line speed was greater than 50 linear feet per minute, the bird moved out of the operator's normal work area during the operation. The released bird, swinging in an arc, then would strike other birds, disturbing other operators farther along the line.

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Figure 6.—Mechanized shears used to remove shanks.

The number of case-study plants using manual snips was small compared to the number using knives.

Shank Removal by Mechanized Shears

Pneumatic shears were tested for cutting off broiler shanks. They had two cutting edges, similar to those of scissors, and severed the shank at the joint readily. However, they were rather bulky and more difficult to aline with the hock joint than were the hand shears. When they were held at the normal ready position, the blades were vertical, requiring a 90-degree turn of the instrument to bring them into position to remove the shanks properly. To avoid frequent turning of the instrument, the birds' legs were raised to a near-horizontal position (fig. 6).

The blades were opened by a spring when hand pressure was released. Fully as much hand pressure was required to overcome the spring resistance as was required to cut off shanks with manual shears. With an air pressure of approximately 80 pounds per square inch, the snips were very powerful, the air cylinder doing practically all the work except that of overcoming the spring tension.

In view of these considerations, the manual shears or a knife were judged to be the most practical for severing the hock joints of broiler-type chickens. Mechanical snips might be more useful for plants processing a high percentage of fowl, cocks, or turkeys, where more force is required to sever the members. No tests on heavy classes of poultry were made in this study. It is the opinion of the authors, however, that the mechanical snips could possibly be modified so as to be more practical for use on broilers.

Comparison of Shank Removing Methods

One operator using a knife could remove the shanks of 41 birds per minute (table 1), compared to 37 removed by mechanized shears or 25 by manual shears, using the same method of bird suspension. This probably explains the preference for the knife over shears in most case-study plants. However, since only one case-study plant used the air-operated snips, this observation cannot be considered conclusive. The knife is much the most economical, because of higher production capacity and lower cost. Initial cost of the air-operated snips is about $175 plus the cost of equipment for supplying air pressure and costs of maintenance.

The difference between production rates of the air-operated snips and manually operated snips arises from the fact that only one shank at a time was snipped off manually, while both shanks were snipped at once when compressed air was used.

In all case-study plants where manual snips were used, the shanks were cut while the birds were on the fast-moving picking line. Only one shank at a time was cut, which significantly increased the time required for removing a pair of shanks (table 1). Actually, the time required to cut one shank with snips was little less than that required for cutting both shanks with a knife.

A saw also is used to remove shanks in some broiler processing areas. However, this method was not used in the area of this study.

Table 1.—*Time required to remove the shanks of 100 broilers by specified methods and equipment*

Equipment	Method of bird presentation	Time required per work element		Total time required
		Reach for bird	Cut off shanks	
		Man-minutes	*Man-minutes*	*Man-minutes*
Snips or shears, air operated[1]	Hung by neck	1. 20	1. 49	[2] 2. 69
Snips or shears, manually operated	Hung by feet	1. 28	2. 44	[3] 3. 72
	Hung by neck	1. 68	2. 27	[4] 3. 95
Knife (6-inch blade)	Hung by neck	0. 91	1. 51	[5] 2. 42

[1] Only one plant was observed using this equipment.
[2] A production rate of 2,232 birds per hour or 37.2 birds per minute.
[3] A production rate of 1,614 birds per hour or 26.9 birds per minute.
[4] A production rate of 1,518 birds per hour or 25.3 birds per minute.
[5] A production rate of 2,478 birds per hour or 41.3 birds per minute.

REMOVAL OF OIL GLAND

The preen or oil gland,[4] located at the junction of the bird's tail and back, is removed in preparing ready-to-cook poultry. In all case-study plants, this gland was removed with a knife. The blade design of the knife and position of the bird had a direct bearing on the amount of edible tissue that was removed with the gland. To remove a minimum of edible product, the cutting edge of the knife blade must enter and leave the skin tissue as close to the oil gland as possible without cutting into the gland itself (fig. 7).

A knife with a broad blade could not be turned sharply enough during the cut to avoid removing considerable edible tissue. A narrow blade, similar to that of a sticking knife, could be turned sharply, with minimum effort, to avoid the removal of edible tissue and keep weight loss at a minimum.

[4] Source of oil for the bird's plumage.

Birds were suspended either from the hocks or the neck during this operation. With either suspension, the cut was begun on the side of the gland toward the bird's head. Studies revealed that there was less edible product loss when the bird was suspended from the hocks (fig. 8). The carcass contour when hanging in this position and the careful knife control required eliminated a tendency to strip all the tissue from the top of the tail bud with a sweeping motion of the hand.

Removing the oil gland efficiently with the bird suspended by the neck (fig. 9) was possible, but closer supervision was required to prevent excess tissue from being cut away with the gland.

Supporting and pressing the tail back with the thumb or finger as a proper cut is made causes the gland to protrude and reduces the quantity of edible tissue removed. Efficiency was improved when shackle guide rails were installed so that the

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FIGURE 7.—Efficient oil gland removal results in minimum loss of edible tissue.

operator's reach was always constant and each bird faced the same direction as it passed. As in the case of shank removal, better crew balance was sometimes possible (at certain production rates) if this part was removed while the birds were still on the defeathering line.

The recorded weight of many oil glands shows that a gland can be removed effectively from an average-size broiler with a weight loss of about 2 grams (approximately .07 ounce). In instances where an improper knife or bird position was employed, or when the operator was careless, 3 to 4 grams per gland were being removed because the operator was cutting practically all the edible tissue from the top of the tail bud. In a small number of case-study plants, workers were removing slightly less than 2 grams per gland. This, however, was exceptional.

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FIGURE 8.—Minimum loss of edible tissue results from correct cut and method of suspending the bird.

The importance of performing this operation correctly is emphasized by the fact that 1 gram of edible tissue unnecessarily removed per bird represents a loss of about $1 per 1,000 birds processed—a sizable loss for a large plant.

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FIGURE 9.—Removing preen gland with bird suspended by the neck.

Labor Requirements

Time studies reveal that greater productivity in oil gland removal can be attained if the birds are suspended by the hocks rather than by the necks (table 2). The difference between the rate of 33.0 birds per minute for "hung by neck" and 36.8 birds per minute for "hung by hocks" is caused by the additional time required for the work element "Reach for next bird." When the birds are hung by the neck, this element requires .29 minute more per 100 birds than when they are suspended by the hock joints.

The difference in time requirements is explained by the difficulty experienced in grasping and positioning birds when they are dangling loosely by their necks. When they are more rigidly suspended by the hock joints (against guide rails), the reach is always short and constant. Hock hanging was employed when the job was performed on the eviscerating line, with one operator handling all birds on the line, whereas the "neck hang" was usually used when the operation was performed on the fast-moving picking line where each worker handled every second or third bird.

Although the normal rate for removing preen glands with birds suspended by the hock joints is 36.8 birds per minute, some skilled operators can maintain a rate of 40 birds per minute. This also happened to be about the average rate for eviscerating lines in case-study plants. Under these circumstances it becomes more practical to have the operator stationed on the eviscerating line. Most plants have the preen gland removed before the opening cut is made, but the gland can be removed anywhere along the line, since removal is not required before Federal inspection.

TABLE 2.—*Labor required to remove preen glands from 100 broilers using different methods of bird suspension*

Method of bird suspension	Time required per work element		Total time required
	Reach for next bird	Hold bird and remove preen gland	
	Man-minutes	*Man-minutes*	*Man-minutes*
Hung by neck	0. 91	2. 12	[1] 3. 03
Hung by hocks	0. 62	2. 10	[2] 2. 72

[1] A production rate of 1,980 birds per hour or 33 birds per minute.

[2] A production rate of 2,208 birds per hour or 36.8 birds per minute.

BIRD TRANSFER TO EVISCERATING LINE

After the birds have been defeathered and washed, they are transferred from the defeathering line to two or more slower moving eviscerating lines. This normally occurs after the shanks have been removed from the bird and always before the bird is opened. The birds may be transferred in either the picking or eviscerating room, depending on the plant layout and available space. Separate overhead monorail conveyors for defeathering and eviscerating operations are necessary to move the birds at the different rates of line speed in the eviscerating area from the rates employed in the defeathering area. The two-conveyor system also allows some flexibility in making quick adjustments if one line breaks down or is stopped for other reasons.

The method of transfer in any particular plant depends on several factors such as type of picking equipment, plant layout, available space, type of shackles used, type of bird suspension preferred on both the picking line and the eviscerating line, and the preferences of plant management. With this number of variable factors involved, there could be almost an unlimited number of transfer methods.

Direct Transfer to Eviscerating Line

In all large-volume poultry processing plants, the birds remain suspended by the shanks on the defeathering line until they have passed through the scald tank. In those plants that had picking machines of the in-line type, the birds remained on the same picking line throughout the defeathering operation. However, their position was reversed (shank to neck) in the shackles about midway through the defeathering machines for increased efficiency in feather removal. Therefore the birds were hanging by the neck when they reached the transfer station.

In such instances, the shanks were always removed before the transfer point. This provided better labor utilization, since less handling was required if the transfer operator placed the bird directly in the eviscerating shackle immediately after releasing the neck from the picking shackle.

Direct transfer of poultry to the eviscerating line from the picking line was by far the most common method in the case-study plants. The main advantages were the saving in labor resulting from reduced handling of the birds and the fact that no auxiliary equipment was needed. Both factors contributed to avoidance of product contamination.

For workers to transfer the bird from one line to another efficiently, the defeathering line and the eviscerating line were parallel and close to each other. Normally, the picking line was 8 to 10 inches above the level of the eviscerating line and 8 to 10 inches closer to the worker who performed the transfer (fig. 10).

Neck-to-Hock Direct Transfer

Neck-to-hock transfer was accomplished by grasping the bird by the neck, releasing it from the picking shackle, turning the carcass and placing the hocks in the eviscerating shackle (fig. 10). This is referred to as the direct neck-to-hock method, and was the most common transfer method in use. The transfer time required was 3.93 minutes per 100 birds, or a production rate of 24.5 birds per minute (table 3).

Neck-to-Neck Direct Transfer

In some plants, birds reached the transfer point suspended by the neck and were also hung by the neck in the eviscerating shackle (fig. 11).

This is referred to as the direct neck-to-neck method and was employed where, because of line arrangement or available space, it was necessary to remove the shanks on the eviscerating line (fig. 11). This method could not be justified otherwise, because it required practically the same amount of labor (3.91 minutes per 100 birds) as the neck-to-hock method (table 3), yet the birds had to be reversed and hung by the hocks before evisceration. Even where three-point suspension (neck and hocks, fig. 17) was used for eviscerating, less labor was required to transfer neck-to-hock, and later to three-point the head, than to hang the bird first by the neck and three-point the hocks later (table 6).

TABLE 3.—*Labor required to transfer 100 birds from the defeathering line directly to the eviscerating line by two methods*

Method	Time required per work element			Total time required
	Reach for bird	Remove from picking shackle	Place bird in eviscerating shackle	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*
Neck-to-hock	0. 83	1. 04	2. 06	[1] 3. 93
Neck-to-neck	0. 83	1. 04	2. 04	[2] 3. 91

[1] A production rate of 1,524 birds per hour or 25.4 birds per minute.
[2] A production rate of 1,536 birds per hour or 25.6 birds per minute.

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FIGURE 10.—Transferring poultry directly from the picking line to the eviscerating line using the neck-to-hock method. The picking line path is the high line close to the operator.

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FIGURE 11.—Transferring poultry from the defeathering line to the eviscerating line using direct neck-to-neck method.

Indirect Transfer to Eviscerating Line

Certain types of defeathering systems, such as those using batch-type pickers, resulted in the chickens reaching the transfer point suspended by the shanks. Two general methods were employed in removing these birds from the picking shackle, neither of which resulted in direct transfer to the eviscerating line. One method was to use automatic trip shackles on the defeathering line so that birds could be dropped to a transfer belt mechanically. The transfer belt delivered the defeathered birds to operators who hung them on the eviscerating line. Another method was to cut the birds down from the defeathering line in conjunction with shank removal, leaving the shanks in the shackles. The latter method was employed where conventional picking shackles were used.

On rare occasions where the birds were suspended by the neck with the shanks removed, the birds were manually removed from the picking shackle and dropped onto a belt or table for hanging onto the eviscerating line. The only justification for this method of transfer was that the layout made it impractical to route the eviscerating lines close to the picking line.

Automatic trip shackles were used on the defeathering line in some case-study plants to release birds without manual labor. No attempt was made in this study to evaluate the merits of this type of shackle or to compare its economy with that of conventional shackles.

Birds were released from the shackles when guide rails, mounted above the monorail conveyor, depressed a spring-actuated collar on top of the shackle. In all case-study plants using this method, the birds were all tripped from the defeathering line at one point (fig. 12). This required that a belt conveyor be used to distribute the birds to the transfer points beneath the eviscerating lines. Birds dropped to a conveyor belt in this manner, especially with the shanks still attached, become entangled (fig. 13) and increase the transfer time from the belt to the eviscerating line (table 4).

When birds reached the transfer point suspended by the shanks on conventional shackles, they were cut down and allowed to drop onto a transfer table or belt. Rarely was a knife used with this arrangement, since shears were easier to handle. Each operator cut only one shank per bird (fig. 5). The last operator cut the bird loose from the shackle, allowing it to drop to the transfer table. Two advantages of cutting the birds down, rather than dropping them with automatic shackles, were that (1) not all birds had to be cut down at one station, thus allowing tables to be used rather than a conveyor belt, and (2) the birds' feet did not become entangled, and the carcasses could be hung on the eviscerating line by the hocks.

Tables used with the indirect transfer method varied in size and design from plant to plant. In most cases, they had a flat, stainless-steel top with low sides (fig. 14). Since tables were usually used where birds were removed from the picking line manually, the workers tossed the birds on the table in fairly good position for hanging onto the eviscerating line.

The main disadvantage of using a flat-top table was that frequently the birds had to be pushed into position for rehanging, and occasionally one dropped to the floor. The most suitable table design, where the layout permitted, was that of a sloping table, so that the birds would slide into position for rehanging onto the eviscerating line.

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FIGURE 12.—Poultry is tripped from shackles automatically and falls onto conveyor belt for transport to eviscerating lines. Note poultry hung by neck on eviscerating line so that shanks can be removed easily.

N–45102

FIGURE 13.—If shanks remain attached, birds become entangled on the transfer conveyor belt.

Table 4.—*Labor required to transfer 100 birds from a moving belt or a stationary table to an overhead shackle conveyor, using two types of bird suspension*

Method	Time required per work element		Total time required
	Reach for bird	Place bird in shackle	
	Man-minutes	*Man-minutes*	*Man-minutes*
Hang by hocks [1]	0. 63	2. 28	[2] 2. 91
Hang by neck [3]	0. 89	2. 37	[4] 3. 26

[1] When birds are suspended by hock joints, the feet have already been removed.
[2] A production rate of 2,064 birds per hour or 34.4 birds per minute.
[3] When birds are suspended by neck, the feet (or shanks) are still attached to the bird.
[4] A production rate of 1,850 birds per hour or 31.0 birds per minute.

Normally, a few birds were allowed to accumulate on the table so that a steady supply would be available for loading all eviscerating shackles, even though the supply from the defeathering line fluctuated from time to time. An effective method of doing this was to operate the picking line at a rate slightly greater than the capacity of the eviscerating lines. However, care had to be exercised to stay reasonably close to the "first-on, first-off" principle so that occasional birds would not be "stored" for a long time.

Tables were placed so that the eviscerating shackle cleared them by 12 to 18 inches (fig. 14). The picking line also was routed past the table in such a manner that birds could be removed and

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Figure 14.—Hanging birds on the eviscerating line from a transfer table.

N—45104

Figure 15.—Transferring birds from a belt conveyor to the eviscerating line.

tossed onto the table easily. The durability and relatively low initial cost of tables made their costs per 100 birds negligible.

Occasionally, a smooth conveyor belt was used to move birds from the drop point under the picking line to the rehanging area under the eviscerating line (fig. 15). With a conveyor belt, the birds could be moved from the drop point to several rehanging stations.

As was the case with transfer tables, there was no standard design for the neoprene belt conveyor units. The ownership and operating costs for a belt conveyor unit are only a small fraction of a cent per 100 birds processed.

Comparison of Methods of Transfer from Defeathering to Eviscerating Line

Comparison of manpower requirements of various transfer methods would be incomplete without including shank removal combined with the three-point suspension operation (where this type of presentation is preferred on the eviscerating line). In some instances, shank removal was part of the transfer operation. In other cases, it was a separate operation on the defeathering or eviscerating line. In still others, the transfer operators also performed the three-pointing operation.

Table 5 shows the man-hour requirements (per 100 birds) for five common methods of bird transfer, with shank removal for each method, as well as the man-hour requirements for three-pointing for the two methods in which this additional operation was involved.

Table 5 indicates that the least labor is required if the shanks are removed while the bird is suspended by the neck on the picking line, and is transferred directly to the eviscerating line in two-point suspension (hung by hocks). Table 5 also shows that method "b," direct transfer (neck to hock), requires only 6.35 man-minutes per 100

TABLE 5.—*Labor required per 100 broilers for removing shanks and transferring from defeathering to eviscerating line, by different methods of transfer and types of suspension*

Method of transfer and type of bird suspension	Time required per work element: Remove shanks from birds [1]	Remove birds from picking shackle	Place bird in eviscerating shackle	Reach for next bird	Place hocks in shackle (3-point)	Total time required
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*
Direct transfer: Remove bird from defeathering line and hang on eviscerating line—						
a. Remove bird while suspended by neck on defeathering line and suspend by neck on eviscerating line	[2] 2.42	1.04	2.04	0.83	[5] 3.62	[6] 9.95
b. Remove bird while suspended by neck on defeathering line and suspend from eviscerating line by hock joints	[3] 2.42	1.04	2.06	.83	([7])	[8] 6.35
Indirect transfer: Birds dropped from defeathering line to a belt conveyor or table, then hung on eviscerating line—						
a. Remove birds from defeathering line by slipping necks from shackle and allowing them to drop to conveyor or table. Pick up birds and hang by hocks on eviscerating line	[3] 2.42	1.68	2.28	.63	([7])	[9] 7.01
b. Cut birds down from defeathering line, leaving shanks in picking shackles and dropping birds on table or conveyor. Pick up birds and hang by hocks on eviscerating line	3.72	([10])	2.28	.63	([7])	[11] 6.63
c. Automatic trip shackles release birds from defeathering line onto belt conveyor. Pick up birds and hang by neck on eviscerating line	[4] 2.42	([12])	2.37	.89	[5] 3.62	[13] 9.30

[1] See table 1.
[2] Shanks removed from birds on either the defeathering or the eviscerating line.
[3] Shanks removed on defeathering line.
[4] Shanks removed on eviscerating line.
[5] Birds' hocks raised and placed in eviscerating shackle to position bird for opening and eviscerating.
[6] A production rate of 614.7 birds per man-hour.
[7] Birds suspended by hocks only and opened and eviscerated while in 2-point suspension.
[8] A production rate of 944.9 birds per man-hour.
[9] A production rate of 855.9 birds per man-hour.
[10] Inexpensive equipment is available for mechanically removing severed shanks from shackles. If this operation is performed manually, an additional 2.78 man-minutes are required per 100 birds, reducing the production rate for this method to 637.6 birds per man-hour.
[11] A production rate of 905 birds per man-hour.
[12] Automatic trip shackles were not evaluated during this study because of their effect on other operations outside the scope of the eviscerating area study.
[13] A production rate of 658.6 birds per man-hour.

birds and gives a production rate of 945 birds per man-hour. In comparison, method "a," direct transfer (neck to neck and three-point), requires 9.95 man-minutes per 100 birds, or a production rate of only 615 birds per man-hour.

At a labor rate of $1.50 per hour (appendix, p. 54), method "a," direct transfer, costs $34.20 per day more than method "b," direct transfer, in a 40,000-bird-per-day operation.

The method with the next to lowest labor requirement (6.63 man-minutes per 100 birds) is method "b," employing the indirect transfer, provided the severed shanks are removed from the shackles mechanically.

Table 5 also shows that plants requiring 3-point suspension increase their labor requirements 3.62 man-minutes per 100 birds at this point on the eviscerating line.

THREE-POINT SUSPENSION

Some plants prefer that chickens be brought into three-point suspension for processing through the eviscerating area. Suspending birds in this manner (fig. 16) usually takes place before the viscera are drawn and can be done before or between any of the opening cuts. The location depends on plant preference, the sequence of opening cuts, and whether the bird is suspended by the neck or hocks before this operation.

To three-point the bird when it is suspended by the hocks, the worker places a downward pressure on the bird's abdomen with one hand while the other hand swings the head upward into the neck slot of the shackle. When the bird is suspended by the neck, the worker grasps one leg in each hand, simultaneously swinging the legs upward into the shackle leg slots (fig. 17).

Less time is required to three-point birds that are hung by the hocks than those hung by the neck (table 6). Hanging the birds by the hocks does not adversely affect the time required for the preliminary hang, because, when the direct transfer method is used, no particular type of hang has an advantage. When a table is used (in connection with transfer), the hock hang is most advantageous.

Table 6 shows that 3.62 minutes are required to place 100 birds in three-point suspension when the birds have been suspended by the necks. When suspended by the hocks, the time is reduced by 0.86 minute. The production rates are 27.6 birds per minute and 36.2 birds per minute, respectively. Examination of the time required to perform each individual work element reveals that the difference in production rates is caused by the extra time required to move two parts (hocks) into position and insert them into slots, compared to moving and inserting one part (head) into the slot. This difference becomes significant when the line speed (approximately 40 birds per minute) of most eviscerating lines is involved. One skilled worker can handle the entire production on one line when converting from hock suspension, whereas two workers are required when the bird is presented suspended by the neck.

N—45105

Figure 16.—Three-point suspension completed by inserting head into shackle neck slot.

N—45106

Figure 17.—Three-point suspension completed by inserting legs into the shackle leg slots.

Table 6.—*Labor required to place 100 birds into three-point suspension, using different methods*

Method of presentation	Time required per work element		Total time required
	Reach for bird	Bring bird to 3-point suspension	
	Man-minutes	*Man-minutes*	*Man-minutes*
Three-pointing when bird is hanging by neck	0.83	2.79	[1] 3.62
Three-pointing when bird is hanging by hocks	.83	1.93	[2] 2.76

[1] A production rate of 1,656 birds per hour or 27.6 birds per minute.

[2] A production rate of 2,172 birds per hour or 36.2 birds per minute.

The opening usually made in the chicken abdomen to remove the viscera extends from the posterior end of the breast bone downward to and around the vent. Three basic cuts are involved: (1) An incision in the bird's abdomen (opening cut) in the area between the vent and the tail, opening the body cavity; (2) cutting out the vent (vent removal cut), while leaving it attached to the large intestine; and (3) a cut splitting the abdomen skin (abdomen incision) from the vent to the tip of the breast bone.

Opening Cut

The opening cut (sometimes called "tail splitting") was usually made by one of two methods. The most common was a slicing motion with a butcher knife having a 6-inch blade (fig. 18). When this method was employed, the manner of bird suspension (two- or three-point) did not affect the labor requirements significantly. However, there is less chance of cutting an intestine with the birds on two-point suspension, since the intestines drop downward with the bird in this position.

The second method used for the opening cut was a stabbing motion with the point of the knife (fig. 19). This method was preferred in some plants because there was less danger of downgrading birds by cutting into the flank meat. The labor requirements were greater for the stabbing method, especially if a long knife blade was used (table 7). The difference in time required was caused by the greater difficulty in positioning the knife and the caution required to avoid rupture of the intestine and contamination of the meat.

N–45107

FIGURE 18.—Making the opening cut by slicing motion.

N–45108

FIGURE 19.—Making the opening cut with a knife point.

The stabbing cut can be used only when birds are on two-point suspension (hanging by hocks), in order to minimize intestine rupture.

Table 7 shows that 1.27 fewer minutes are required per 100 birds for the slicing cut (method A) than for the stabbing cut with a long-bladed knife (method B), and 0.36 minute less is required for the slicing cut than for stabbing with a short blade. The greater speed of the short knife blade is due to better control in positioning the knife and less requirement for precaution against intestine rupture. This decrease in time permits the worker to open about 10 birds more per minute. Method A, however, allows still greater speed and, in addition, permits greater versatility in bird presentation (either two- or three-point suspension).

TABLE 7.—*Labor required for performing opening cut on 100 birds employing different cutting methods*

Method	Description	Time required per work element		Total time required
		Reach for bird	Hold bird and make cut	
		Man-minutes	*Man-minutes*	*Man-minutes*
A	Slicing cut with 5″–6″ knife blade	0.67	1.55	[1] 2.22
B	Stabbing cut with point of knife			
	5″–6″ blade	.99	2.50	[2] 3.49
	1½″–2″ blade	.66	1.92	[3] 2.58

[1] A production rate of 2,700 birds per hour or 45 birds per minute (employing 2- or 3-point suspension).
[2] A production rate of 1,722 birds per hour or 28.7 birds per minute (employing 2-point suspension).
[3] A production rate of 2,328 birds per hour or 38.8 birds per minute (employing 2-point suspension).

Vent Removal Cut

Two methods were in general use for removing the vent when this cut was performed as a separate operation. One method involved cutting around the vent with a knife after a previous worker had made the opening cut. The second method employed a pair of shears rather than a knife, and was performed after the abdomen incision had been made.

N–45109

FIGURE 20.—Making the vent removal cut with a knife.

N–45110

FIGURE 21.—Removing vent with a pair of shears.

In the first method, a forefinger was inserted through the opening incision and hooked around the large intestine near the vent; the thumb and forefinger pulled the intestine, making the skin taut around the vent; a knife was inserted

TABLE 8.—*Labor required for removing the vent from 100 broilers by two methods*

Method	Time required per work element		Total time required
	Reach for bird	Hold bird and make cut	
	Man-minutes	*Man-minutes*	*Man-minutes*
Remove vent with knife before abdomen cut	0.85	4.33	[1] 5.18
Remove vent with scissors after abdomen cut	.70	3.93	[2] 4.63

[1] A production rate of 1,158 birds per hour or 19.3 birds per minute.
[2] A production rate of 1,296 birds per hour or 21.6 birds per minute.

through the opening cut (fig. 20) and the skin was cut close to the vent by an upward motion.

In the second method, the operator grasped the large intestine near the vent and pulled the abdomen skin taut, trimmed the skin around the vent with a pair of scissors (fig. 21), and then pulled the large intestine (with vent attached) 3 or 4 inches out of the carcass and allowed it to hang free so as to avoid contamination.

Table 8 shows that, if vent removal is to be performed after the opening cut and before the abdomen cut, 5.18 man-minutes per 100 birds are required, compared to 4.63 man-minutes for the method using shears (after both the opening and abdomen cuts). This results in a production rate of 2.1 birds per minute more for the method using shears (21.5 compared to 19.4 birds per minute).

Abdomen Incision

In some instances, the abdomen incision was performed as a separate operation. In all these cases, shears were used because of the possibility of rupturing an intestine with a knife point. For this reason, the shear blade inserted under the skin should have a blunt point and, for best results, the blades should be approximately 3 inches long. The incision was made by inserting the lower blade of the shears through the opening cut, underneath the abdomen skin, and snipping the skin open to the end of the keel bone (fig. 22).

N–45111

Figure 22.—Making the abdomen incision with shears.

Table 9.—*Labor required for making the abdomen incision with shears on 100 birds at different stages of evisceration*

Method	Time required per work element		Total time required
	Reach for bird	Make abdomen incision	
	Man-minutes	*Man-minutes*	*Man-minutes*
Abdomen incision before removing vent	0.63	2.10	[1] 2.73
Abdomen incision after removing vent	.71	1.80	[2] 2.51

[1] A production rate of 2,196 birds per hour or 36.6 birds per minute.
[2] A production rate of 2,388 birds per hour or 39.8 birds per minute.

A production rate of 36.6 birds per minute could be maintained by an operator if the abdomen incision was made prior to removing the vent, whereas he could average 39.8 birds per minute if the incision was made after the vent was removed (table 9).

Combination Cuts

In order to decrease labor requirements and improve crew balance on the eviscerating line, basic opening cuts were made in combination with other cuts so that one worker could perform two of the cuts in one operation rather effectively. In making the opening cuts, the manner in which the birds were presented (two- or three-point suspension) also played an important part in worker effectiveness.

Combined Opening and Vent Removal Cuts

In combining the opening and vent removal cuts the worker makes the opening cut, inserts the forefinger into the incision, grasps the large intestine close to the vent, and pulls it taut. The knife is then inserted into the opening just beyond the forefinger and an upward stroke of the blade removes the vent. It is important that the cut be made as close to the vent as possible so as not to remove edible tissue. Studies of this combination operation included both two-point and three-point bird suspension.

Table 10 shows a difference of two birds per minute in favor of three-point suspension (14.7 compared to 16.7 birds per minute). It is evident from the elemental times in table 10 that the manner of bird presentation is primarily responsible for the difference in time required to perform the combined operations.

Table 10.—*Labor required for making combination opening and vent removal cuts on 100 chickens by different methods of suspension*

Method of bird suspension	Time required per work element			Total time required
	Reach for bird	Opening cut	Vent removal cut	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*
2-point	0.98	1.77	4.03	[1] 6.78
3-point	.65	1.39	3.94	[2] 5.98

[1] A production rate of 882 birds per hour, or 14.7 birds per minute.
[2] A production rate of 1,002 birds per hour, or 16.7 birds per minute.

Combined Abdomen Incision and Vent Removal Cuts

Another variation of combined operations involved the abdomen incision and vent removal cut. Starting at the end of the opening cut, the abdomen is snipped open by passing close to the vent and continuing along the median line of the abdomen to the posterior end of the keel bone.[5] The intestine leading to the vent is pulled taut and the vent is trimmed loose. One worker made both cuts using a pair of shears.

The operation was observed and timed with birds presented in both two- and three-point suspension. Table 11 shows the labor requirements for one person performing the combined operation on 100 birds. Again, three-point suspension shows a lower labor requirement.

[5] U.S. Department of Agriculture regulations governing the inspection of poultry and poultry products require precaution against adulteration and contamination. This cut reduces the hazard of trapping water or processing debris between the skin and flesh.

Table 11.—*Labor requirements for the combination abdomen incision and vent removal cuts with different methods of bird suspension*

Method of bird presentation	Time required per work element			Total time required
	Reach for birds	Abdomen incision	Vent removal cut	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*
2-point suspension	1.10	3.26	2.03	[1] 6.39
3-point suspension	1.22	2.78	1.59	[2] 5.59

[1] A production rate of 936 birds per hour, or 15.6 birds per minute.
[2] A production rate of 1,074 birds per hour, or 17.9 birds per minute.

With three-point suspension, the production rate is 2.3 birds per minute, or 138 birds per hour, more than with two-point suspension. From a sanitation standpoint, in this instance, however, more caution must be used to prevent rupturing an intestine while birds are in three-point suspension. Blunt scissors are required to lessen this danger.

Comparison of Methods of Opening Birds

Table 12 compares the labor requirements for four methods of performing the basic opening cuts. This table shows that labor utilization is better if two of the three basic operations are combined.

Two of the methods, C and D, show that three-point bird suspension is more advantageous than two-point suspension. However, this advantage is offset by the additional labor required to three-point the birds (table 6).

Table 12.—*Labor required per 100 birds for making the three basic opening cuts in various combinations, sequences, and methods of bird presentation* [1]

Method	Opening cut (knife)	Remove vent (knife)	Opening cut and remove vent (knife)	Abdomen incision (shears before venting)	Remove vent (shears after abdomen incision)	Abdomen incision and remove vent (shears)	Abdomen incision (shears, after venting)	Total time required
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*
A (2- or 3-pt.)	2.22	5.18					2.51	[2] 9.91
B (2- or 3-pt.)	2.22			2.73	4.63			[3] 9.58
C (2-pt.)			6.78				2.51	[4] 9.29
C (3-pt.)			5.98				2.51	[5] 8.49
D (2-pt.)	2.22					6.39		[6] 8.61
D (3- pt.)	2.22					5.59		[7] 7.81

[1] Figures in this table are taken from previous tables in this section.
[2] A production rate of 10.1 birds per man-minute.
[3] A production rate of 10.4 birds per man-minute.
[4] A production rate of 10.8 birds per man-minute.
[5] A production rate of 11.8 birds per man-minute.
[6] A production rate of 11.6 birds per man-minute.
[7] A production rate of 12.8 birds per man-minute.

DRAWING VISCERA

In the processing of chickens into ready-to-cook form, the viscera must be removed with skill and care, to avoid contaminating the carcass and to prevent mutilation and loss of edible parts. The viscera of each bird must retain their identity with the bird from which they were drawn until they have been examined by an inspector. The common method of complying with this requirement is to let the viscera hang outside the body cavity, attached to the carcass.

The evisceration is performed by supporting the bird with one hand and inserting the fingers of the other hand through the incision in the abdomen (fig. 23). The three middle fingers (sometimes the little finger, too), extended, slide past the viscera until the heart is reached. They are then partly closed in a loose grip, followed by a gentle twisting action, and the viscera are slipped out of the body and released.

The way in which the viscera are left suspended has a direct effect on other operations along the eviscerating line. For example, for rapid and proper inspection, poultry carcasses should enter the inspection area with all viscera completely drawn and hanging from the same side of each bird (fig. 24). The most favorable situation, from an inspection standpoint, is to have the abdomen skin folded back, exposing the inside of the body cavity for inspection without further positioning by the inspector. The viscera should be suspended so as to leave the heart, liver, and gizzard closely grouped together just outside the body cavity, in full view of the inspector.

N-45112

FIGURE 23.—Fingers inserted into body cavity to draw viscera.

N-45113

FIGURE 24.—Viscera drawn and positioned properly.

The manner in which the viscera hang from the carcass also affects the giblet trimming operations. The giblets are more accessible and easier to grasp if they hang just outside the body cavity, facing the operator.

If possible, the sheet of leaf fat usually attached to the abdomen wall below the keel bone and the gizzard should be separated from the viscera before drawing. If the fat is drawn with the viscera, it is almost certain to be lost during the giblet processing operations. This loss can be significant, since the fat involved often weighs up to 20 grams (approximately 0.7 ounce) in large, well-fed broilers.

Time studies were made of drawing operations with birds on two-point and three-point suspension. There was no significant difference in the labor requirements.

The elemental time requirements for drawing 100 birds were: (1) Draw viscera, 6.13 minutes; (2) reach for next bird, 1.17 minutes; total, 7.30 minutes. This establishes a production rate of 822 birds per hour per operator, or 13.7 birds per minute.

Federal inspection of poultry was in effect for many years on a voluntary basis. On January 1, 1959, the Poultry Inspection Act went into effect, making all poultry and poultry products entering into interstate commerce (and certain other classifications) subject to mandatory inspection.

The influence of Federal inspection is felt in every area of the processing plant. Every operation, whether performed by man or machine, must be performed so as to maintain the wholesomeness of the product.

In the eviscerating area, where a post-mortem inspection is performed on each poultry carcass (fig. 25), the layout of the inspection station and the manner in which the carcass is presented for examination are of major importance for effective inspection.

The number of birds that a Federal inspector can properly examine in a given period of time depends on many things: The percentage of wholesome birds, the manner in which the carcass is presented for inspection, the effectiveness of preceding operations, the distance between birds, the type of shackle used and how it is supported, lighting, the competency of help furnished, location of hand-wash nozzle, height of birds in relation to inspector, type and position of hangback rack, type of equipment and layout of the helper's work station, location of reject cans, ability of inspector, and signals used by inspector and helper. The attitude of the inspector, the attitude of management, and the relationship between plant management and inspection personnel also can influence inspection rates.

N–45114

FIGURE 25.—A Federal inspector (left) being assisted by a worker who trims or removes occasional birds.

With this number of variables involved, it is easy to understand that inspection rates can vary considerably between plants. It can also be seen that most of the items that contribute to efficient inspection can be controlled by plant management. How well plant-controlled factors are handled affects the rate of inspection and influences inspection error.

Obviously, the less time an inspector and his assistant (trimmer) have to spend in reaching, searching, positioning, and other functions, the more time is available for the essentials of proper inspection. Several recommendations can be made to plant management that will contribute to better inspection.

Bird Presentation

Each bird should approach the inspector positioned in such a manner that the overhead light illuminates the body cavity, so that there is no need for tilting or turning the carcass for inspection of the cavity. The viscera should be drawn and left hanging from either the right or left side (whichever is preferred) of the body opening, with the heart and liver just outside the bird, facing the inspector. This decreases inspection time by eliminating the search element for hand and eyes, and helps to establish a more uniform hand motion pattern.

Two-Point vs. Three-Point Suspension

From general observation and time studies, there appeared no detectable advantage in inspection whether carcasses were suspended by hocks only (two-point), or by hocks and head (three-point), provided the birds were positioned properly. If inspectors were required to tilt the carcass (three-point only) for better lighting, more time was required.

Since Federal inspection regulations do not require three-point suspension, it is doubtful that the extra labor for raising and lowering the head to three-point position can be justified. However, if three-point suspension is used, the head and hocks should enter shackle slots from opposite directions. This raises the body cavity opening into better position for rapid interior inspection than when hocks and head are placed in shackle slots from the same side.

Shackles

Conventional shackles designed for the eviscerating operations were the most commonly used in case-study plants. They had fixed slots for hocks and necks that held birds firmly enough for all eviscerating operations, yet were easy to load and unload. Some plants used automatic trip shackles on the eviscerating line for mechanical line unloading. The automatic trip shackle did not appear to be as practical at the inspection station as the conventional shackle. Two reasons are that both hands are required to release a bird from an automatic shackle; and, when the inspector wishes to release one hock (or the head where three-point is used) as a signal to the trimmer, it is more difficult than releasing it from a conventional shackle.

No matter which shackle is used, guide rails properly positioned (fig. 25) are essential for good inspection. The guide rails should be positioned about 2 to 3 inches below the top of the shackle so as to give a firm drag on the shackle. This leaves room for getting hocks into and out of the slots, yet is low enough to keep the bird from swinging to and fro.

Each shackle should be mounted with a swivel or "S" hooks so that the inspector can turn the bird carcass at least 180 degrees for inspection of the opposite side. All shackles should be of the same type and should hang at the same level so that the inspector is not thrown off pace.

Shackle Spacing

Shackle spacing affects the rate at which an inspector can properly inspect chickens. A limited number of time studies showed, for instance, that an inspector can examine birds better and faster if individual birds are on 12-inch centers rather than on 6-inch centers (when the inspector examines each bird). The number he can properly inspect decreases by 1 to 2 birds per minute if the birds are placed on 6-inch centers. This indicates that the time required to search for, grasp, and control a bird in a congested group requires more time than it takes for the eyes to travel the extra distance. Also, additional manipulation is required to get a good look at the exterior of the carcass. An additional decrease of one to two birds per minute can be expected if an inspector looks at alternate birds on the line, and yet another decrease will follow if the inspector examines every third bird. These decreases are due to additional time required for "reach" and "search" elements.

Station Equipment and Layout

The relative position of all essential equipment at the inspection station is important to efficient operation. Figure 26 illustrates an effective station layout when equipment in common use today is properly positioned.

Lights

The bank of lights (fig. 26) is set at 20 degrees from the vertical over the shackle. This angle of the light illuminates the carcass interior effectively when birds are presented on two-point suspension. If three-point suspension is used, the lights will be more than 20 degrees from the vertical over the shackle. To illuminate the body cavity properly and not cast an interfering shadow, the bird may have to be elevated. A bank of two fluorescent light tubes positioned as close to the inspector as possible usually gives adequate inspection illumination.[6]

Trim Stations

The trim station must be adequately equipped and properly arranged to permit maximum assistance to the inspector (fig. 26).

The "rejected parts container" is positioned on the left side of the trim station, because parts that are removed are normally discarded with the trimmer's left hand. The same reasoning applies in positioning the "rejected birds container" on the right side of the trimmer, because rejects are normally discarded with the right hand.

The "hang back" rack for temporary storage of birds of questionable wholesomeness should be designed and located so that the trimmer uses a minimum of time in placing a bird on the rack. The rack is mounted on casters, permitting maneuverability both sidewise and endwise. When one side is filled, the other side can quickly and easily be rotated into position.

The trim station requires a water-flushed tray or shallow basin for trimming or cleaning an occasional carcass removed from the line. It should be large enough to hold three or four carcasses when several birds need to be removed from the line in rapid succession.

The trim operator keeps a tally of all condemned birds. The tally board, with pencil attached, should be placed so that the worker does not have to stretch or turn away from the normal work position to make an entry (fig. 26). If the worker at the trim station is required to turn away, the inspector has to wait until the normal position is resumed before signaling orders concerning other birds on the line. Frequent interruptions of this sort can cause missed signals or reduction in line speed.

Signals

For an efficient inspection operation, signals used between inspector and trimmer are most important. Where the noise level of the plant permits, concise oral signals are preferred to hand signals. This leaves the inspector's hands free for essential inspection manipulations. The signals should be standardized for the entire plant inspection staff, so that trimmers or inspectors can be rotated to different stations, or be absent or on vacation, without causing undue delay, confusion, or errors.

Other essential signals are those used to assign birds to certain inspectors. Colored tags placed on shackle chains, or different color coding of shackles, easily identify each bird an inspector is supposed to examine. When tags are used, they

[6] U.S. Department of Agriculture regulations require a lighting intensity of not less than 50 foot-candles at the inspection station.

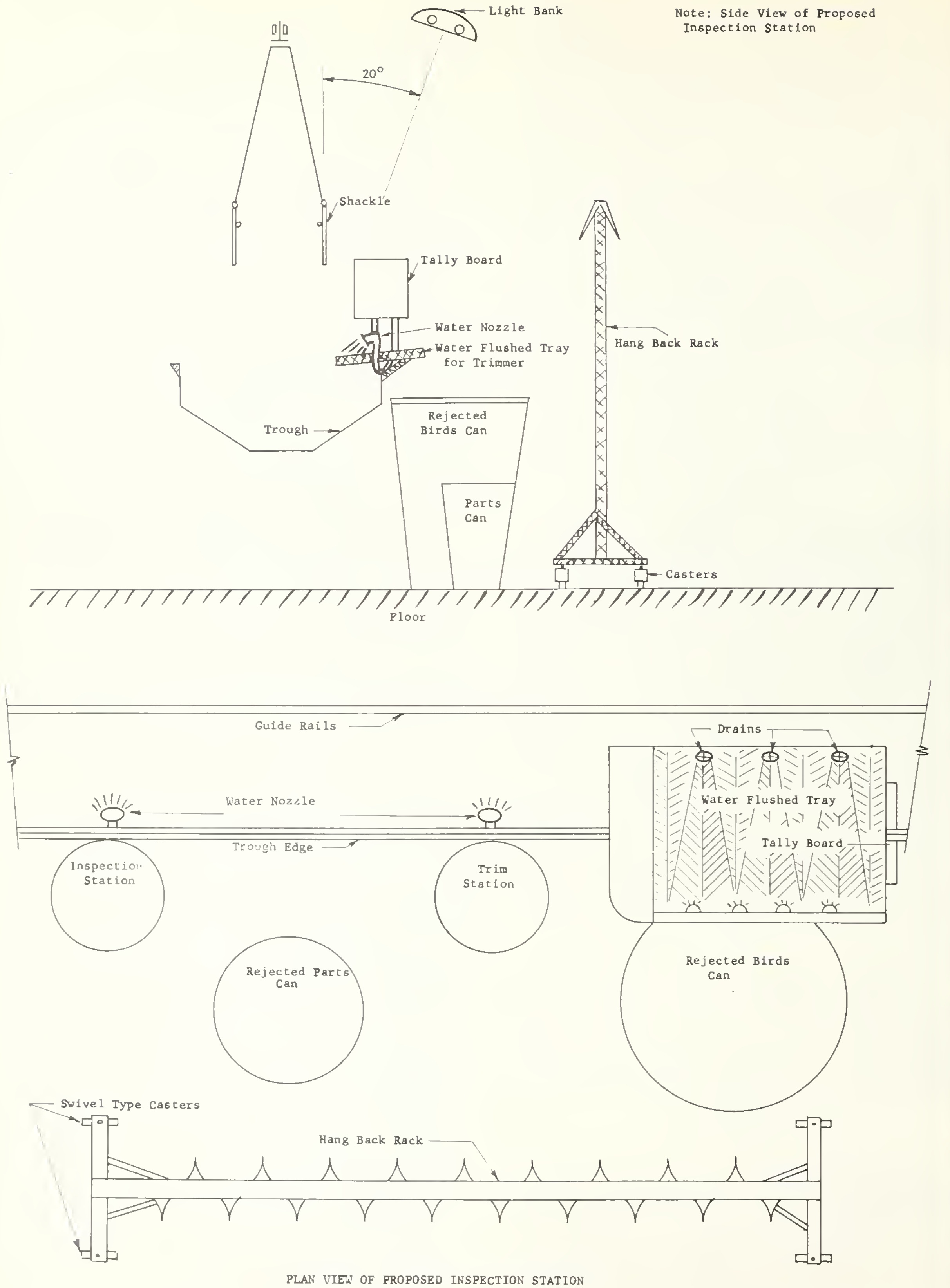


FIGURE 26.—An inspection station layout showing the relative position of equipment for an efficient inspection operation.

should be large and colorful enough to be seen easily, and should be placed at the top of the shackle so that the inspector does not have to raise his head or shift his eyes to see them.

Hand-Washing Nozzles

Hand-washing facilities should be positioned directly in front of the inspector and the trimmer. A shower spray nozzle with universal joint attachment is preferred over the goose-neck pipe with a solid stream, because the dispersed stream directs water to all parts of the hand, providing a faster rinse with less water, and the spray direction can be changed to suit the operator. It should be positioned as high as possible without interfering with the operator's hand movements.

General Requirements

If the preceding recommendations are followed by plant management, maximum inspection rates can be achieved with minimum incidence of errors.

The main objective in following these recommendations is to establish a favorable environment for inspection and trimming, by eliminating unnecessary movements, reducing essential movements to a minimum, providing sufficient, properly directed light, providing carcass and viscera positions that permit visual inspection of a maximum number of items with minimum manipulation, and providing for equipment arrangement of the trim station that permits maximum trimmer assistance to the inspector.

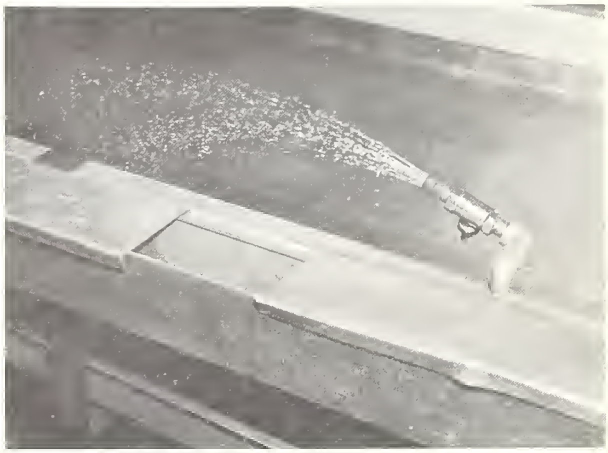
GIBLET PROCESSING

A giblet package with a ready-to-cook chicken includes the heart, liver, gizzard, and, usually, the neck. The giblets are wrapped in parchment paper and accompany each bird. About one-third of the eviscerating area labor force is required for processing these parts; that is, separating them from the bird, trimming, cleaning, packaging, and placing the package into the body cavity of the bird. Although the labor requirements are high, the cost of processing is justified because the total weight of one package of chicken giblets (broiler class) is about a quarter of a pound. In a plant of average size, processing 40,000 broilers per day, this amounts to about 10,000 pounds of poultry meat daily for a labor cost of approximately $240 (24 employees).

Giblet Processing Work Stations

Proper equipment and work station layout are essential to efficient and sanitary giblet processing. For trimming giblets from the viscera, it is essential that the birds pass the operator at the proper height, well within convenient reach. The most comfortable height for the hands to work is at approximately elbow height. A convenient disposal chute or container is also essential, into which giblets are dropped after trimming. This equipment should be within easy reach of the operator and within the normal path of the hands, so that the operator is not required to bend or turn continuously to deposit giblets. The chute or container opening for receiving the edible products should be sufficiently high to avoid contamination by waste material during the trimming and washing operation.

A third essential is a water spray nozzle of the proper type, so located that the operator's hand and the giblets can be washed without moving the hands out of a normal operation path.



N–45115

FIGURE 27.—An improved trim station for the heart and liver operation. A spray nozzle and funnel to giblet flume are attached to the side of the offal trough to reduce worker reach and encourage frequent hand rinse.

Heart and Liver

In some instances, the heart and liver were removed from the viscera in separate operations. However, in most cases, both were removed at once. When they were removed individually, the heart was snipped or pulled loose first and then the liver was pinched off. The heart and liver usually were passed through a spray rinse immediately after removal (fig. 27) and flumed to a chill medium or the wrapping station. The waste tissue was trimmed off and dropped into a water-flushed waste trough as the operator reached for the next bird.

Removing the Heart

The heart is pulled (fig. 28) or snipped away from the viscera (fig. 29), trimmed by cutting away the pericardial sac (fig. 30), and allowed to

N–45116

FIGURE 28.—Heart removal by pinching it away from connecting tissue.

drop into a flume. Time study showed that pulling the heart off and trimming with scissors could be done at a normal rate of 100 birds in 3.91 minutes (25.6 birds per minute), compared to 4.58 minutes (21.8 per minute) when the hearts were snipped off and trimmed (table 13).

The additional time required for snipping resulted from having to position the scissors before cutting, thereby reducing the production rate by 2.7 birds per minute.

Removing the Liver

In plants where the liver was removed separately, it was pinched rather than snipped from the viscera (fig. 31).

The determining factor favoring this method was the smaller loss of edible meat when the liver

N–45117

FIGURE 29.—Heart removal by snipping.

N–45118

FIGURE 30.—The heart is trimmed by snipping off the pericardial sac.

N–45119

FIGURE 31.—The liver is pinched from the viscera.

TABLE 13.—*Labor required to remove, trim, and wash hearts and livers from 100 birds, using different methods*

Method	Time required per work element			Total time required
	Reach for bird	Remove organ and wash	Trim	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*
Pull heart from viscera, wash, and trim	0. 97	1. 14	1. 80	[1] 3. 91
Snip heart from viscera, wash, and trim	. 97	1. 81	1. 80	[2] 4. 58
Pinch liver from viscera, and wash	1. 07	3. 34	([3])	[4] 4. 41
Snip heart and liver from viscera, wash, and trim (one operation)	1. 03	3. 87	2. 12	[5] 7. 02

[1] A production rate of 1,536 per hour or 25.6 per minute.
[2] A production rate of 1,308 per hour or 21.8 per minute.
[3] No additional trimming was performed, since the bile sac was separated from the liver during the operation and remained attached to the viscera.
[4] A production rate of 1,362 per hour or 22.7 per minute.
[5] A production rate of 852 per hour or 14.2 per minute.

and bile sac were separated. When scissors were used, the operator cut far enough back of the bile sac to avoid rupturing it. This always resulted in trimming away a small piece of liver.

An operator can pluck the liver from the viscera, rinse it, and drop it into a flume at a rate of 100 birds in 4.41 minutes (table 13), or 22.7 birds per minute.

Removing Heart and Liver Simultaneously

When the heart and liver were removed simultaneously (fig. 32), the bile sac was left attached to the viscera (fig. 33). During the trimming and rinsing, under a water spray, the heart and liver were separated. This method had a lower labor requirement than the combined labor requirements of the separate operations (table 13).

One worker can detach, wash, and trim both the heart and liver at the rate of 100 birds in 7.02 man-minutes, compared to 8.82 man-minutes [7] for the two separate operations. Simultaneous removal permits the processing of 852 birds per man-hour, compared to 681 birds when the operation is performed in two steps, a gain of 171 birds per man-hour.

[7] When two people perform the operations separately, the liver removal operation requires 4.41 minutes. The man-minutes expended for both operations must therefore be twice this amount of time or 8.82 man-minutes.

N-45120

FIGURE 32.—Snipping off the heart and liver in one operation.

N-45121

FIGURE 33.—The bile sac is left attached to the viscera.

Gizzard Processing

Labor costs for processing the gizzard were greater than for any other giblet item. In addition to removal from the viscera and trimming, the gizzard had to be opened and cleaned and its inside lining removed. In addition to the higher labor requirements, auxiliary equipment also was required for processing.

Processed gizzard weights range from 20 to 60 grams, and average about 36 grams (1¼ ounces). An average plant, processing 40,000 chickens per day, therefore produces over 3,000 pounds of ready-to-cook gizzard meat daily, at a labor cost of about $100. It is obvious, therefore, that the return justifies the high processing labor and equipment requirements.

Manually Trim, Split, and Wash Gizzards

The gizzard is removed from the bird by grasping it, pulling the proventriculus taut, and snipping it loose from the carcass at a point about 3 inches above the gizzard, just above the stomach bulb (fig. 34). The intestines are then trimmed away (fig. 35) and the viscera are allowed to drop into the water-flushed disposal trough.

The gizzard is then split open by inserting the lower blade of a pair of scissors through the center (fig. 36), and closing the blades. Scissors used for this purpose were of heavy-duty type, with fine-quality steel, because of the gizzard gravel encountered in the splitting operation. The operator seemed to have better control of the scissors if the blades were short (3 to 4 inches).

N—45122

Figure 34.—Removing gizzard by pulling the large intestine taut, and snipping it about 3 inches above gizzard.

N—45123

Figure 35.—Trimming the viscera away from the gizzard.

After the gizzard is opened, it is held under a water spray of fairly high velocity to rinse away the contents (fig. 37).

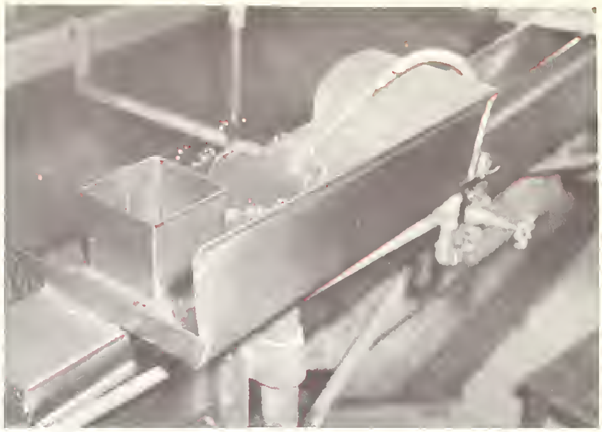
A low-pressure water spray rinsed the gravel and feed from the split gizzard, but frequently permitted some of the foreign material to become lodged in the gizzard fat. A high-pressure water spray, on the other hand, did the job quicker and tended to eliminate contamination of gizzard fat, resulting in a faster operation and cleaner product. Tests showed that a water spray was more effective than a solid stream for cleaning, and required less water. The spray nozzle should be conveniently located in the normal path of the hands, so that abrupt changes in hand motions are unnecessary. The disposal chute for washed gizzards should be located so that no additional reach or sudden change in direction of travel by the hand is necessary to place the gizzards in the chute (fig. 38). An operator could normally remove, trim, open, and wash 100 gizzards in 8.56 minutes, a production rate of 702 gizzards per hour, or 11.7 per minute (table 14).

N—45124

Figure 36.—Splitting gizzard with a pair of scissors.

N–45125

FIGURE 37.—Washing the gizzard after opening.



N–45126

FIGURE 38.—A well-laid-out gizzard trim station with convenient water nozzle and disposal chute.

Mechanical Splitting and Washing of Gizzards

In some instances, gizzards were split and washed by machine. After they were removed from the viscera and trimmed by hand, they were placed into a chute or flume leading to an automatic splitter. Here they were automatically impaled on a hook-equipped conveyor, passed over a circular saw (fig. 39), split and forced open on guide bars as water spray rinsed away the contents. An operator could normally remove, trim, and drop 1,392 gizzards per hour (23.2 per minute) into the chute leading to the splitter (table 14).

Although splitting and washing gizzards mechanically required only half the labor involved in the manual operation (table 14), much of this economy was offset by additional labor required for peeling and for owning and operating the equipment.

TABLE 14.—*Labor requirements for removing, trimming, opening, and washing 100 gizzards, by two methods*

Work element	Manual split and wash	Automatic split and wash [1]
	Man-minutes	*Man-minutes*
Reach for bird	0.83	0.83
Snip and trim	3.02	3.02
Open with scissors	1.83	----------
Wash away grit and feed	2.42	----------
Toss into chute	.46	.46
Total	[2] 8.56	[3] 4.31

[1] This method frequently involved inconsistent machine performance because of variable gizzard size or improperly alined gizzards.

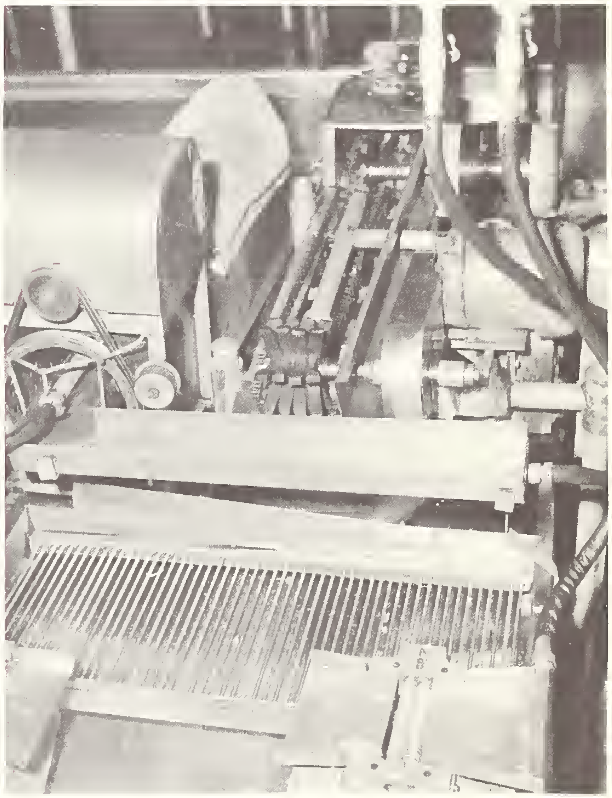
[2] A production rate of 702 gizzards per hour or 11.7 per minute.

[3] A production rate of 1,392 gizzards per hour or 23.2 per minute.

Gizzard Peelers

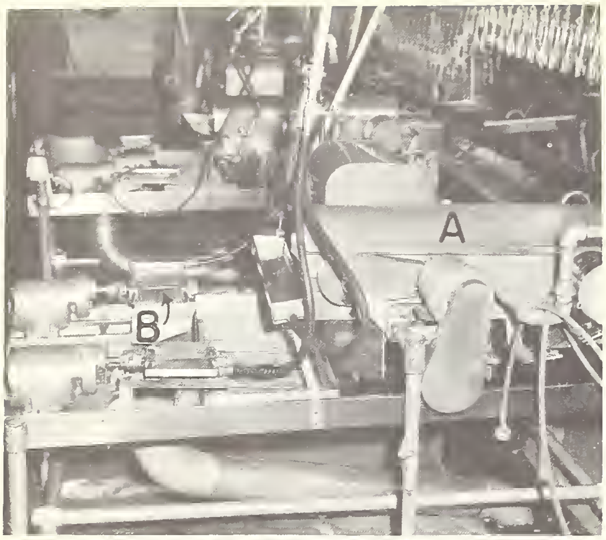
After gizzards are split and cleaned, the linings are removed. In all case-study plants, this operation was performed with a cleverly designed machine (fig. 40) that stripped the lining away without harm to the gizzard.

All peeling machines worked on the same principle. Two rollers measuring 6 to 10 inches in



N–45127

FIGURE 39.—A mechanical gizzard-splitter (top removed) showing the internal works. Grid in foreground for receiving split and washed gizzards ready for peeling.



N–45128

FIGURE 40.—A mechanized gizzard-splitter "A" served by a peeler "B". A duplicate set of this equipment appears in the background.

length and about three-fourths of an inch in diameter were mounted side by side in a horizontal plane. The surface design of the rollers varied. Some had rows of rough ridges at a 90-degree angle to the roller axis, spaced so as to mesh with matching depressions in the opposite roller. Other types had spiral gears that meshed. Regardless of the type of rollers used, they rotated toward one another and were spaced sufficiently close to permit only the passage of the gizzard lining.

Two types of gizzard peelers were in use, semiautomatic and automatic. The semiautomatic type was most common in case-study plants, and was sometimes referred to as the manual ejection peeler. The rollers were usually of the nonspiral gear type (fig. 40-B), and were mounted flush with a small feed-in apron in front of the operator. Normally, gizzards were fed onto the rollers one at a time by one hand and taken over by the other hand during the peeling period. After two or three peeled gizzards were accumulated in the operator's hand, they were tossed into a chute to be flumed to a gizzard washer.

Some operators were observed placing a handful of gizzards on the rollers, allowing them to roll and tumble while awaiting peeling. This practice caused fat to be stripped from the gizzards. The resulting reduction in weight yield was significant, since the attached fat weighed several grams per gizzard, depending on the conditions of the birds and the care in drawing. In the majority of case-study plants, most of the gizzard fat was being lost during the peeling operation because of improper peeling procedure.

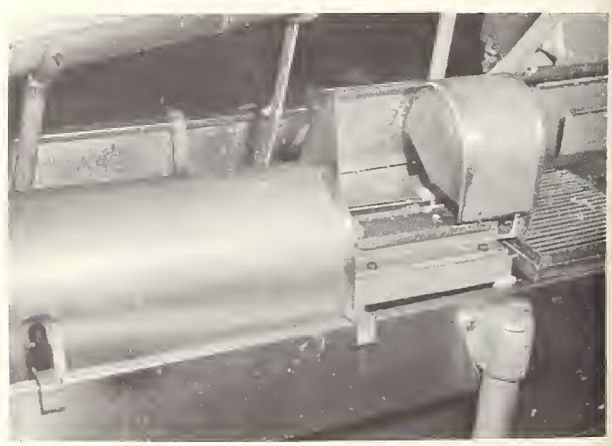
Extra labor for peeling resulted from inconsistent mechanical splitting of gizzards, due to lack of uniformity in gizzard size (table 15, footnote 1). This caused cuts to be made off center on some gizzards, requiring special attention before peeling. If automatic splitters were not kept in fine adjustment, feed and grit became embedded in the gizzard fat, requiring that the fat be discarded.

For maximum yield, the gizzard should be turned inside out and the lining fed into the rolls at the center of the gizzard, rather than at one edge. The gizzard should be lifted from the rollers immediately after the lining is removed. When it is so handled, there is less chance that the rollers will catch and strip the fat from the outside of the gizzard.

TABLE 15.—*Labor required to peel the linings from 100 gizzards using different methods and equipment*

Method	Time required per work element			Total time required
	Reach for gizzards	Place gizzards on rollers and peel	Peel rejects	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*
Automatic ejecting peeler	0. 61	1. 00	[1] 0. 26	[2] 1. 87
Manual ejecting peeler:				
Gizzards hand-split	. 78	1. 84	--------	[3] 2. 62
Gizzards machine-split	. 78	2. 55	--------	[4] 3. 33

[1] Based on a reject level of 14.3 percent. Actual elemental time for "peel rejected gizzards" is 1.87 minutes per 100 gizzards.
[2] A production rate of 3,210 gizzards per hour or 53.5 per minute.
[3] A production rate of 2,292 gizzards per hour or 38.2 per minute.
[4] A production rate of 1,800 gizzards per hour or 30.0 per minute.



N–45129

FIGURE 41.—An automatic gizzard peeler.

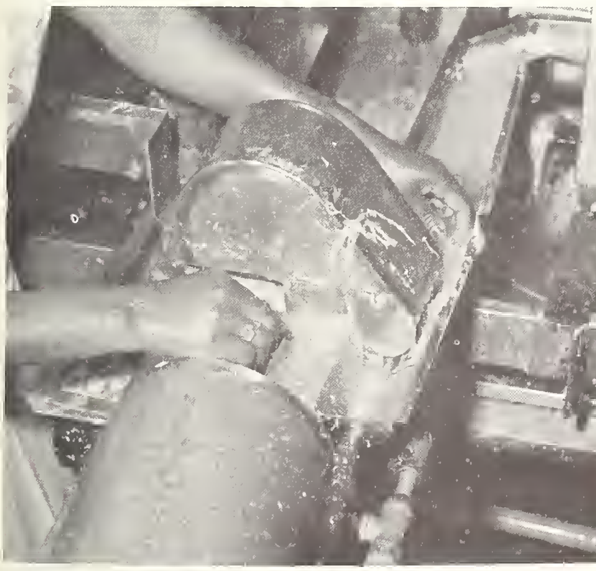
Labor requirements for peeling lining from gizzards that were hand split were 2.62 man-minutes per 100 gizzards, compared to 3.33 man-minutes for those that were machine split (table 15). This amounts to 38.2 and 30.0 gizzards per minute, respectively, or about 27 per cent more labor for peeling gizzards split by machine.

Peeling gizzards "automatically" is so named because the operator has only to place the gizzard on the rollers in the correct manner and release it. The machine peels off the lining and deposits the gizzard in a flume. This type of peeler uses spiral rollers (fig. 41). The operator places the gizzard at one end of the rollers and it is transported to the other end rapidly as the lining is peeled off. A propeller-type wheel is mounted at the discharge end of the rollers and knocks the peeled gizzard off into a flume.

There is a disadvantage in using this machine. If part of the lining is not peeled loose, gizzards with partial linings remaining have to be rerun. Usually they are separated at the giblet packaging station from those completely peeled. Limited observations indicate that as many as 15 percent of all gizzards had to be returned for additional peeling.

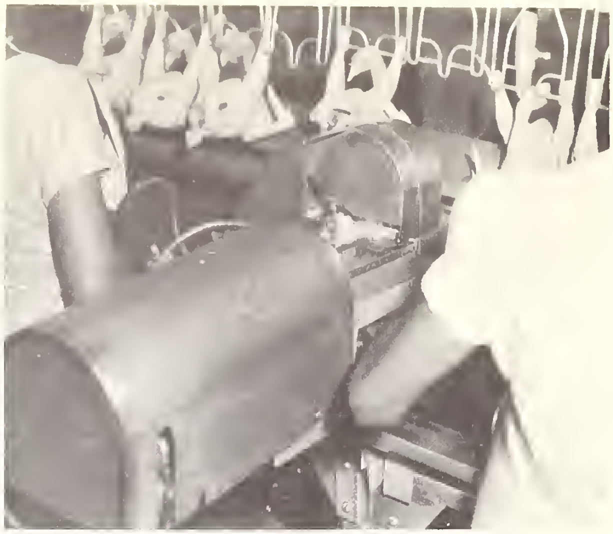
This disadvantage was partly overcome in some plants by having the operator place the gizzards on the rollers with the right hand in rapid succession while she held the left hand in the flume and inspected each peeled gizzard (mostly by touch) as it passed down the flume (fig. 42). Most of those that needed rerunning through the peeler were intercepted and tossed back into the unpeeled gizzard hopper.

Labor requirements for peeling gizzards with the automatic peeler were 1.87 man-minutes per 100 gizzards, or 53.5 gizzards per minute (table 15). This rate includes rerunning gizzards that were not completely peeled at first. Gizzards peeled on this machine were split by hand in all case-study plants.



N–45130

FIGURE 42.—Placing gizzards on automatic peeler with right hand and using left hand in inspecting peeled gizzards.



N–45131

FIGURE 43.—Automatic gizzard peeler positioned between two workers on side of waste-disposal trough.

Combined Operation of Trim, Split, Wash, and Peel Gizzards

In some instances, each operator performed all gizzard processing operations, using the automatic ejecting peeler. The peeling machine was mounted on the edge of the waste disposal trough between two operators (fig. 43). The operator would remove, trim, split, and wash a gizzard, then place it on the peeler rolls. Each operator could process gizzards at the rate of 100 in 10.56 minutes, which is 570 per hour or 9.5 per minute (table 16).

Two additional cost items must be considered when an automatic peeler is used in this manner (table 17). First, from 10 to 15 percent of the gizzards that passed over the peeling machine were not completely peeled. The production rate of 100 gizzards in 10.56 minutes includes an allowance for extra labor. These accumulated at the giblet-wrapping station and had to be reprocessed. Second, additional peeling machines had to be acquired and maintained for cleaning up this portion of gizzards. One operator peeling gizzards only and checking for those that needed reprocessing ran 50 or more gizzards per minute over the machine. With two operators using one machine, when all gizzard processing operations were combined, only about 21 gizzards per minute passed over the machine. Thus, the machines operated at less than one-half capacity.

Gizzard Washers

Gizzard linings fell from the peeler into an offal trough, and the gizzard was placed in a flume

TABLE 16.—*Labor requirements for trimming, opening, washing, and peeling 100 gizzards by 4 methods*

Method [1]	Remove and trim gizzard	Split and wash mechanically	Remove, trim, split, and wash manually	Peel, manual ejection	Peel, automatic ejection	Remove, trim, split, wash manually, peel, automatic ejection	Total time required
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*
A	4.31	(2)		3.33	(3)		7.64
B			8.56	2.62			11.18
C			8.56		[4] 1.87		10.44
D						[4] 10.56	10.56

[1] Method A: Remove and trim gizzard manually, split and wash mechanically, and peel on manual-ejecting machine. Method B: Remove, trim, split, and wash gizzard manually, peel on manual-ejecting machine. Method C: Remove, trim, split, and wash gizzard manually, peel on automatic-ejecting machine. Method D: Manually remove, trim, split, and wash gizzard, and peel on automatic-ejecting peeler (one operator).

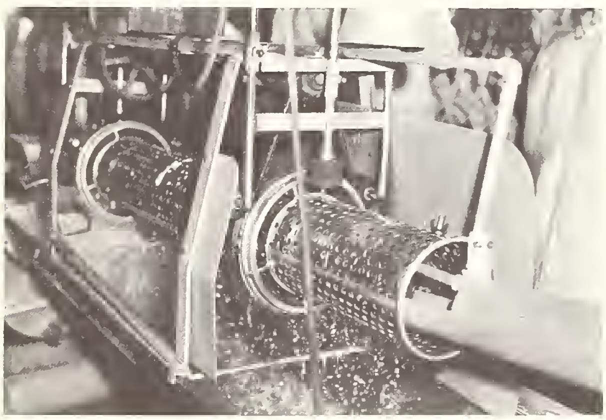
[2] A machine operation.

[3] No case-study plants were observed using this peeling machine in conjunction with an automatic splitting machine.

[4] Includes an allowance for running 14.3 percent of gizzards over rollers a second time for complete peeling.

which conveyed it into a mechanical spray rinse. The spray rinse was usually a cylinder-shaped sieve 4 to 6 feet long and 8 to 10 inches in diameter (fig. 44).

It was mounted on an incline and rotated so that when the gizzards were dropped into the higher end, they tumbled over and over as they passed through the sieve. A water pipe with fine holes extending the length of the sieve sprayed the gizzards continuously as they passed through.



N—45132

FIGURE 44.—A sieve-type gizzard washer.

TABLE 17.—*Labor and equipment costs for trimming, opening, washing, and peeling 100 gizzards by 4 methods*

Method [1]	Labor cost [2]	Equipment cost [3]	Total cost
	Dollars	*Dollars*	*Dollars*
A	0.191	0.041	0.232
B	.279	.011	.290
C	.261	.009	.270
D	.231	[4] .018	.249

[1] Method A: A mechanical gizzard-splitter and a manual-ejection peeling machine used. Method B: Gizzards split with scissors; manual-ejection peeler. Method C: Gizzards split with scissors; automatic-ejection peeler. Method D: Manually trim, split, and wash gizzard, and peel with automatic-ejecting machine, by one operator.

[2] From man-hour figures in table 16, based on a labor rate of $1.50 per hour.

[3] From table 25 (appendix, p. 55).

[4] One-half of peeler cost applied, since 2 people use same machine.

LUNG REMOVAL

Removal of lungs and reproductive organs is a requirement for ready-to-cook chickens. The lung removal operation is performed after the viscera have been drawn and trimmed from the body cavity, and, for best results, before the crop removal operation (see "Removal of Crop and Windpipe," p. 36). In case-study plants, two general methods were used: (1) A hand rake with a circular saw-tooth-type edge was inserted into the body cavity (fig. 45) to dislodge one lung at a time; and (2) a specially designed vacuum system was used, that removed the organs when a nozzle was inserted into the body cavity (figs. 46 and 47) and placed over each organ in rapid succession.

Removal by Hand Rake

The hand method of removing lungs and reproductive organs with a rake was used quite widely in processing plants before compulsory Federal inspection. However, since January 1, 1959, when compulsory Federal inspection went into

N–45133

FIGURE 45.—Removing lungs from broilers with a hand rake.

effect, use of this method has been declining, with increased preference for the vacuum method. An effective job can be done with the hand rake, and the initial equipment cost is almost nil compared to that of a vacuum system, but considerable skill and worker attention are required for good results. The main disadvantage of using a hand rake is that frequently lung tissue is not removed completely, and the labor requirements are from 17 to 29 percent greater than for vacuum methods (table 18).

Lung Removal With Vacuum

Vacuum systems observed did not vary greatly in principle. The way in which some systems were installed and used, however, caused considerable variation in effectiveness and economy.

The correct amount of vacuum applied in the proper manner is essential for effectiveness. For this reason, each system must be especially designed in accordance with plant layout and expected capacity.

Vacuum equipment includes, as basic components, a motor, vacuum pump, collector tank, hose, and nozzle. These units are connected by pipes and fittings varying in size and length with the individual installation.

The pump must be of sufficient capacity to maintain the proper vacuum for the maximum number of nozzles likely to be in use at one time.

A vacuum pump is usually noisy and irritating to personnel who work nearby. Therefore, this unit should be located outside the eviscerating area, to reduce the noise level. Pipes from the collector tank to the vacuum pump can be adequately sized to do this with little loss in efficiency.

The collector tank for removed parts should be located as near the lung removal operation as possible, to reduce the distance that waste product must travel and to permit easier cleaning of the system. The collector tank should be located so that it can be emptied and cleaned conveniently.

Two main types of nozzles are used, the open-flow type, and the shutoff-valve type.

The open-flow nozzle (fig. 46) remains open at all times and air moves through the system continuously after the pump is started.[8] For satisfactory results, the system employing this type of nozzle requires that all component parts be of specific size and capacity, since effectiveness depends on a rather exact vacuum pressure at the nozzle tip. The pump size, length and size of connecting pipes and hoses, nozzle sizes, and number of nozzles required must be designed and balanced so as to give a nozzle vacuum ranging between 14 and 19 inches of mercury. A pressure within this range, when used with adequate connecting hoses, proved to be best because: (1) The nozzle was easy to control, (2) the pressure was sufficient to remove lungs without having to scrub or rake with the nozzle tip, and (3) the air velocity did not cause the nozzle to grab the carcass as it entered the body cavity.

[8] A Vacuum System for Removal of Lungs and Other Waste Products from Broilers, Univ. Ga., College Exp. Sta. Cir. N.S. 17.

N–45134

FIGURE 46.—Removing lungs by vacuum, open-flow-type nozzle.

The most common problem observed in using the system employing the open-flow nozzle was in maintaining the proper vacuum pressure. Most plants did not have enough vacuum at the nozzle opening to pull the lungs out properly. In such cases, the operators had to help dislodge the organs by a scrubbing action with the nozzle tip. This extra effort reduced worker productivity and probably extracted unnecessary moisture and tissue, especially kidneys, from the carcass, thereby reducing weight yield.

The most common reason for low vacuum pressure at the nozzle tip was pipe friction, involving a long-distance header pipe between the collector tank and the nozzle tip. Another shortcoming that reduced vacuum pressure was the use of many tees and turns in the line to the receiving tank. This problem can be solved by using greater pump capacity or relocating the collector tank at a point near the lung-removal operation, thereby reducing the connecting pipe length. To make certain that the proper vacuum pressure is always available, a good vacuum gage is required on the collector tank. A high nozzle velocity is not only difficult for the operator to handle because of its tendency to grab at the carcass, but it also snatches away small pieces of strip fat and tissue as it enters and leaves the body cavity. For this reason, it is recommended that nozzles not in use be plugged and a bleeder valve used on the tank to regulate the pressure.

To control the velocity on systems using open-flow nozzles, the smallest hose diameter that will permit passage of waste material should be used. For broiler chickens, a hose of ⅝-inch inside diameter proved to be the most satisfactory. If a clear plastic hose is used, an obstruction in the hose can be detected readily. If the ⅝-inch hose connects the nozzle directly to the collector tank, the length should be from 15 to 30 feet for best results. To get satisfactory results with the ⅝-inch hose, connectors with ⅝-inch inside diameter must be used.

In the system using a shutoff valve in the nozzle (fig. 47), the valve is opened only after the nozzle is in position within the body cavity. It was found that when this nozzle was used correctly, it had advantages over the open-flow type, including: (1) A lower capacity pump could be used than would be required for the same number of open-flow nozzles, because the valve-type nozzle was open only a relatively short time per bird, and all the nozzles of a system were seldom, if ever, opened at once; (2) the operator had better control over the instrument, since the nozzle did not grab the carcass as it entered and left the body cavity; (3) since the nozzle did not grab the carcass, edible tissue and fat were not removed, resulting in a better yield; and (4) the hose size and length were not so critical as with the open-flow nozzles. Probably due to these advantages, the rate at which lungs and reproductive organs could

N–45135

FIGURE 47.—Removing lungs by vacuum, shutoff-type nozzle.

be removed from broilers was 3.4 birds per minute faster when using the valve-type nozzle than the open-flow-type nozzle (table 18).

The disadvantages of the valve-type nozzle were: (1) It was a little clumsy and awkward to use; (2) the trigger pull became tiresome to the operator; (3) some operators were observed to hold the valve open continuously rather than opening and closing it rapidly as was required for efficient operation, thereby reducing the effectiveness of the system drastically; and (4) some of the nozzles leaked through the slot where the shutoff mechanism was located, and spattered the operator each time the valve was activated. These dis-

TABLE 18.—*Labor required for removing lungs and reproductive organs from 100 birds, by 3 types of equipment*

Method and equipment used	Time required per work element		Total time required
	Reach for birds	Remove lungs and reproductive organs	
	Man-minutes	*Man-minutes*	*Man-minutes*
Hand rake	0.69	4.92	[1] 5.61
Vacuum nozzle, open system	.69	3.97	[2] 4.66
Vacuum nozzle with cutoff valve	.69	3.32	[3] 4.01

[1] A production rate of 1,068 birds per hour or 17.8 birds per minute.
[2] A production rate of 1,290 birds per hour or 21.5 birds per minute.
[3] A production rate of 1,494 birds per hour or 24.9 birds per minute.

advantages could probably be eliminated if the shutoff-activating mechanism were used at some point in the system other than the nozzle. One such system, not within the scope of this study, employed a foot-pedal trigger.

Comparison of Lung Removal Methods

Most large-volume poultry processing plants use vacuum systems for removing lungs and reproductive organs from broilers. However, labor requirements for removing these organs with a hand rake are included in table 18 for comparative purposes.

Of the three methods compared in table 18, the valve-type nozzle system is best laborwise. One operator can remove lungs and reproductive organs at a rate of 24.9 birds per minute, compared to 21.5 birds per minute using an open-flow nozzle. With the hand-rake method, production is only 17.8 birds per minute. It is evident from the elemental times for the work element "Remove lungs and reproductive organs" (table 18) that the equipment used is solely responsible for the difference in time required to perform this operation. It should be kept in mind, however, that in order to maintain these production rates, sufficient vacuum pressure must be maintained to "pop" the organs out of the bird, and, where the open-type nozzle is used, the vacuum pressure should not be so high as to interfere with control of the nozzle as it enters and leaves the bird.

HEAD REMOVAL

It has been found that adequate inspection for wholesomeness requires that the chicken's head be attached to the carcass at the time of postmortem inspection. Therefore, heads are removed in the eviscerating room. It should be noted here that it is preferable to remove the lungs before removing the head. If this practice is followed, there is less chance of leaving bits of windpipe in the body cavity.

The head can be pulled off or cut off, or a combination of the two methods can be used. Methods of pulling heads off included the manual method, in which the operator grasped the head, with the bird suspended by the hocks, and then bent the head backwards and exerted downward pressure until the vertebral column snapped and the neck skin tore loose. This method was not widely used, because of its difficulty and the excess neck skin pulled off with the head.

Two mechanical methods were observed that pull off the heads without any labor. The first required a V-shaped slot of ⅝-inch round galvanized iron, mounted underneath and horizontal to the eviscerating conveyor, so that the necks of birds entered at the large end of the V and then slipped on into the narrow part of the slot. As the conveyor advanced the carcass, the heads were restrained and then pulled off (fig. 48).

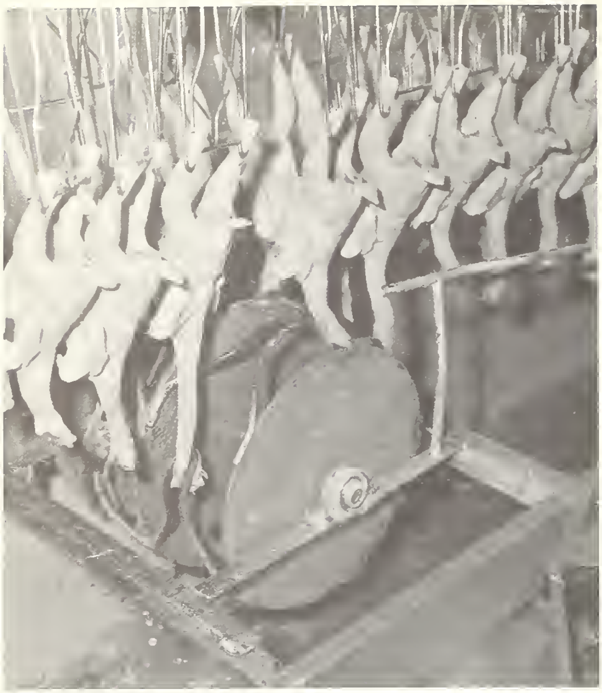
N-45136

FIGURE 48.—A stationary head puller removing heads from eviscerated poultry.

The other method employed a revolving drum-type device about 18 inches in diameter, with V-type slots in the outer surface. It was mounted under the line and rotated in the same direction as the oncoming line of chickens. The chicken heads were caught in the slots and pulled off by the downward rotation of the drum (fig. 49). The head slots in the drum rotated faster than the conveyor line speed, so that heads were pulled with the bird in a perpendicular position.

Pulling off the heads with fixed V-slots over the waste disposal trough was the most common method observed in the case-study plants. This was a simple and positive method, without labor or maintenance cost, and the initial cost for equipment was very low. The V-slots had to be designed properly for satisfactory results. The ends turn down and have large circles at the tips (fig. 48). These circles are provided so that the chicken heads will drop freely and not clog the device after removal. However, this type of head puller did clog to some extent. Windpipes wrapped around the rod and continued to build up until the slot clogged. Best results were attained by providing firm supports on each side of the rods and leaving the ends open.

The rotating drum-type head puller (fig. 49) removed the heads with a V-slot similar to those of the stationary puller. There was greater initial cost and maintenance cost for the powered rotating drum; however, this cost was small on a long-range, high-volume basis. One advantage of the drum was that birds did not swing to and



N–45137

FIGURE 49.—A rotating drum-type head puller mounted on eviscerating line.

fro after the head came off, as they did when the stationary puller was used. Thus, personnel could work closer to the puller without being disturbed.

The only instances where the heads were actually cut off was where the operation was performed manually with a pair of snips. Where this method was used, the same operator also "cracked" the neck vertebrae next to the body (a separate operation generally occurring farther down the line). This method was used on rare occasions; apparently, the saving in labor (by doubling up two operations) was not greater than the gain in edible product weight that is possible when employing mechanical equipment.

Mechanical head puller-cutter combinations also were used without any labor. The machines were designed for use on the eviscerating line so that the neck of each bird passed into a narrow slot (fig. 50). As the conveyor moved the birds, the neck was pulled into a very narrow slot, and rollers or vibrating jaws disjointed the neck vertebrae close to the skull. The neck skin was then stretched considerably before being severed by a circular saw mounted horizontally at the end of the slot. These machines could be adjusted to cut off a minimum amount of skin and neck with the head. It was noted, however, that improper maintenance and adjustment, in many cases, caused heads to be cut improperly; some were missed, and the machines would become clogged with severed heads. This machine (for double lines over one trough) operated at a cost of $0.71 per hour (appendix, p. 55. Table 25).

As far as could be determined, there are no reliable figures available indicating which method of removing poultry heads yields the most salable product. Disregarding this factor, the fixed head puller (fig. 48) is the most practical.

N–45138

FIGURE 50.—A mechanical head puller-cutter dislocates vertebrae, stretches neck skin and severs it close to the head.

REMOVAL OF CROP AND WINDPIPE

The crop and windpipe are usually removed from chickens after the viscera and head have been removed from the carcass. This leaves both ends of these parts detached and permits easy removal. Because of their attachment to other tissues, it is almost impossible to remove them by pulling from either end; instead, they are pulled loose through an incision at a point where the neck joins the body. This incision was made in one of two ways. The most common method was to sever the vertebrae at the back of the neck close to the bird's body with snips, leaving a portion of skin on the underside of the neck to keep the neck attached and providing an opening for removal of the windpipe and crop.

The snipping operation was performed while the birds were suspended by the hocks. The operator grasped the bird's neck with the left hand and exerted downward force. Then, with a pair of snips in the right hand, he snipped through the skin on the back of the neck and through the vertebrae close to the body, being careful not to cut the outer skin, windpipe, or crop on the underside (fig. 51). Then the left thumb was inserted into the slit and the neck vertebrae were pushed down until a gap of one to two inches was left

N–45139

FIGURE 51.—Severing the neck vertebrae with a pair of snips.

between the neck and body. This provided room for the fingers to be inserted to remove the crop and windpipe (fig. 52). An operator could sever the vertebrae with a pair of snips and push the bone down about an inch at a rate of 2.7 minutes per 100 birds (37 birds per minute). One disadvantage of this method was that a neck was occasionally pulled off during the crop removal

N–45140

FIGURE 52.—A poultry carcass with the neck vertebrae severed and lowered, permitting removal of crop and windpipe.

N–45141

FIGURE 53.—Making an incision down the back of the neck through which the crop and the windpipe can be removed.

operation, causing loss of time and possibly of the neck itself. Another objection was the hazard to the crop puller's hands. Sharp fragments of a shattered vertebra frequently cut the fingers and hand as they grasped the crop and windpipe.

The second method of preparing the neck for crop and windpipe removal was to make a 2- or 3-inch slit along the back of the neck (fig. 53).

There were two main disadvantages to this method: (1) The crop and windpipe were more difficult to remove, requiring more labor (table 19); and (2) the birds had to be hung by the head or on three-point suspension to permit rapid cutting. The latter requirement is of particular concern to a plant where birds are usually placed in the eviscerating shackle by the hocks and pass through the eviscerating area on two-point suspension.

One operator could make the neck incision at the rate of 100 birds in 1.46 minutes, or 68.5 necks per minute.

With either type of neck opening, the crop and windpipe were removed by grasping both at once and pulling downward to dislodge them from inside the body cavity. Then, while holding the neck, the operator stripped the parts from the attached tissue (fig. 54).

The lungs were usually removed before crop and windpipe removal. This sequence was desirable because it resulted in a more complete removal of the windpipe from inside the body cavity. If the windpipe is pulled first, it sometimes breaks off one or two inches from the lungs. If the lungs are removed first, the complete windpipe is likely to come out every time, since the ends are both loose.

N–45142

FIGURE 54.—An operator removing the crop and windpipe.

Table 19 shows that an operator can remove the crop and windpipe from approximately 7 more birds per minute (21.1 compared to 14.4) when they are removed through the opening made by severing the neck vertebrae. The difference in labor requirements for the two methods of removing the neck are explained in the section "Remove Necks," p. 39.

TABLE 19.—*Time required to remove the crop and windpipe from 100 birds by different methods*

Method	Time required per work element		Total time required
	Reach for bird	Remove crop and windpipe	
	Man-minutes	*Man-minutes*	*Man-minutes*
Removal through opening left by severing vertebrae	0.93	3.82	[1] 4.75
Removal through slit in neck skin	.93	[2] 6.03	[3] 6.96

[1] A production rate of 1,266 birds per hour or 21.1 birds per minute.
[2] The greater time required here was largely because the operator had greater difficulty in grasping the crop and windpipe through the neck incision.
[3] A production rate of 864 birds per hour or 14.4 birds per minute.

HOUSE INSPECTION

House inspection is performed by plant personnel after all waste products and giblets have been removed from the carcass. The inspection station is at the end of the eviscerating line just before or after the final bird wash. A small table or a rack is provided near the inspector (fig. 55) so that a number of birds can be stored temporarily, if necessary. The inspector is provided with a hand lung rake and sometimes a vacuum nozzle for removing viscera fragments left inside the body cavity.

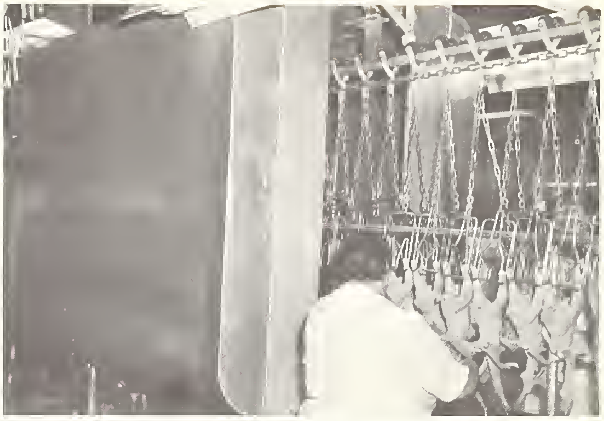
Inspectors look for errors in workmanship that would prevent acceptance as ready-to-cook, particularly involving a check on those operations performed after Federal inspection. The veterinarian in charge of plant inspection makes frequent spot checks of the effectiveness of the house inspection.

N–45143

FIGURE 55.—House inspectors examining eviscerated poultry for acceptable workmanship.

INSIDE AND OUTSIDE BIRD WASH

After eviscerating operations are completed, the poultry is passed through a bird washer (fig. 56) with several banks of spray nozzles that direct fine streams of water, under high pressure, against all parts of the carcass and into the body cavity. Most bird washers in high-volume plants are 8 feet long and are designed for either single or double eviscerating lines over one trough. They use a large volume of water that falls into the offal trough and helps float the inedible waste in the eviscerating area to the offal room.



N-45144

FIGURE 56.—Birds entering one type of inside and outside bird washer.

REMOVAL OF NECKS

Two methods were used for manually removing necks from broilers. One method was to cut them off with a knife by severing the remaining neck skin after the neck vertebrae had been severed in a previous operation (see "Removal of Crop and Windpipe," p. 36). Very little effort was required for this job, and one operator could usually cut off necks of birds on two eviscerating lines if they were close enough together (fig. 57). The other method required the use of snips to sever both the vertebrae and neck skin in one operation.

N-45145

FIGURE 57.—One operator cutting necks from birds on two eviscerating lines which are routed close together. Neck vertebrae have been snipped and operator is using a knife to cut through remaining neck skin.

Time studies established that a worker could usually remove necks with a knife, where neck vertebrae had been previously snipped, at a rate of 100 in 1.27 minutes (78.8 per minute). The time required to remove 100 necks with snips where the vertebrae had not been previously snipped was 2.79 minutes per 100 necks or 35.8 per minute.

A mechanical in-line neck cutter eliminated manual labor for this operation. Necks are fed into a slot, severed at the spinal column by a circular saw, and dropped into a chute for conveyance to the giblet-wrapping station. The saw could be adjusted for cutting at the proper position. This machine was used when the neck skin had been slit for removing the crop and windpipe. In most instances, the bird was chilled with neck attached, and the neck was removed from a single line of birds while on the "drip line" where excess moisture is permitted to drip from the carcasses.

Combined Crop, Windpipe, and Neck Removal Operation

To determine the most economical methods for removing the crop and windpipe, the neck incision and the neck removal operations must be considered simultaneously. When only the neck skin is slit, more time is required to remove the crop and windpipe, and either manual snips or a mechanical cutter must be used for severing the neck bone. Table 20 shows the labor requirements for three combinations of methods. Method A shows the labor requirements for slitting the neck skin and using a mechanical neck cutter. The labor cost amounts to $0.21 per 100 birds, but the total cost is increased to $0.23 per 100 birds when the cost of equipment is added (footnote 2, table 20).

Method B employs the same setup as method A except the necks are cut off with manual snips rather than with a mechanical neck cutter. This increases the labor cost to $0.28 per 100 birds. In method C, the neck vertebrae are severed for crop and windpipe removal and the neck is removed later with a knife. This is the most economical, since the total cost is only $0.22 per 100 birds.

This comparison of methods is accurate only if the operations are performed under optimum conditions; that is, the mechanical neck cutter has to be used on a drip line or in some way so as to fully utilize its capacity. In method C, the worker cutting off necks with a knife has to cut necks from birds on more than one eviscerating line, in order to be fully occupied.

TABLE 20.—*Labor required to remove crop and windpipe and necks from 100 broilers, using various methods*

Method [1]	Time required per operation					Total time required
	Slit neck skin	Snip neck vertebrae	Pull crop and windpipe	Cut off neck with knife	Cut off neck with snips	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*	*Man-minutes*
A	1. 46	------------	6. 96	------------	------------	[2] 8. 42
B	1. 46	------------	6. 96	------------	2. 79	[3] 11. 21
C	------------	2. 70	4. 75	1. 27	------------	[4] 8. 72

[1] Method A—Remove crop and windpipe through knife slit in neck and cut off neck mechanically. B—Remove crop and windpipe through knife slit in neck and snip off neck with shears. C—Remove crop and windpipe through opening made when snipping neck vertebrae, and cut off neck.

[2] A labor cost of $0.21 per 100 birds for method A (labor @ $1.50 per hour, appendix, p. 54). Add $0.02 equipment cost for mechanical cutter used at a rate of 4,800 necks per hour (appendix, table 25, p. 55). Total (labor and equipment) cost of $0.23 per 100 birds for method A.

[3] A labor cost of $0.28 per 100 birds for method B (labor @ $1.50 per hour).

[4] A labor cost of $0.22 per 100 birds for method C (labor @ $1.50 per hour).

WRAP AND STUFF GIBLETS

As indicated in the section discussing giblet processing, there is a definite economic advantage in salvaging giblets. One phase of this operation is that of assembling the giblet items (heart, liver, neck, and gizzard) and placing them in the body cavity of the chicken carcass.

Giblets are usually flumed or conveyed from the trim stations to a central area for assembly and packaging. In case-study plants, they were packaged by wrapping in 9- by 12-inch sheets of parchment paper. The wrapping equipment usually included a horizontal conveyor belt 8 to 10 feet long for moving the giblets past wrapping stations that were on either side of the conveyor. A flat metal apron about 1 foot wide on each side provided space for wrapping (fig. 58).

Some giblet-packing tables recirculate the giblets (an undesirable practice) that were not picked up on the first pass, dropping them off into a water flume under the table for return to the opposite end of the supply conveyor.

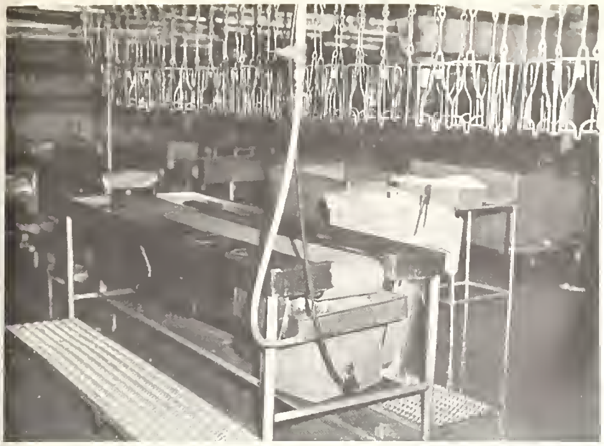
The eviscerating line loaded with birds moves along just over the giblet supply belt, and workers select a set of giblets, wrap them, and stuff the package into the body cavity of a bird (fig. 59).

The greatest disadvantage of this method of packaging giblets is the difficulty the operators have in selecting a complete set of giblets from a random mixture as they pass on the conveyor. All personnel wrapping giblets must maintain a given production rate to insure that each bird on the eviscerating conveyor is stuffed with a giblet package. Often this does not allow sufficient time to do a good job of giblet selection, and, as a result, a high percentage of giblet packs do not have a complete set of components.

Packaging and stuffing giblets in this manner, while the birds were still on the eviscerating line, was done only when birds were to be chilled in chill tanks or certain types of "drag-through" chillers. Where chiller action involves a tumbling action and might cause the giblet package to fall from the carcass, the giblets were stuffed into the body cavity after chilling. This practice, in turn, required that giblets be chilled in specially designed equipment prior to wrapping.

When birds are chilled prior to insertion of the giblets into the body cavity, the stuffing operation becomes more difficult,[9] as is indicated in table 21.

[9] Chilling stiffens the carcass and constricts the giblet passageway.



N-45146

FIGURE 58.—A giblet-wrapping station, showing the conveyor belt with metal aprons on each side for selecting and wrapping sets of giblets.

N-45147

FIGURE 59.—Workers wrapping giblet packs and stuffing them into the body cavities of birds on overhead conveyor.

The reduced production per worker amounts to one bird per minute (from 13.8 warm to 12.8 chilled). Another observation that can be made from studying table 21 is that no advantage (in saving labor) is gained in having part of the crew select and wrap sets of giblets while others do nothing but stuff the packages into the body cavities. For example, a worker can normally select and wrap about 18 sets of giblets per minute (5.61 minutes per 100 sets) and one person can stuff 50 of the wrapped sets per minute. Using these production figures, it can be seen that the same number of workers will be required for any given production rate, regardless of whether the operations are combined or not. One reason why there is no advantage in separating the wrapping and stuffing operations is that additional time is required for laying the wrapped packages aside and picking them up again.

TABLE 21.—*Labor required to select and wrap 100 sets of giblets and insert them into chicken body cavities*

Method	Time required per work element			Total time required
	Select set of giblets	Wrap	Stuff in body cavity	
	Man-minutes	*Man-minutes*	*Man-minutes*	*Man-minutes*
Giblets stuffed into warm birds	2. 92	2. 69	1. 65	[1] 7. 26
Giblets stuffed into chilled birds	2. 92	2. 69	2. 18	[2] 7. 79

[1] A production rate of 828 birds per hour or 13.8 per minute.
[2] A production rate of 768 birds per hour or 12.8 per minute.

INFLUENCE OF WORK METHODS, CREW BALANCE, AND WORK STATION LAYOUT ON PRODUCTION

Line speeds or production levels can be calculated, using established work rates, where the maximum use of direct labor is obtainable. The great variation in methods and equipment used by the poultry processing industry in the eviscerating area makes it impossible to discuss or illustrate all possible combinations. Two tables (tables 22 and 23) were drawn up, however, to illustrate the method of determining the most economical eviscerating line speeds for two types of conveying systems.

The methods of performing operations in these examples were selected to depict typical eviscerating operations, and are not necessarily recommended in every case.

The plan in establishing the most economical line speeds for labor utilization is to arrive at the production level where the most birds possible are processed properly per man-hour of labor expended. This is determined by dividing the number of birds processed in one hour by the number of workers on the line. The answer is expressed in birds per man-hour.

In table 22, a single conveyor with 6-inch shackle spacing is used for production levels of 1,800, 2,100, and 2,400 birds per hour. For production rates greater than 2,400 birds per hour, a divider is installed in the line after the bird is opened for drawing viscera, to route alternate shackles to the

Table 22.—*Manpower requirements for eviscerating chickens at specified production levels, using a single conveyor divided in 2 lines at rates above 40 birds per minute* [1]

Operation	Established rates per worker [2]	1,800 birds/hr. (30/min.)	Labor used	2,100 birds/hr. (35/min.)	Labor used	2,400 birds/hr. (40/min.)	Labor used	2,700 birds/hr. (45/min.)	Labor used	3,000 birds/hr. (50/min.)	Labor used	3,300 birds/hr. (55/min.)	Labor used
	Birds/min.	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*
Remove shanks-w/knife, bird suspended by neck [3]	41. 3	1	72. 6	1	84. 7	1	96. 8	1	[4]100. 0	2	60. 5	2	66. 6
Remove oil gland, bird suspended by hocks [3]	36. 8	1	81. 5	1	95. 1	1	100. 0	2	61. 4	2	67. 9	2	74. 9
Transfer bird to eviscerating line (from neck to hocks suspension)	25. 4	2	59. 0	2	68. 9	2	78. 7	2	88. 6	2	98. 4	2	100. 0
Open bird:													
Tail cut and vent removal	14. 7	2	100. 0	3	79. 4	3	90. 7	3	100. 0	4	85. 0	4	93. 5
Abdomen incision w/scissors	39. 8	1	75. 4	1	87. 9	1	100. 0	2	56. 5	2	62. 8	2	69. 0
Draw viscera	13. 7	2	100. 0	3	63. 9	3	73. 0	2 2	82. 1	2 2	91. 2	2 2	100. 0
Inspection	(5)												
Heart and liver, trim and wash	14. 2	2	100. 0	3	61. 6	3	70. 4	2 2	79. 2	2 2	88. 0	2 2	96. 8
Gizzard removal, trim, split, and wash manually	11. 7	3	64. 1	3	74. 8	4	85. 5	2 2	96. 1	2 2	100. 0	3 3	78. 3
Peel gizzard (manual ejection)	38. 2	1	78. 5	1	91. 6	1	100. 0	1 1	58. 9	1 1	65. 4	1 1	72. 0
Remove lungs, cutoff valve nozzle	24. 9	2	60. 2	2	70. 3	2	80. 3	1 1	90. 4	1 1	100. 0	2 2	55. 2
Snip neck vertebrae and depress w/thumb	37. 0	1	81. 1	1	94. 6	1	54. 0	1 1	60. 8	1 1	67. 6	1 1	74. 3
Remove crop and windpipe	21. 1	2	71. 1	2	82. 9	2	94. 8	1 1	100. 0	3	79. 0	3	86. 0
Remove neck with knife	78. 8	1	38. 1	1	44. 4	1	50. 8	1	57. 1	1	63. 4	1	69. 8
Wrap and stuff giblets, warm birds	13. 8	2	100. 0	3	84. 5	3	96. 6	3	100. 0	4	90. 6	4	99. 6
Total number of workers		23		27		28		34		38		42	
Birds per man-hour		78. 3		77. 8		85. 7		79. 4		78. 9		78. 6	

[1] Division points in line are indicated by two columns of figures in "number of workers" columns.

[2] Developed in tables 1 through 21.

[3] Operation normally performed on the defeathering line.

[4] If line speed did not exceed established rate for manpower used by 10 percent, an additional worker was not added.

[5] Production rates for Federal or house inspection were not established.

TABLE 23.—*Manpower requirements for eviscerating chickens at specified production levels, using twin shackle or dual conveyor eviscerating line* [1]

Operation	Established rates per worker [2]	2,400 birds/hr. (40/min.)	Labor used	3,000 birds/hr. (50/min.)	Labor used	3,600 birds/hr. (60/min.)	Labor used	4,200 birds/hr. (70/min.)	Labor used	4,800 birds/hr. (80/min.)	Labor used	5,400 birds/hr. (90/min.)	Labor used
	Birds/min.	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*	*No. workers*	*Percent*
Remove shanks w/knife, bird suspended by neck [3]	41. 3	1	96. 8	2	60. 5	2	72. 6	2	84. 7	2	96. 8	2	100. 0
Remove oil gland, bird suspended by hocks [3]	36. 8	1	[4] 100. 0	2	67. 9	2	81. 5	2	95. 1	2	100. 0	3	81. 5
Transfer bird to eviscerating line (from neck to hocks suspension)	25. 4	2	78. 7	2	98. 4	3	78. 7	3	91. 9	3	100. 0	4	88. 6
Open bird, tail cut and vent removal	14. 7	2 2	68. 0	2 2	85. 0	2 2	100. 0	3 3	79. 4	3 3	90. 7	3 3	100. 0
Abdomen incision w/scissors	39. 8	1 1	50. 2	1 1	62. 8	1 1	75. 4	1 1	87. 9	1 1	100. 0	2 2	56. 5
Draw viscera	13. 7	2 2	73. 0	2 2	91. 2	2 2	100. 0	3 3	85. 1	3 3	97. 3	4 4	82. 1
Inspection	(5)	------	------	------	------	------	------	------	------	------	------	------	------
Heart and liver, trim and wash	14. 2	2 2	70. 4	2 2	88. 0	2 2	100. 0	3 3	82. 1	3 3	93. 9	3 3	100. 0
Gizzard, trim, split, and wash manually	11. 7	2 2	85. 5	2 2	100. 0	3 3	85. 5	3 3	100. 0	4 4	85. 5	4 4	96. 1
Peel gizzard (manual ejection)	38. 2	1	100. 0	1 1	65. 4	1 1	78. 5	1 1	91. 6	1 1	100. 0	3	78. 5
Remove lungs, cutoff valve type nozzle	24. 9	1 1	80. 3	1 1	100. 0	2 2	60. 2	2 2	70. 3	2 2	80. 3	2 2	90. 4
Snip neck vertebrae and lower w/thumb	37. 0	1 1	54. 0	1 1	67. 6	1 1	81. 1	1 1	94. 6	1 1	100. 0	2 2	60. 8
Remove crop and windpipe	21. 1	1 1	94. 8	2 2	59. 2	2 2	71. 1	2 2	82. 9	2 2	94. 8	2 2	100. 0
Remove neck w/knife	78. 8	1	50. 8	1	63. 4	1	76. 1	1	88. 8	1	100. 0	1	100. 0
House inspection	(5)	------	------	------	------	------	------	------	------	------	------	------	------
Wrap and stuff giblets	13. 8	3	96. 6	4	90. 6	4	100. 0	5	100. 0	6	96. 6	7	93. 2
Total number of workers	------	33	------	39	------	44	------	51	------	54	------	64	------
Birds per man-hour	------	72. 7	------	76. 9	------	81. 8	------	82. 3	------	88. 9	------	84. 4	------

[1] Involves two separate conveyors running parallel and close together or a single line supporting two shackles per crossbar. Where a single column of figures appears in the "No. workers" column, the employees serviced both lines.

[2] Developed in tables 1 through 21.

[3] Operations normally performed on the defeathering line.

[4] If line speed did not exceed established rate for manpower used by 10 percent, an additional worker was not added.

[5] Production rates for Federal or house inspection were not established.

right and to the left, making two eviscerating lines with 12-inch shackle spacing.[10]

When using the single conveyor with 6-inch shackle spacing and the specified methods of performing each operation, as shown in table 22, it is best not to split or divide the line until a production rate of more than 40 birds per minute is desired. For example, if the line were divided when production was 40 birds per minute, additional workers would be required for opening and venting, trimming hearts and livers, and snipping and depressing the neck vertebrae. This would increase the total of workers from 28 to 31 and would lower the output of birds per man-hour from 85.7 to 77.4.

However, if the line speed is increased beyond 40 shackles per minute, dividing it into 2 lines is desirable. This type of line is rarely operated at more than 50 birds per minute because the speed is too high for effective workmanship. It can be seen also (table 22) that 80 birds per man-hour is about the maximum production that can be expected from a split or divided line employing the specified methods.

At 60 birds per minute, a dual line system[11] is preferable (table 23), because a rate of 81.8 birds per man-hour can be achieved, compared to 78.3 birds per man-hour for two 30-bird-per-minute lines (table 22). Likewise, at 70, 80, or 90 birds per minute, the dual-line system is best.

The figures in tables 22 and 23 show that each processing plant must calculate its own most effective production levels, based on the equipment used, type of finished product processed, and eviscerating methods employed. This can be accomplished by determining a production rate (tables 22 and 23, column 1) that workers can attain for each operation, then listing the number of personnel required for performing each operation, based on the production rate for each operation. The total number of personnel required divided into the hourly production rate gives the birds per man-hour.

The rates established in this report are not to be considered the maximum that can be achieved by a worker, but rather the rates that average workers can maintain throughout the workday.

EQUIPMENT AND WORK STATION LAYOUT

The arrangement of equipment in the eviscerating area, where a concentrated group of workers is employed, is important for economical labor utilization and for maintaining high sanitation standards. Some suggestions for arrangements follow, which are not expensive to implement in a new or an existing plant.

Offal Trough

The offal trough positioned under the eviscerating conveyor line serves several essential purposes. First, it is the cheapest way to transport offal from the eviscerating room to the offal room (by floating it away with waste water). Second, it helps to maintain sanitary conditions, preventing waste from falling on the floor or from accumulating in the eviscerating area. Third, it allows plant modification or changes in line position more readily than would trench-type floor drains. To conserve water and obtain the most effective use of an offal trough as a conveyor, its layout and installation must be carefully engineered.

After chickens have passed through the eviscerating operations and approached the end of the trough, they are routed through a mechanical inside-outside washer (fig. 56), a tunnel equipped with banks of nozzles that spray water under high pressure on the eviscerated carcasses as they pass through. The waste water from the washer drops into the trough below. For best utilization of the washer water as a conveyance and offal trough rinse, it is most practical for the water and waste products to empty at the opposite end of the trough from the sprayer. This means that the water in the offal trough must flow in the direction opposite to the movement of the eviscerating line.

If the offal flows in the same direction as the line movement and is discharged at the end of the trough beyond the washer, the water from the mechanical bird washer hinders rather than helps in floating away the waste product. This is because the great volume of water from the spray nozzles fills the trough, reducing the velocity of water flow. As the water velocity decreases, waste solids accumulate on the bottom and at corners of the trough. Also, more water is required to float waste from the trough head toward the washer.

Little waste falls into the trough from the head end to the giblet trim stations. Therefore, the trough outlet can be placed anywhere from the head end to the giblet trim station and still utilize water from the mechanical washer to float away the bulk of the waste products. With this arrangement, water from the hand-wash nozzles and that used for flushing the sides of the trough is usually sufficient for floating the small amount of offal from the head of the trough to the outlet. More trough slope can be attained, if it is desirable, by having the drain near the center of the trough.

No attempt was made in this study to determine the proper design for an offal trough or to

[10] "Monorail Conveyors Used in Eviscerating Poultry," AMS-290. Agr. Mktg. Serv., U.S. Dept. Agr. 1959.

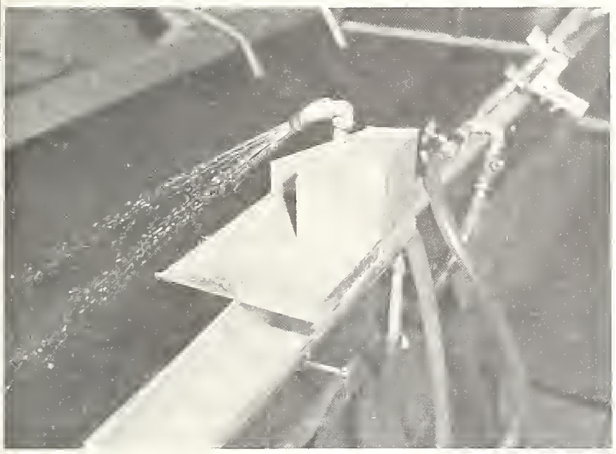
[11] See footnote 10.

determine the slope or amount of water necessary for best performance. It was evident, however, that the slope of the trough and the quantity of water used were the two variables that determined the effectiveness of the system. It was obvious that, by experimenting with these two factors, offal could be floated away effectively with much less water than is now being used in many processing plants.

Work Station Layout

The proper layout of individual work stations along the eviscerating trough eliminates unnecessary hand motions and keeps the "reach" element to the shortest distance—permitting a smooth, rhythmic performance of each task. Benefits derived from a good work station layout are increased productivity, high-quality performance, better sanitation (employees wash their hands more often), and reduced worker fatigue.

This phase of the study was directed toward developing improved work station layout and equipment. By measuring performance time and workmanship, improved hand-wash nozzles and locations were designed, relative heights of operator to birds and auxiliary equipment were determined, and the location and design of disposal chutes for giblet operations were developed. Experimental stations were constructed and placed on the line (fig. 60) and adjusted to achieve the best relationship of height of the operator to height of the bird on the line and to provide the most effective hand-motion patterns.



N-45148

FIGURE 60.—An experimental gizzard trim and wash station where nozzle and disposal chute effectiveness were determined.

The height of the worker in relation to height of the bird on the line and of the auxiliary equipment must be carefully considered for best results. Since it is not easy to change the height of the monorail conveyor, it should be positioned so that the tallest workers can perform eviscerating operations at a comfortable height while standing on the floor. Workers of short stature need to stand on some type of platform. It is most comfortable for the hands to work at or slightly below elbow height.[12] The horizontal distance from the worker to the area in which the hands perform most of their task should be short. A minimum of fatigue is incurred if the task is performed 12 to 15 inches in front of the worker (fig. 61).

The productivity of workers handling giblets can be especially affected by layout of the station, due to the several elements involved in the operations. The "reach" distances from the giblet flume opening to the bird, to the wash nozzle, and return affect the quality and rate of performance. A poorly located wash nozzle may cause workers to neglect the washing of giblets or their hands.

Frequent hand washing is encouraged by positioning wash nozzles in the pathway followed by the operator's hands during a normal work cycle (fig. 62).

Figures 64 and 65 show in detail a recommended layout for a heart and liver trim station and a gizzard trim station. Locations are shown for water nozzles, disposal chutes, and other equipment in relation to the lower tip of the eviscerating shackle. The distances shown must be exact in order to permit smooth hand motions. Other work stations (fig. 61) are concerned only with the relative location of the water nozzle to the shackle, along with the proper height of the worker's elbow, regulated by the platform height.

Studies made in seven processing plants revealed that amounts of water used at hand-washing stations varied from about ½ gallon per minute to over 9 gallons per minute (table 24). The mean value for all stations was 2.29 gallons per minute. Most of these hand-wash stations used the gooseneck open-pipe type of nozzle. Because of the large volume of water required by this type of nozzle for fast rinsing action and because the high sweep of the gooseneck tended to interfere with a smooth hand-motion pattern of the worker, an improved nozzle was developed[13] and tested (fig. 63).

The improved nozzles could be regulated to give a quick, effective hand wash while using only 0.75 gallon of water per minute, compared to 2.29 gallons per minute with the conventional type (table 24). This represents a saving of 92.4 gallons per hour for each nozzle used. The improved nozzle is convenient (fig. 67) for rapid hand rinsing, since only two quick motions are necessary, that is, drop the hand into the path of the spray, and reach for the next bird.

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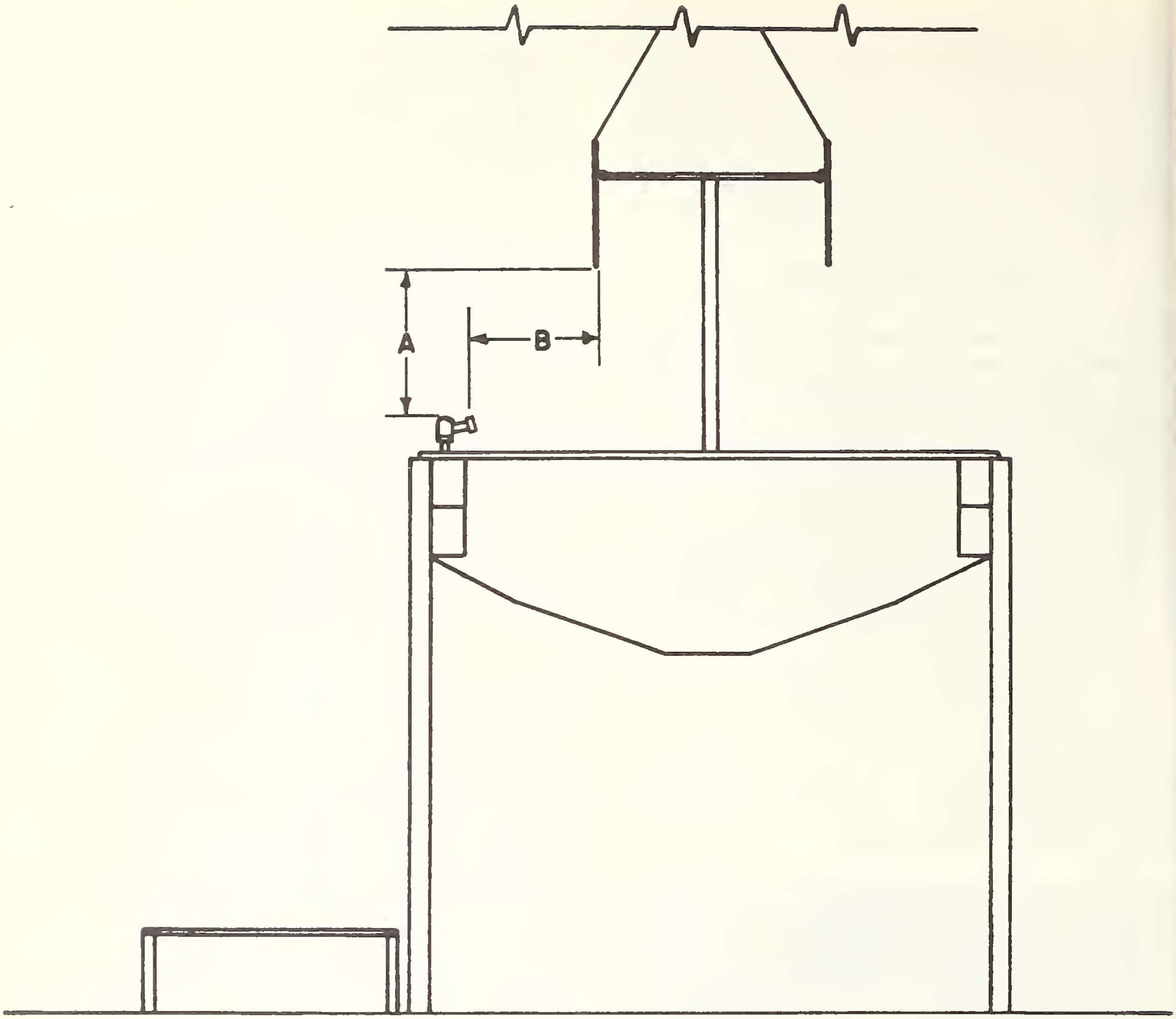
[12] Maynard, H. B., Industrial Engineering Handbook. McGraw-Hill, Inc. New York City, 1956.

[13] "Hand Washing Nozzles for Use in Poultry Processing Plants," N.S. 25, Univ. Ga., Expt. Sta., Athens, Ga. September 1961.



DIMENSIONS FOR VARIOUS WORKSTATIONS				
STATION	2 POINT A	2 POINT B	3 POINT A	3 POINT B
OPEN CUT, TAIL SPLIT	7.5"	10.5"	9"	10.5"
OPEN CUT, VENT	7.5"	10.5"	9"	10.5"
OPEN CUT, BODY INCISION	7.5"	10.5"	9"	10.5"
DRAW VISCERA	7.5"	10.5"	10.5"	10.5"
LUNG & REPRODUCTIVE ORGAN REMOVAL	14.5"	7"	14.5"	7"
CUT & LOWER NECK BONE	14.5"	7"		
CROP REMOVAL	13.25"	9"		
FINAL INSPECTION	10.75"	10"		

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Figure 61.—A diagram showing proper relative heights for work stations along the eviscerating line.

N–45149

FIGURE 62.—An improved heart and liver trim station. The water spray is in the path of the worker's hands as they move from point of removal (A) to flume opening (B).

Because only a few experimental nozzles were available, an accurate comparison in time saving between nozzles was not possible, but more time was required for hand rinsing with conventional nozzles because more movements for proper rinsing were required (fig. 68).

N–45150

FIGURE 63.—Experimental spray hand-wash nozzles (left) and conventional gooseneck open-type (right).

TABLE 24.—*Quantity of water used during evisceration in plants employing gooseneck nozzles at work stations* [1]

Operation	Plant number—						
	1	2	3	4	5	6	7
	GPM [2]	*GPM*	*GPM*	*GPM*	*GPM*	*GPM*	*GPM*
Open bird	0. 53	4. 40	1. 74	. 98	1. 36	1. 25	3. 54
Draw viscera	1. 29	3. 26	3. 13	1. 43	1. 39	1. 10	3. 24
Government inspection	1. 32	3. 00	3. 75	1. 21	1. 09	1. 37	2. 75
Liver and heart	1. 41	2. 86	1. 97	0. 81	0. 91	1. 76	2. 75
Remove lungs	(3)	(3)	9. 36	0. 89	1. 87	1. 43	1. 66
Cut neckbone	1. 53	2. 89	4. 40	0. 81	2. 50	(3)	(3)
Cut off head	1. 50	2. 89	(3)	0. 94	1. 60	(3)	(3)
Pull crop	2. 50	3. 95	5. 34	0. 98	2. 03	1. 87	3. 33

[1] Approximately 40 birds per minute.
[2] Gallons per minute.
[3] No nozzles were available at these stations.

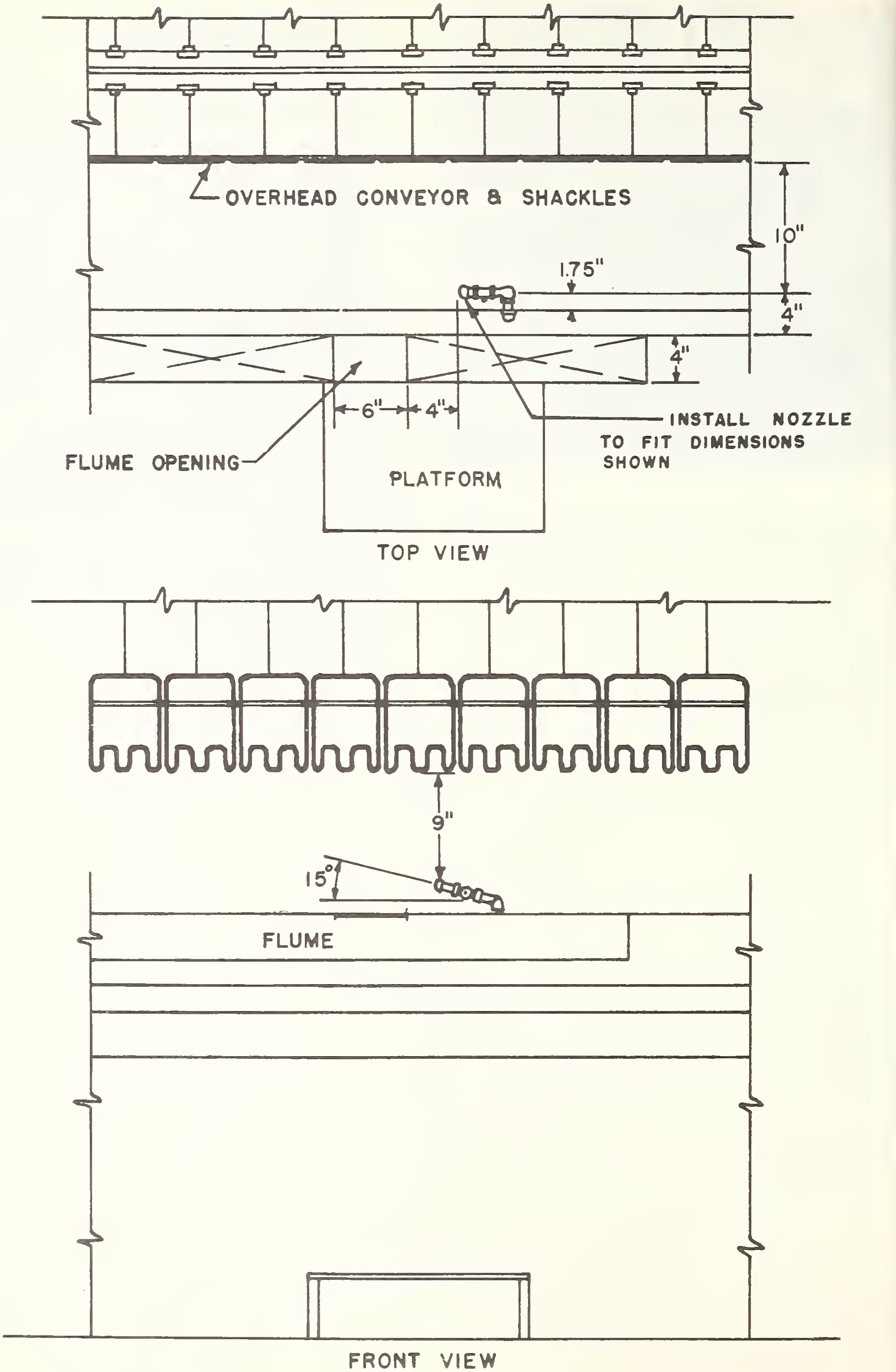

FIGURE 64.—Layout details for a heart and liver trim station.

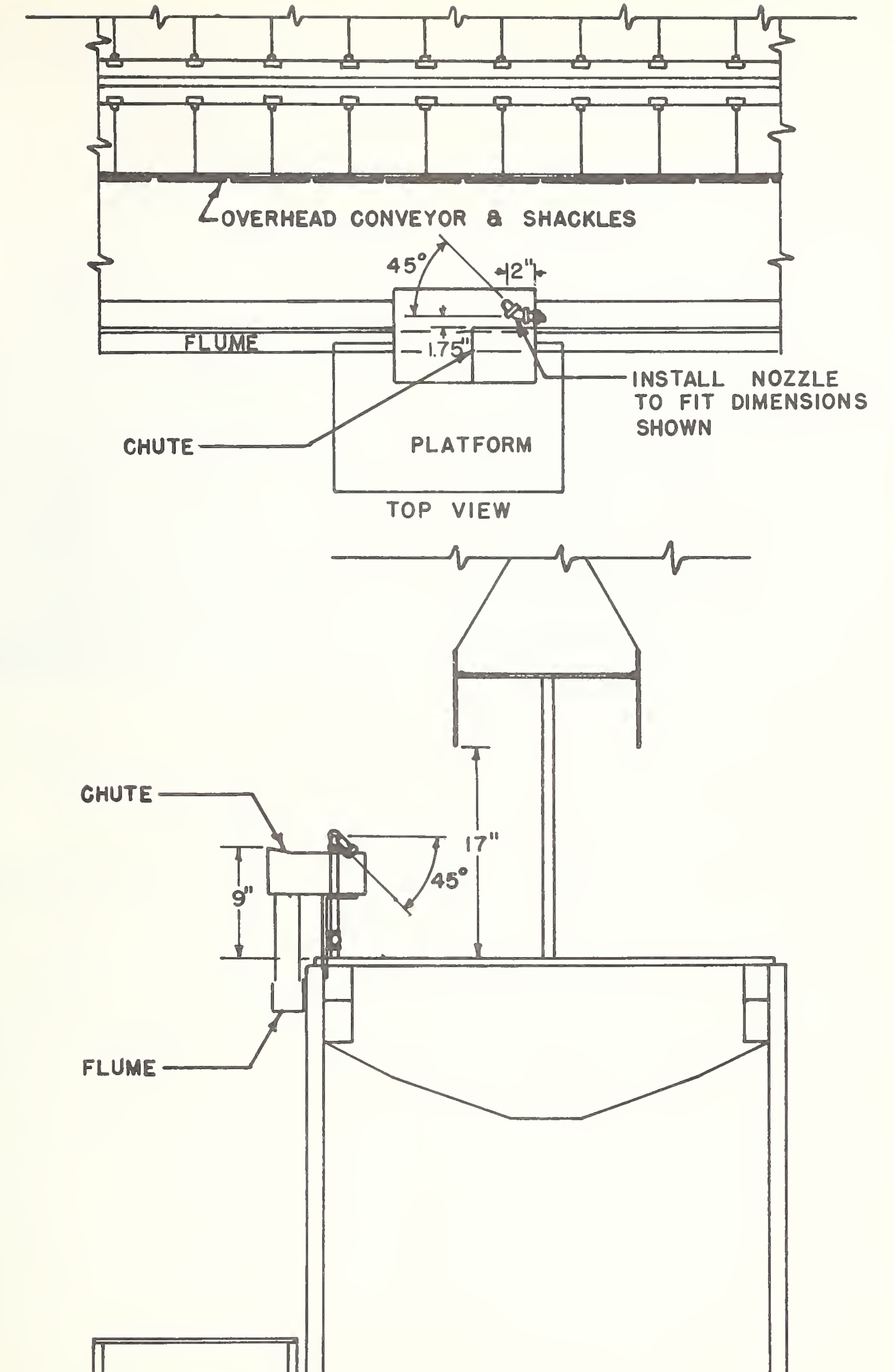

Figure 65.—Layout details for a gizzard trim and wash station.

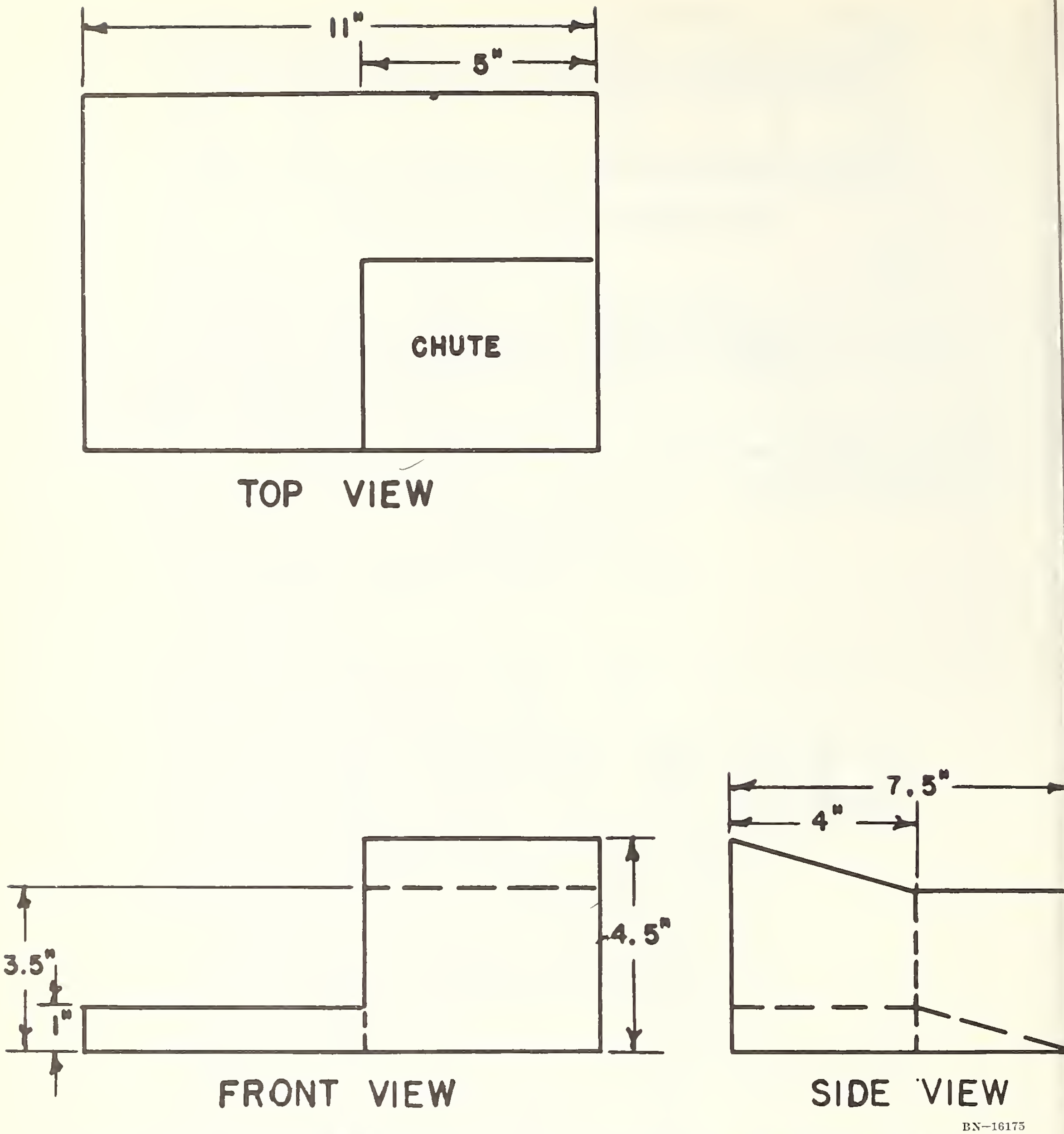

FIGURE 66.—Detail dimensions for constructing a gizzard work station chute shown in figure 65.

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FIGURE 67.—Rinsing the hand with the improved spray rinse nozzle.

N—45152

FIGURE 68.—Rinsing the hand with the gooseneck type, open-pipe nozzle.

RECOMMENDED MANAGEMENT CONTROL TECHNIQUES

It is impractical, if not impossible, for plant management to supervise constantly the performance of the many employees working in the eviscerating area in large-volume operations. Therefore, quality control techniques by spot checking worker performance are required, especially where several people perform the same operation. Some of the techniques used to check on the quality of workmanship are discussed here.

Color Coding Shackles

A simple and effective check system frequently employed is the use of colored tags attached to successive shackles on the eviscerating line. Two or more colors are used, four being the most common number. Where the same operation is performed by more than one person (such as "open bird" or "draw viscera"), each worker is assigned a code color, and he performs a prescribed operation only on those birds tagged with his code. This makes it easy for each worker to select the proper bird on which to work, while insuring against missed birds and permitting an accurate check against substandard performance through inspection farther down the line. Once the color tags are on the shackles, this method of quality control can be applied to many of the operations where more than one worker is required. When coding by colored tags is employed, all shackles should carry the tags. This eliminates the confusion of two persons performing the same operation or handling the same bird. Color coding is used extensively on eviscerating lines with more than one Federal inspection station.

Offal Analysis

A very effective method of pinpointing trouble spots along the eviscerating line consists of catching a quantity of offal from the discharge end of the flow-away trough at intervals during the day and examining it for edible product that should not have been thrown away. Frequent fragments of fat, neck tissue attached to the head, or excess skin tissue attached to the vent or oil sac denote poor workmanship.

For this method to be most effective, a means of collecting offal must be used that does not alert employees. On the other hand, employees should be aware that offal sampling is a company policy and they should be praised or corrected according to the findings in the samples. The psychological effect of this technique keeps the workers alert and tends to develop better working habits.

Weighing Technique

One of the best methods to determine losses that involve trimming operations is to check an occasional sample of the part that was trimmed away and compare the average weight with a predetermined standard weight for the trimmed-away part. This checking method is used as a control on operations such as trimming giblets, peeling gizzards (fat loss), head removal, and removing the preen gland.

Maintenance Program

A planned maintenance program is a "must" for uninterrupted plant operation. Such a program requires regular inspection schedules for all equipment by a qualified maintenance man. Preventive maintenance must be applied where experience shows that it will prevent unscheduled shutdowns. Very few machines break down or wear out if they are properly maintained.

A maintenance program is limited in effectiveness without a sufficient number of qualified personnel, a well-equipped shop, and a sufficient supply of essential materials and parts. Another essential part of a good maintenance program is a set procedure to follow in the event of a breakdown of any major piece of equipment. All maintenance personnel concerned should be fully briefed on the procedure so that no confusion arises and repairs can be made in a minimum of time.

Operating Personnel Chart

This management tool provides an overview of the plant, showing the number and location of all operating personnel. The plant floor plan, with equipment in place, is used for the chart base. Colored pins are used to represent all operating personnel at fixed work stations. Different colors are used for different adjacent operations so that the number of personnel assigned to each operation can be readily seen.

This chart is an important control device in large-volume plants for making cross checks on the payroll. It also counteracts the possibility of padding the work force in order to have standby help.

Small Equipment Control

Losses and damage to knives, shears, gloves, and other equipment can be greatly reduced by making each employee responsible for equipment issued. This was effectively done by marking each piece of equipment and issuing the same pieces to each employee day after day. This responsibility gives an incentive for personal care in the upkeep and protection of the equipment.

CONCLUSIONS

Chicken processing plant operators can reduce their costs substantially by:

1. Paying more attention to seemingly insignificant losses at work stations on the eviscerating line. Small amounts of edible product that can be saved by proper performance of such operations as oil gland removal, drawing viscera, and peeling gizzard linings can easily amount to as much as $100 per day in large-volume plants.

2. Providing for a thorough employee training program, backed up by effective workmanship inspection, to implement recommendation No. 1.

3. Improving the productivity and quality of workmanship of eviscerating line operators through improvement of work-station layouts, so that products and all equipment are positioned to permit smooth hand-motion patterns, minimum "reach" distances, and reduction of the frequency of "search" or "fumble" elements.

4. Maximizing labor input through optimum crew balance.

5. Gearing line speed to methods and equipment yielding the highest production rate per worker consistent with good workmanship, rather than striving for the greatest possible total production.

6. Being on the alert for unusual conditions (bird condition, temperature, humidity) that might require quick changes in crew composition or line speed.

The most important findings of this study are those providing guidelines to methods, equipment, and crew size and makeup that can eliminate many very small but frequently recurring losses in edible product and in worker productivity due to unnoticed defects in operating practices. Such defects can cost thousands of dollars annually for the average commercial chicken processing plant.

Time Study Technique

Because work cycles[14] for each of the eviscerating operations recurred in rapid succession and involved short, rapid motions, a method of timing other than by a stopwatch was required. The task of obtaining accurate time values manually was further complicated by workers standing side by side rather close together, making it difficult to observe the hand movements and the beginning and ending of each cycle. Micromotion technique[15] was therefore selected as the most reliable means of accurate time measurement.

Operation cycles were broken down into elements, just as is done in stopwatch study, except that the elements were very short. The operation was then photographed with a 16-mm. constant-speed motion picture camera (fig. 69) at 24 frames per second. Highly sensitive black-and-white film was used to avoid the use of lighting that would have distracted the workers. A stepladder was used so that operations could be filmed over the shoulders of employees when congestion prevented the filming from other positions. A 10-mm. wide-angle lens was used to provide a sufficient field of vision to cover the entire operation at a focal distance.

Developed film was cranked through a special projector (fig. 70) that mechanically counted the number of frames shown. Since each frame represented a time value of 0.000694 minute, each work element was timed by multiplying the number of frames per element by this time value.

[14] The longest cycle involved about 6 seconds.

[15] An industrial engineering time study technique employing the use of a motion picture camera where relatively fast, short work cycles are involved.

Production Rates

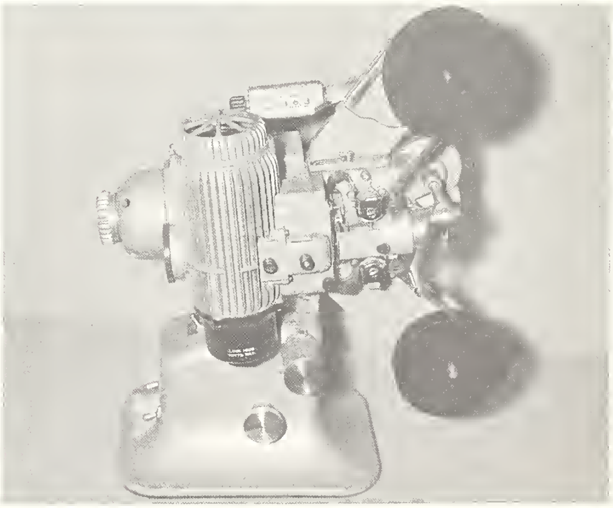
Production rates established in this report were computed by determining the actual or base time required for an average worker or workers to perform an operation or series of operations on 100 chickens of average quality and condition, adjusting the figure to allow for fatigue, and then determining the number of chickens the worker(s) can process per hour. The adjusted figure, or productive time, does not include a "personal" allowance for the worker, since industry practice provides two rest periods of 10 to 15 minutes each day, and a roving "floor walker" is always available to relieve a worker in case he must leave his work station for personal needs at times other than rest periods.

Since all of the operations on the eviscerating line are of a nature that do not involve strenuous labor, a fatigue allowance of only 5 percent was used in adjusting the base time for each operation.

It should be emphasized that the production rates in this report are based on the sustained productivity (productive time) of an average worker handling average chickens. Further, when a better-than-average worker (faster without loss of accuracy) is involved, increases in productivity as high as 25 percent can be expected. Even an average worker can be expected to increase his output by 15 to 20 percent for short periods of time without decreasing the quality of workmanship. However, the effects of these better-than-average outputs were deliberately excluded from productive time values in order to make the data applicable on a national basis that requires inclusion of a wide range of variation in worker ability and flock quality.

N-45153

FIGURE 69.—An industrial engineer filming an operation with a 16-mm. motion picture camera.



N-45090

FIGURE 70.—A special time-study projector. Note frame tally, top center.

Labor Costs

There were only slight differences between plants in hourly wage rates for labor in the eviscerating area. The rate ranged from $1.15 to $1.25 per hour. An average of rates encountered, adjusted to account for administrative and miscellaneous expense, resulted in an hourly rate of $1.50 per hour.

Equipment, Ownership, and Operating Costs

The types and amounts of equipment vary considerably from one processing plant to another, depending on the volume of poultry processed, the form of the finished product, or the preference of management. This makes it difficult to establish equipment costs for specific plant sizes or production volumes. Instead, ownership and operating costs were computed for various units of equipment and system components, so that overall plant equipment costs can be determined by the number of these units or components required.

Table 25 breaks down the ownership costs into depreciation, interest, and insurance, based on the initial equipment cost. The power costs are based on usage (with electricity at $0.02 per KWH). Annual and hourly cost rates are based on 2,000 hours of operation per year.

Standard Data

Labor requirements per 100 birds and production rates per operator for performing chicken eviscerating operations employing various methods and equipment:

	Productive time [1]	Production rates [2]
	Man-minutes per 100 birds	*Birds per minute*
Remove shanks from birds		
Air-operated shears, birds suspended by neck	2.69	37.2
Manual snips, birds suspended by feet	3.72	26.9
Manual snips, birds suspended by neck	3.95	25.3
Knife (6'' blade), birds suspended by neck	2.42	41.3
Remove preen (oil) gland from birds		
Birds suspended by neck	3.03	33.0
Birds suspended by hocks	2.72	36.8
Transfer birds directly from picking to eviscerating line		
From neck to hock suspension	3.93	25.4
From neck to neck suspension	3.91	25.6
Transfer birds from belt or table top to eviscerating line		
Hang birds by hocks	2.91	34.4
Hang birds by neck	3.26	31.0
Place birds in 3-point suspension		
Three-pointing when birds hang by neck	3.62	27.6
Three-pointing when birds hang by hocks	2.76	36.2
Open birds (tail cut)		
Slicing cut with 5''–6'' knife blade	2.22	45.0
Stabbing cut with point of knife 5''–6'' blade	3.49	28.7
Stabbing cut with point of knife 1½''–2'' blade	2.58	38.8
Remove vent		
With knife before abdomen cut	5.18	19.3
With scissors after abdomen cut	4.63	21.6
Abdomen incision (with scissors)		
Before removing vent	2.73	36.6
After removing vent	2.51	39.8
Combination cut: Open birds and remove vent		
Birds on 2-point suspension	6.78	14.7
Birds on 3-point suspension	5.98	16.7
Combination cut: Abdomen incision and vent removal cut		
Birds on 2-point suspension	6.39	15.6
Birds on 3-point suspension	5.59	17.9
Draw viscera		
Birds on 2- or 3-point suspension	7.30	13.7
Trim hearts and livers		
Pull heart from viscera, wash, and trim	3.91	25.6
Snip heart from viscera, wash, and trim	4.58	21.8
Pinch liver from viscera and wash	4.41	22.7
Snip heart and liver from viscera, wash, and trim	7.02	14.2
Trim, open, and wash gizzards		
Using scissors to open gizzards manually	8.56	11.7
Using automatic gizzard splitter-washer	4.31	23.2
Peel gizzards		
Using automatic ejecting peeler	1.87	53.5
Using manual ejecting peeler, hand split gizzards	2.62	38.2
Using manual ejecting peeler, machine split gizzards	3.33	30.0
Remove lungs and reproductive organs		
Hand rake	5.61	17.8
Vacuum nozzle, open-flow type	4.66	21.5
Vacuum nozzle, cutoff-valve type	4.01	24.9
Snip neck vertebrae		
Using manual snips	2.70	30.0
Remove crop and windpipe		
Through opening left by severing vertebrae	4.75	21.1
Through slit in neck skin	6.96	14.4
Wrap and stuff giblets		
Giblets stuffed into warm birds	7.26	13.8
Giblets stuffed into chilled birds	7.79	12.8

[1] Personal allowance is not included, since all case-study plants provided rest periods and on-the-line relief as necessary; includes a 5 percent fatigue allowance for all operations.

[2] These production rates are considered normal in that an operator with average skill can maintain the rates consistently while rendering acceptable workmanship.

TABLE 25.—*Ownership and operating costs for one unit each of various types of eviscerating equipment in poultry processing plants*

Item	Unit [1]	Initial cost [2]	Ownership cost: Expected life	Ownership cost: Depreciation [3]	Ownership cost: Interest [4]	Ownership cost: Insurance and taxes [5]	Ownership cost: Total	Operating cost: Power [6]	Operating cost: Maintenance	Operating cost: Total	Total: Annual cost	Total: Cost per hour [7]
		Dollars	*Years*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Bird washer (inside and outside):												
Single line	1	1,166.00	10	116.60	29.15	46.64	192.39	-----	[10] 23.32	23.32	215.71	.11
Double line	1	1,231.36	10	123.14	30.78	49.25	203.17	-----	[10] 24.63	24.63	227.80	.11
Catwalk, 18″ width	1	10.33	10	1.03	.25	.41	1.69	-----	[10] .21	.21	1.90	-----
Cleanup equipment, hot-water type	1	355.68	5	71.14	8.89	14.23	94.26	-----	[11] 28.45	28.45	122.71	.06
Conveyor, eviscerating with shackles on 6″ centers:												
Single track	100′ section	[8] 1,962.22	[9]	331.46	49.05	78.48	459.00	11.11	[11] 156.27	168.08	627.09	.31
Dual tracks	100′ section	[8] 3,547.76	[9]	625.14	88.68	141.90	855.72	22.22	[11] 283.82	306.04	1,161.78	.58
Single track, dual shackles (equivalent to 2 lines).	100′ section	[8] 2,725.00	[9]	436.46	68.12	109.00	613.58	11.11	[11] 218.00	229.11	842.69	.42
Flume, giblet	10′ section	95.40	10	9.54	2.39	3.82	15.75	-----	[10] 1.91	1.91	17.66	.01
Giblet wrapping table (10′ long)	1	2,142.96	10	214.30	53.57	85.72	353.59	10.00	[11] 171.44	181.44	535.03	.27
Gizzard peeler:												
Manual ejecting	1	667.80	3	222.60	16.70	26.71	266.01	20.00	[11] 54.42	73.42	339.43	.17
Automatic ejecting	1	694.30	3	231.43	17.36	27.77	276.56	20.00	[11] 55.54	75.54	352.10	.18
Gizzard splitter, mechanical	1	3,339.00	3	1,113.00	83.48	133.56	1,330.04	50.00	[11] 267.12	317.12	1,647.16	.82
Gizzard washer, mechanical	1	141.32	3	47.11	3.53	5.65	56.29	10.00	[11] 11.31	21.31	77.60	.04
Head cutter, mechanical:												
Single line	1	1,729.56	3	576.52	43.24	69.18	688.94	30.00	[11] 138.36	168.36	857.30	.43
Double line	1	2,856.70	3	952.23	71.42	114.27	1,137.92	60.00	[11] 228.54	288.54	1,426.46	.71
Knives:												
6″ blade	dozen	21.20	¼	84.80	1.07	.85	86.72	-----	[12] 150.00	150.00	236.72	.12
5″ blade	dozen	12.86	¼	51.44	.64	.51	52.59	-----	[12] 150.00	150.00	202.59	.10
Knife holder	1	6.86	10	.69	.17	.27	1.13	-----	[10] .14	.14	1.27	-----
Lung removal equipment:												
Hand rake	dozen	24.00	1	24.00	1.20	.96	26.16	-----	[10] .48	.48	26.64	.01
Vacuum system (4 nozzles)	1	4,611.00	5	922.20	115.28	184.44	1,122.92	600.00	[11] 368.88	968.88	2,190.80	1.10
Neck cutter, mechanical	1	3,704.70	3	1,234.90	92.62	148.19	1,475.71	20.00	[11] 296.38	316.38	1,792.09	.90
Scissors, curved blade	dozen	50.50	1/12	606.00	2.53	2.02	610.55	-----	[12] 150.00	150.00	760.55	.38
Scissors, 6″	dozen	40.75	¼	163.00	2.04	1.63	166.67	-----	[12] 150.00	150.00	316.67	.16
Sharpener:												
Mechanical	1	145.04	5	29.01	3.63	5.80	38.44	.20	[11] 11.60	31.60	70.04	.04
"Steel"	1	3.50	1	3.50	.18	.14	3.82	-----	[10] .07	.07	3.89	-----
Shears, neck cutting	dozen	27.00	1/12	324.00	1.35	1.08	326.43	-----	[12] 150.00	150.00	476.43	.24
Trough, waste disposal (35″ width)	10′ section	253.40	10	25.34	6.34	10.14	41.82	-----	[10] 5.07	5.07	46.89	.02
Trough components:												
Downspout with end	1	48.76	10	4.88	1.22	1.95	8.05	-----	[10] .98	.98	9.03	-----
Gizzard removal and trim station	1	45.58	3	15.19	1.19	1.82	18.20	-----	[10] .91	.91	19.11	.01
Hand-wash station	1	9.94	5	1.99	.25	.40	2.64	-----	[11] .80	.80	3.44	-----
Heart and liver removal and trim station.	1	40.28	3	13.43	1.01	1.61	16.05	-----	[10] .81	.81	16.86	.01
Inspection station	1	329.00	10	32.90	8.23	13.16	54.29	-----	[10] 6.58	6.58	60.87	.03
Trough end section	1	7.42	10	.74	.19	.30	1.23	-----	[10] .15	.15	1.38	-----
Trough legs	1 pair	14.84	10	1.48	.37	.59	2.44	-----	[10] .30	.30	2.74	-----

[1] Based on most common sale unit. [2] Includes installation cost, estimated at 6% of the initial cost. [3] Straight-line depreciation for the number of years shown. [4] 5 percent of average investment (computed at 50 percent of initial investment). [5] 4% of initial investment. [6] Estimated at $0.02 per KWH. [7] Based on 2,000 hours operation per year. [8] Single track at $19.62 per ft., dual track at $17.74 per ft. of each track, and single track dual shackles at $27.25 per ft. [9] Estimated life of trolleys 3 years, shackle chains and cables 5 years, all other components 10 years. [10] Based on an estimated 2% of initial cost. [11] Based on an estimated 8% of initial cost. [12] Estimated at 100 hours per year per dozen sharpened.

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