

New Technology In Poultry Processing Techniques

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INTRODUCTION

Poultry consumption worldwide continues to increase yearly. In the USA, per-capita figures have passed the 100-lb. mark for all types of poultry products produced. It is forecast that production and consumption will continue to increase throughout the foreseeable future. This presentation gives an indication of the efforts being made by manufacturers and processors, not only to meet the increasing demands of the marketplace, but also to comply with and assist in the implementation of the proposed rules on pathogen reduction and HACCP systems.

No one segment of the food chain is responsible for total food safety, but we within the manufacturing side of the industry, continue daily to strive for new and improved systems to endeavor to reach the goals recommended.

This presentation covers the following systems, which have been developed to reduce contamination, reduce handling of the product, and to increase line speeds.

1. Maestro Automated Eviscerating System for Broiler Carcasses.
2. Automated Giblet Harvesting
3. Automated Turkey Evisceration
4. Cut-up and Deboning Technology
5. Complete Hands-off Processing and Inspection Procedures (Future Development)

MAESTRO AUTOMATED EVISCERATING SYSTEM

In today's highly automated chicken eviscerating system, *E Coli* and other types of bacteria are relevant. Fecal contamination is also amongst the major contributors to downgrading, reprocessing condemnation.

Using the philosophy that prevention is better than the cure, the Maestro Eviscerating System has been introduced in Europe and is now being introduced in North America.

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The System is made up of the following components.

1. Maestro Eviscerator
2. Viscera Package Holding Assembly
3. Pan Conveyor with liver and heart transport
4. Fully Automatic Giblet Harvesting System

Separation of the carcass and viscera is as follows:

The bird enters the first stage of the system. A hinged bracket (spoon) enters the cavity, surrounds and then captures the viscera below the crop and above the *proventriculus*. Due to the design of the bracket, broken ribs and liver damage are a thing of the past.

Working on a cam mechanism, the hinged bracket lifts and separates the viscera from the bird and transfers it to the package holding unit. The bird carcass goes in one direction and the viscera another, to meet up in sequence prior to inspection.

The viscera package, held securely in the holding unit, is transferred automatically to a pan conveyor. This continuous pan conveyor is designed to travel in synchronization with the overhead conveyor holding the corresponding bird. Relationship of the bird to the correct viscera package is 100% effective. The positioning of the viscera in the pan eliminates the need for two or three viscera presentors prior to inspection.

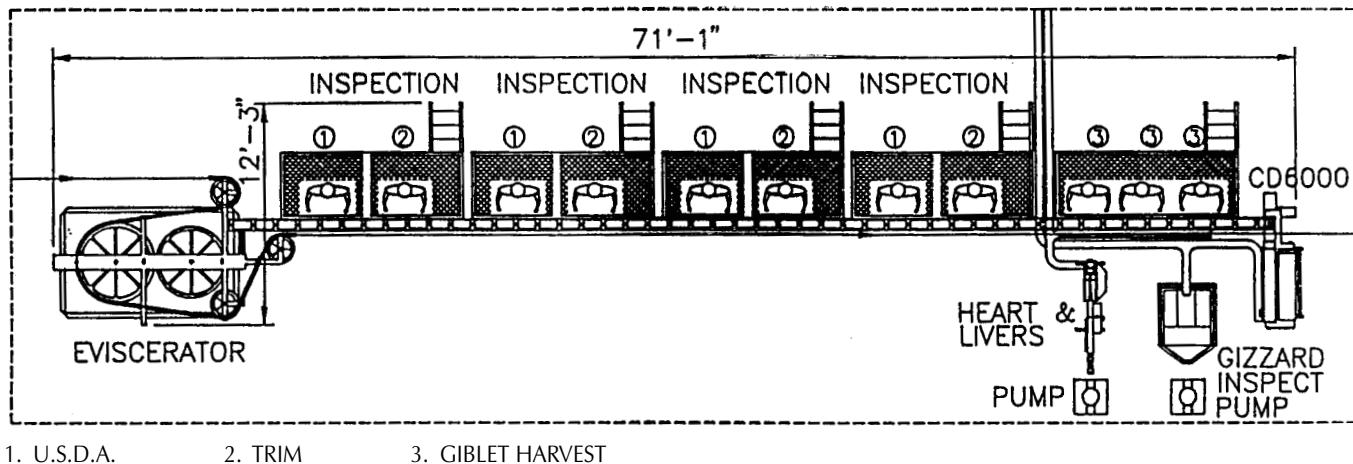
FULLY AUTOMATED GIBLET HARVESTING

A giblet harvesting system available for the MAESTRO automatically separates the edible organs from the inedible portions of the viscera package. Following inspection of the giblet packages, the entrails in each of the individual pans are dropped into a single automatic-indexing edible-organ harvesting machine. This machine works in 3 phases:

- Heart and Lung Separation
- Gizzard Separation
- Liver Separation

Within the machine, the heart and lungs are automatically separated and distributed into a heart and lung separating machine. The lungs are separated and collected by floatation and the hearts are transported to a heart-inspection area where the heart caps are removed and then pumped to a designated giblet chilling area.

Figure 1. MEYN Automated Eviscerating System
Capacity: 140 B.P.M. Line Speed: 70 B.P.M.



1. U.S.D.A. 2. TRIM 3. GIBLET HARVEST

The gizzard, with the complete *proventirculus* attached, is separated next and then automatically deposited into a gizzard-harvesting machine. The final process of the fully-automated harvesting system separates the liver from the remaining viscera package. Following this separation, the livers are transferred to an inspection area, then pumped to a designated chilling area. The inedible portion of the viscera package is simply released from the machine and taken away through wet or dry offal transportation means.

AUTOMATION IN THE TURKEY INDUSTRY

Turkeys have always presented a problem in the evisceration area because of their size. Manual handling of the product has continually caused cross-contamination, and a percentage of downgrading.

Human hands are probably one of the main sources of microbes on the product. It is not unusual for at least 70% of the operators' hands to contain *E Coli* and other forms of bacteria.

We have developed a complete line of automated eviscerating equipment for the turkey industry. Some of this equipment has already received USDA approval, and we are actively pursuing the introduction of other equipment to facilitate and implement a completely automated system.

The system includes the following equipment.

1. Automatic Fecal Remover
2. Automatic Vent Cutter
3. Automatic Three Point Suspension
4. Automatic Opening Machine
5. Automatic Eviscerator
6. Cropping Machine
7. Automatic Lung Remover
8. Automatic Neck Remover
9. Automatic Inside/Outside Bird Washing

Also under development are:

- Automated Breast and Thigh Deboning
- Bone Detection
- Computer Imaging

HANDS-ON PROCESSING AND INSPECTION PROCEDURES

Temperature, time and hands all contribute to the growth of microbes on the product. Under optimum temperatures, bacteria can reproduce and double in numbers in as little as 17 minutes. At present line speeds of up to 91 BPM, hot birds can be on an eviscerating line between 10 and 15 minutes, not counting any line stoppage by USDA.

It is essential that the carcass remains and moves on the line as fast as possible until it reaches the chilling medium, where the body heat can be removed as quickly as possible to reduce bacteria growth. Hands-off processing and inspection procedures would greatly assist in the reduction of the micro load on the product.

Another area of consideration in reducing bacteriological contamination would be to trim the carcass of the bird post-chilling. Opening up and cutting into the carcass creates greater possibilities of cross-contamination, while the bird with the skin intact creates a greater barrier to bacteria growth.

Technology is now available to allow processors to defeather, eviscerate and chill a poultry carcass without touching the outside of the product. Automatic transfer from one line to another is now routine. Identification of downgraded product and the removal of the carcass from the line automatically is also now available.

Vision grading will be available within the next year to assist with in-plant inspection. Automated reprocessing can also assist in reducing the handling of the product. Finally, all plants in the USA are using some form of water-chilling to reduce temperatures to below 40°F.

Consideration should be given to using some form of air and water spray medium to achieve temperature reduction. Using this form of temperature reduction, processors may go a long way in achieving zero defects in their processing plant.

Figure 2. MAESTRO.

Summary

1. Complete Removal of Viscera Package
2. Capacities up to 140 Birds Per Minute
3. Fully Automatic Giblet Harvesting
4. 99%+ Eviscerating Performance
5. Hands-Off Inspection
6. Contamination Virtually Eliminated
(Entrails do not come in contact with birds)
7. Weight Range Variance from 3.0 to 6.5 lbs.
(Without changing eviscerating brackets)
8. Labor Savings of 4 or More People Per Shift, at 91 BPM
9. High Durability and Low Maintenance

Figure 5. Opening Machine.

- Very simple design.
- Enlarges opening so viscera package can be taken out.
- Cut is made from original opening where vent was cut to the keel bone.
- Opening arm designed so that two separable halves make the cut. One half holds against the back of the bird, and the second makes the actual cut. The ball on the arm holds the intestines down out of the way while the cut is being made.
- Capacity: 10 units – 50 birds per minute.
- Labor Savings: 1 person.
- Performance Efficiency: 97%-98%.

Figure 3. Head Conveyor

- The easiest way to eviscerate a turkey is horizontally.
- Was developed to save labor and automatically position bird for evisceration and inspection.
- Is adjustable in height by means of a hydraulic hand pump and is equipped with a Variable-Speed Drive.
- Can be made in any length.
- A Head Cutter can be installed at the end of the conveyor.
- Automatically returns bird to two-point suspension at the end of the conveyor.

Figure 4. Vent Cutter

- Designed to avoid damage to intestines.
- Uniquely designed Conical Pin that positions itself in the center of the vent.
- The vent is clamped between the pin and disc and pulled upward. This is to avoid intestine damage and prevents the vent from rotating with the circular blade. Air-operated circular blades then cut the vent and the *Pursa of Fabricius*.
- The vent is then placed over the back of the bird.
- Birds should be off feed 6 hours.
- Intestinal damage: Less than 5%.
- Capacity: 10 units – 50 birds per minute.
- Labor Savings: 3 people.
- Performance Efficiency: 94% - 96%.

Figure 6. Eviscerating Machine.

- Automatically removes the viscera from the cavity of the bird.
- Uses a specially-designed spoon that when inserted in the body cavity of the bird, gently removes the entire viscera package.
- Biggest advantage to eviscerating in the horizontal position is the ease with which the spoon can go inside the bird, without any force and without damaging the viscera, which could cause fecal contamination.
- This is an in-line machine, processing 6 birds at a time.
- Capacity: 50 birds per minute.
- Labor Savings: 3 people.
- Performance Criteria: 85%-95%.

Figure 7. Cropping Machine.

- Automatically removes the crops and windpipes. The neckskin should not be cut or the neck broken. By means of a rotating probe, the crops/windpipes are pushed out through the neck and thoroughly cleaned by two rotating brushes. During cleaning, the rotation direction of the units changes, in order to get a cleaner result.
- Cropping units are available in several diameters and are quickly interchangeable.
- Capacity: 50 birds per minute.
- Additional advantage of the cropper is that the units break the membranes.
- Performance Criteria: 8 lb-26lb: 85%-95%.
26 lb-35 lb: 75%-78%.
- Labor Savings: 2 people.

Figure 8. Lung Remover.

- Automatically removes the lungs, by means of vacuum. The unique point is that the units are provided with (2) independent suction pipes, which give a better result, especially on turkeys.
- Another advantage: When a shackle passes the machine without a turkey, no vacuum comes on, thus preventing vacuum dips.
- Labor Savings: 2 people.
- Capacity: 50 birds per minute.
- Performance Criteria: 70%-75% Toms*
80%-85% Hens*

*These percentages are without use of an eviscerator or cropping machine.

Figure 9. Automatic Neckbreaker.

- Has double-sided blocks, which ensures that the necks are broken at the desired place. Wing damage is eliminated.
- After breaking, the neck is removed by the machine as well.
- As a back-up, a Neckpuller is provided to make sure the necks are removed.
- A Neckskin Trimmer is usually installed after the Neckbreaker, for cutting any remaining skin.
- Capacity: 50 birds per minute.
- Performance Criteria: 97%-99%.

Figure 10. Inside/Outside Birdwasher.

- Automatically washes the inside and outside of the turkey. The machine uses a rotating nozzle that not only cleans the bird, but pierces through the membrane at the throat, so the water drains out.
- Used in combination with a Lung Removal Machine, virtually all lung fragments are removed from the bird.
- Capacity: 50 birds per minute.
- Performance Criteria: 99%.
- Lung Removal %, After Washer: 95+% Hens
85+% Toms

Figure 11. Vision Grading.

- Ability to identify the parts missing, bruised or discoloration on the bird.
- Ability to then identify that bird, and after weighing, drop into the appropriate packing area.
- Different cut-up parts can also be distinguished, and then put into different packing bins by belt grading.
- Software is basically written through the establishment of a library. After the library is filled with what the computer needs and a database is formed, then it can select the appropriate grade the bird falls into by historical data.
- To work on our packing lines, two-legged weighing shackles have to be used with cameras looking at both the front end and the back of the bird.

Figure 12. 2nd Generation Deboning: Labor Reduction in Trimmers/Inspectors.**A. White Meat**

1. Automatic Breast Fillet Machine
2. Bone Detectors
3. Computer Imaging Trimming/Bone Removal

B. Dark Meat

1. Thigh Deboning
2. Drumstick Deboning
3. Whole Leg Deboning

Bone Detectors:

Current design uses the software of change in density. New software being written will use the "Pattern Recognition" concept. This eliminates the thin/thick dilemma that is common in chicken meat.

Software packages then can be linked to a 3-D cutter that has the capability of removing the bone precisely when the bone detector has identified where the hidden bone is.

Computer Imaging:

Being able to take the product apart in grids and remove sections or trim fat, big labor savings.

Figure 13. Line Transportation.

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|------------------------|---------------------------|
| 1. Hanging on Ev. Line | 10. Neck-Breaker |
| 2. Ventcutter | 11. Neck-Peeler |
| 3. Opening Machine | 12. Neck-Washer |
| 4. Head Conveyor | 13. Neck-Skin-Trimmer |
| 5. Eviscerator | 14. Lung-Remover |
| 6. Inspection | 15. Inside/Outside Washer |
| 7. Trim | 16. Bird Unloader |
| 8. Evisceration Trough | 17. Shackle Washer |
| 9. Cropping Machine | 18. Head Conveyor |

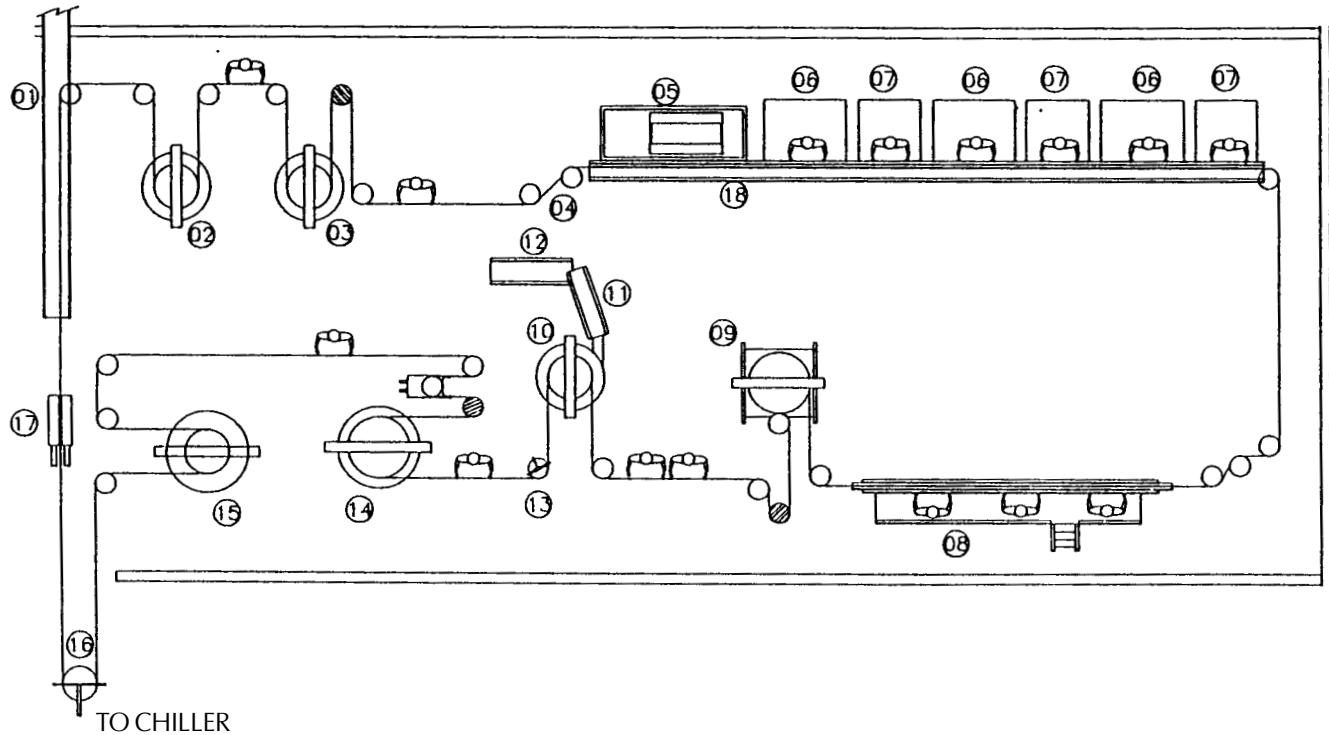


Figure 14. 51 B.P.M. Automatic Turkey Staffing Specifications

	Current	Automated
Vent	3	—
Opener	2	1
Draw	4	1
G. Harvester	9	4
Cropper	4	2
F.I.M.	4	2
Neckbreaker	2	1
In/Out Washer	—	—
	28	11

Average Savings: 17 people or 34 people double shift

Based On:

\$18,000/year earnings x 34 people =
\$612,000 Annual Savings