Meat & Meat Products Processing Level II

Based on May 2011, Version 2 Occupational standards

Module Title: - Operating Leg Boning Machine

LG Code: IND MPP2 M 10 0920 LO (1-3) LG (37-39)
TTLM Code: IND MPP2 TTLM 09 20 v 1

October, 2020

United Nations
Educational, Scientific and
Cultural Organization

Table of Contents

LG #37	LO #1- Perform preparatory cuts

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Selecting Legs for de-boning.
- Inspecting Legs for defects and trim or dispose.
- Make Preparatory cuts prior to mechanical boning.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Select Legs for de-boning.
- Inspect Legs for defects and trim or dispose.
- Make Preparatory cuts prior to mechanical boning.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Selecting Legs for de-boning.

1.1. Introduction

The primary weapon in reducing bacterial contamination of carcasses is employing effective sanitary dressing procedures during slaughter. There is no substitute for trying to keep bacteria off the carcass in the first place. Workers should know, understand and use the recommended sanitary dressing techniques in whatever slaughter method is used.

Carcass Wash

- As usual part of the slaughter process to remove bone dust and other material from trimmed carcasses. It will also remove bacteria.
- Recommend that a warm carcass wash be used (90-120 ^{o}F). This will more effectively remove debris from the carcass.
- Careful not to allow spray from the carcass being washed to contact previously washed carcasses.
- Since this is a usual part of slaughter, it is not usually regarded as an intervention, but an important part of carcass dressing and preparing the carcass for other interventions.

1.2. Preparation of meat for deboning

After carcass including leg are washed and sanitized with chlorine labeled “inspected and passed”. They are then kept in the chillers at 0-4 °C for 24 hours. After chilling, the meat is deboned in the deboning hall where all the lymph glands and connective tissues are removed. The next processing task is to take the full carcass and cut it into three primal pieces the forequarter, middle, and hind legs. The forequarter is separated by a planar cut between the ribs and must provide a specified number of ribs in the forequarter, or leave a specified number of ribs in the middle. Each carcass will have a different height and pitch angle for the cut. The middle can be separated in various ways, but all involve a horizontal cut at a height based on the location of the aitch bone (pelvis) of the carcass. The legs are separated manually or mechanically from another carcass. The separated

leg is then taken also by manually or mechanically to deboning room where temperature is maintained at 12°C up to 15°C.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (5 point)

1. Which one is appropriate temperature for deboning hall?
   a. 12°C up to 15°C.
   b. 25^{o}c
   c. 30^{o}c
   d. None

2. The chilling temperature of meat is ----------°C for 24 hours

a. 0-10

b. 10-15

c. 15-20

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Information Sheet 2- Inspecting legs for defects

2.1. Introduction

Production requirements-

Product characteristics: Typical product information such as

- Quantities to be produced
- Number of steps
- Number of alternatives.

Descriptions of apparatuses:

- Information about size
- Type and category of apparatuses.

Inspection is mandatory and has the mission of assuring wholesomeness, safety, and accurate labeling of the meat supply. Although inspection procedures vary from country to country, they are centered around the same basic principles and may be performed by government officials, veterinarians, or plant personnel.

The incidence of surface contamination and body defects causes a substantial financial burden to the meat industry. The slaughtering process is the critical stage where most initial contamination of meat occurs. The situation is similar for cattle and sheep, particularly involving materials such as faeces and ingesta. Note that there are two issues with faeces: the inevitable occurrence on the hide, and spillage during slaughter.

The quality of a carcass from a contamination point of view depends much on the skill and work ethic of the slaughtermen, particularly those involved with hide preparation and removal; as well as the diligence of the inspection personnel. Also, the trimmers have a responsibility to ensure the work they do is of an appropriate standard, i.e. removing all suspect material whilst minimizing the spread of contamination. Supervisors have a part to play in ensuring that the processors documented “best practice” procedures are being followed at all times

Inspecting is the process of checking any foreign or un wanted things that may happen on in meats including legs. Defect trimming is required for the removal of materials such as meat bruises and fractured bones. This type of defect is generally not within the control of slaughter operations, and its occurrence does not appear to be recorded or quantified.

During inspection, precautions must be taken to ensure that contamination of the meat by actions such as palpation, cutting or incision is kept to a minimum. Minimal handling of the carcass should take place. Moreover, depending on the result of inspection the leg is passed or failed to the next process that means preparatory cuts.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: say true if the statement is and false if statement is false (3 point)

1. Inspection is mandatory and has the mission of assuring wholesomeness and safety of the meat.
2. The incidence of surface contamination and body defects causes a substantial financial burden to the meat industry.
3. Inspecting is the process of checking any foreign or un wanted things that may happen on legs.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet 3- Make Preparatory cuts prior to mechanical boning.

Mechanically deboned meat (MDPM) and mechanically separated meat are terms used to describe meat that remains on the bones of a carcass after hand trimming, that is removed using deboning machines. In the mechanical deboning process, bones and attached meat are ground up and fed into special deboning machines.

Preparatory cut is taking place after selecting, inspecting and trimming leg. Preparatory cut is cutting of legs to fit the designed machine that means to attach the legs to machine which remove the meat from the bone.

The legs are supplied in crates, cartons or separated onto a conveyor belt directly from the cut-up line. Subsequently, the legs are manually precut by two operators and transported to the loading operator. An automatic whole leg pre-cutter is available. loading operators take the legs and place them on the product carriers, which slowly pass by in front of him. Next, the product carrier takes the legs through a sequence of automated deboning steps and Fixating the leg to machine.

The fully-automated deboning process requires raw material to be suspended by the hock from a clamper. Peripheral cutting by a round cutter at right angles toward the hind shank bone is first carried out at a position just below the hock and a meat separator having a pair of plates similar in shape to the hind shank bone pinches the hind shank bone at the peripheral cutting position. From this spot the raw material is lifted upward against the resistance of the meat pinching separator, stripping the hind shank muscle away. The mechanical deboning procedure then proceeds to the following work stations, alternately repeating the cutting and ripping procedure several times.

Peripheral cutting around ankle- a round cutter is used to make a peripheral cut around the ankle directly below the clamper. This work station is composed of a cutter unit and a rotation unit. Peripheral cutting is carried out around the ankle, however, the hind shank bone is composed of a combination of tibia bone and splint bone, so the sectional view is

quite complex. Especially, it is difficult to rip off muscle between the two (2) bones using the two (2) meat separation plates without leaving a considerable quantity of meat.

It is therefore necessary to use a small round cutter which is small in diameter to ensure appropriate peripheral cutting around the complicated sectional plane of the hind shank bone.

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: say true if statement is true and false if statement is false. (2 pts)

1. Preparatory cut is taking place after selecting, inspecting and trimming leg
2. Preparatory cut is cutting of legs to fit the designed machine.

Test II: Give short answer

1. Notify how to carry out peripheral cutting. (2 pts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

LG #38	LO #2- Prepare and maintain boning machinery

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Performing routine checks and maintenance
- Reporting faulty or out-of-specification performance of machinery
- Operating Mechanical boner

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Perform routine checks and maintenance
- Report faulty or out-of-specification performance of machinery
- Operate Mechanical boner

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets”.
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Performing routine checks and maintenance

1.1. Introduction

In meat industry machine and equipments that are not kept in good repair and condition are a potential source of microbiological and physical contamination of meat as well as reduce the longevity of the machine. Poorly maintained machineries and equipment cannot be cleaned effectively. Poor maintenance may allow the entry of other sources of physical, microbiological and chemical contaminants such as water, pests and dust.

When developing maintenance and repair programs, refer to the manufacturer's instructions.

Maintenance and repair program should specify:

- where servicing is needed?
- how much servicing is needed?
- what type of servicing is needed?
- how often it needs to be serviced
- who is responsible for maintaining repair and maintenance programs?
- how defects will be fixed?
- what standards are used for performance testing and evaluation?

Table 1.1. Maintenance check list

Machine	Result of checks		Notes (added to maintenance plan)
	Week 1	Week 2	
Leg deboning machine			

Table 1.2. Maintenance plan

Plan of year----------				
Machine	Wok required	Planed date	Date complete	Signed

1.2. legbone machine maintenance tips

Proper maintenance helps ensure the longevity of equipment.

When it comes to debone machine tools, it's extremely important to perform the proper maintenance on them in order to ensure its longevity. Whether it's the maintenance on operational components or specific attachments, the importance of routine check-ups cannot be stressed enough. The last thing that you want to have happen is a machine breakdown because of improper maintenance. In order to properly conduct a maintenance check-up, here are some steps that should be followed:

Check the lubrication: For debone machine tools that are frequently used, it's extremely important to inspect the machine's lubrication levels on a weekly basis. By ensuring that the moving parts are properly lubricated, you will be able to protect the motor over an extended period of time. This includes greasing of moving parts, oiling or internal moving components and visual inspection of all part movement in action. Without the right amount of oil, grease or other lubricant, any machine tool could face unnecessary wear and tear. This could lead to breaking downs or extreme damage.

Sharpen important components: If you are using machinery that has components designed for sharpening, cutting, slicing or chopping, you need to ensure that these components maintain their sharpness. If you don't perform routine maintenance on specific parts that need to sustain a particular sharpness, you could be putting production quality at a very high risk. The sharpness of a machine part is important because you need to make sure that cut materials are shaped correctly and accurately. This could

include checking the sharpness of tools like end bills, drill bits, lathe tools and precision cutters.

Check alignment specifications: The last thing that you want when it comes to your machine tool is to have a particular component or attachment out of alignment. This could greatly affect your work quality in a very negative way. To determine if your machine tool is properly aligned, simply perform a few test jobs and measure the resulting parts to inspect how the equipment is currently working. If the alignment is off, you will need to realign the machine in order to maintain accurate specifications.

Inspect the cleanliness: Although this is somewhat obvious, you need to make sure that your machine is cleaned on a regular basis. By cleaning various pieces of equipment either daily or weekly, you will ensure that a machine is running at maximum capacity. The cleanliness of a machine can often be taken for granted and overlooked when it comes to specific parts breaking down. For example, when a machine collects a lot of grime or begins to rust, long-term problems can start to appear.

Take good care of accessories and parts: In order to properly maintain bone machine tool, it's very important to perform routine maintenance checks on all of your components and accessories. An important part of this preventative care is to make sure that all of bone machine parts and accessories are handled and stored responsibly. You definitely don't want to be careless with any part of machine tool. Common sense plays a major role here. Use all of senses to detect potential problems. An odd sound, a strange smell or unordinary vibration can mean trouble. All things that can be more easily taken care of when detected early on. Keeping a checklist and carefully logging all maintenance performed will optimize this process.

Processing plants undergo a daily routine of cleaning and disinfection together with equipment repairs after normal operations have been discontinued. During this span, the risk for injury can increase, particularly with both functions operating at the same time. Repair personnel need photo to have equipment locked out and guards removed while they make repairs, while sanitation personnel may need equipment running to more thoroughly clean various moving mechanisms. Furthermore, sanitation personnel, frequently use temporary perches (such as ladders or equipment ledges) to gain a

cleaning angle needed to hose down a device, which increases the risk of falls. In response to these and other unique challenges the industry has assembled training materials that discuss the unique risks poised by third shift sanitation and maintenance and proper safety protocols to use to minimize that risk.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (1 point).

1. Poor machine maintenance allows the entry of physical, microbiological and chemical contaminants such as water.

Test II. Give short answer (3 pts)

1. List steps to conduct a maintenance check-up.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

Information Sheet 2- Reporting faulty or out-of-specification performance of machinery.

2.1. Measure machinery performance

Performance- A machine's performance score compares the number of units it produces per hour with the ideal production rate it would meet if it ran at its maximum rated speed at all times. So, a score of 100 per cent means that the machine is running as fast as possible.

Quality- Another factor affecting productivity is material wastage and quality shortfalls. Rejected materials, factory seconds and products that need to be reworked after production can negatively affect a business' productivity.

2.2. Types of machinery failure.

Their causes and solutions are listed below.

By identifying potential causes of failure before they occur, you can save hundreds or thousands of dollars and maintain consistent work flows.

Sudden failure is when machinery breaks without warning. Usually, the reason is obvious. The part is then fixed or replaced, and the equipment is returned to service.

Intermittent failure happens sporadically. This stoppage happens randomly, and it can be difficult to identify the cause. Intermittent failure is frustrating, costly in downtime and usually can be prevented by anticipating the cause and addressing it during maintenance.

Gradual failure is entirely preventable by doing routine maintenance and inspections. Wearing parts and components are noted to be near the end of their lifespan and are replaced before failure occurs.

Moreover, while working with machine that means leg deboning machine there may be faulty or out of specification may occur some examples of faulty of legbone machine is low pulling of the meat from the leg, unload the bone, the clumper cannot carry the leg, low sharpness of the blade. This faulty may affect the quality of the meat and low

production and makes the products out of specification. Before such like risk is happened, it is recommended to make pre operational test and inspect the machine prior to actual work. If the risk my happen you have immediately report to the supervisor.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. Give short answer (4 pts)

1. List the points how to measure machine performance
2. Notify types of machine failure.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet 3- Operating Mechanical boner

3.1. Hygiene and sanitation requirements

Equipment that comes into contact with food (excluding containers and disposable packaging) needs to be constructed so that it can be kept clean, washed, disinfected and maintained in sound condition.

Before purchase and installation of equipment, the following should be carefully considered:

- Material surfaces are smooth, washable, easy to clean, corrosion-resistant, and non-toxic.
- Suitable materials are stainless steel or food grade plastics; galvanized metal is prone to corrosion and is therefore not acceptable for direct contact with exposed food.
- All parts and surfaces coming into contact with food are available for cleaning and disinfection and there is no space where materials/dirt can be trapped.
- The moving parts requiring lubrication (e.g. bearings) are away or protected from food contact surfaces (while ensuring that lubricants do not contaminate product)
- Surfaces should allow water and cleaning residues to drain away quickly;
- The location and the installation of equipment should allow all parts of the equipment and the surrounding areas to be accessible for maintenance, good hygiene practices and reliable control; fitting equipment in places where access or cleaning is difficult should be avoided.

3.2. Workplace requirements.

General safety challenges in processing operations go back many years. In response, the industry as adapted a range of safety measures to reduce the risk of injury and illness and to fully comply with federal safety statutes.

From the introduction of modern processing equipment, safety guards have been put on motor drives and sprocket wheels to prevent workers from getting hands, arms, legs,

clothing, and even hair caught in the mechanisms that can lead to cuts, fractures, amputations, and death.

Slippery floor surfaces present constant safety challenges in plants leading to sprains, fractures, bruises, and back pain. Much has been done over the years to address this challenge including the addition of grit to painted floor surfaces to provide better traction against slipping and improved shoe and boot treads that add traction when it is needed.

The use of sharp knives and scissors always presents challenges with regard to cuts, punctures, and lacerations. Protective gloves are commonly worn on the non-knife hand to help reduce accidental cuts. In addition, knife sharpening programs have been introduced to helped workers improve control over the cutting activity reducing accidental knife slips that can lead to cuts.

The industry has also incorporated confined space protocols, to prevent individuals from entering limited egress spaces without proper precautions. These precautions include the ability to support breathing in oxygen starved (or rich) and/or toxic gas (or vapor) environments and protection against being entombed by fluidized solids (such as grain) or soil (with a trench cave-in), all life-threatening experiences for both the individual entering the space and others who might be called on to attempt a rescue.

In accordance with OHS standards, plants have introduced Lock Out/Tag Out procedures to prevent the accidental startup of equipment while repairs and/or routine maintenance is being performed. Such sudden startups can lead to fractures, cuts, amputations and multiple traumatic injuries.

The industry, also has added electrical safety protocols, in accordance with general industrial safety codes, that include compliance against arc flash accidents, which can lead to severe burns and death to personnel working around high voltage switchgears and transfer stations.

Lifting assistance

3.3. Mechanical deboning machine

Carcasses from chill stock are weighed-in to the deboning hall. Upon entering the Streamline, the meat primal are distributed to workstations, based on operator availability. At the workstation the meat is deboned, trimmed, and further processed according to individual product specifications and orders.

When the meat arrives at an operator's workstation, real-time instructions become available at a deboning and trimming station terminal in front of the operator, showing the type and task to be performed. All cuts are traceable down to the specific carcass and operator.

Mechanical deboning machine- there are different types of deboning machine. The difference may be depending on the number of legs it processed per hour.

Figure 3.1. Whole poultry leg deboner machine

3.4. Poultry leg deboning

Hanging area

At the hanging area, there is sufficient space for three operators to hang whole legs. The specially developed shackle ensures easy loading to accommodate a capacity of 6,000

legs per hour (figure 3.1). Depending on the configuration, the system is suitable for only left legs, only right legs or a combination of both.

Figure 3.2. Hanging poultry leg

a. **Leg Positioning System**- Three-point detection area, checking for product, shackle height shackle position

b. X-Ray Measurement System

This patented X-ray measurement system accurately measures the position of the kneecap and the length of the drum and thigh bone. The information gathered by the X-ray is then transferred to the automatic adjusting system, ensuring a precise cut along the kneecap.

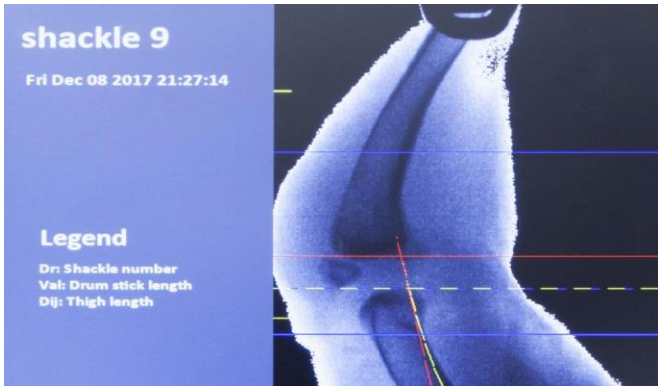

Figure 3.3. Ray Measurement System

c. **J-Cut Station-** To ensure optimal deboning, the leg must be cut along the drum and thigh bone. A specially designed unit makes a precise cut along the bone without damaging the meat or the bone. One of the most important but also labor-intensive processes to debone whole legs is to make the pre-cut (J-cut) along the drum and thigh bone. Making a proper J-cut is a critical step to ensure good yields and high-quality boneless leg meat that meets all boneless dark meat requirements. With the Automated J-Cutting Unit, all the issues with manual J-cutting are addressed making the investment in leg deboning automation even more justifiable and giving it an even faster return on investment.

d. **Drum Tendon Cutting Station**- A horizontal moving device will cut the drum tendons leaving the pin bone attached to the drum bone.

e. **Drum Scraping Unit-** the first deboning step is the deboning of the drumstick part of the leg. The deboning takes place using the specially designed scraping unit, which ensures optimal yield without damage to the meat or the bone.

f. **Knee-joint Cutting Station-** the combination of X-ray data and height adjustment allows this station to cut the tendons precisely around the kneecap, ensuring high yield and keeping the kneecap attached to the leg bone.

g. **Thigh Scraping-** by using the same scraper mechanism as used for the drum bone, this unit provides high yield with no damages to the thigh bone.

h. **Meat Cutting Station-** the meat cutting station cuts the meat just underneath the thigh bone to ensure the least possible meat remains on the bone.

i. **Bone Unloading Station-** the bone is unloaded from the shackle and returns to the hanging area to be reloaded.

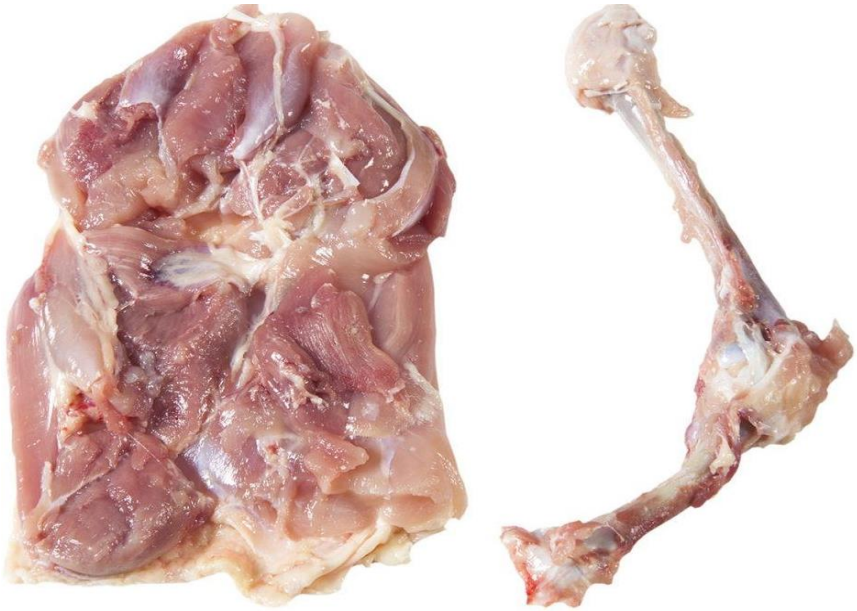

Figure 3.4. meat separated from bone

j. **Final Product-** exceptional yields; appearance of the end-product is equal or superior to manual operation, meeting the highest quality requirements for diverse food applications.

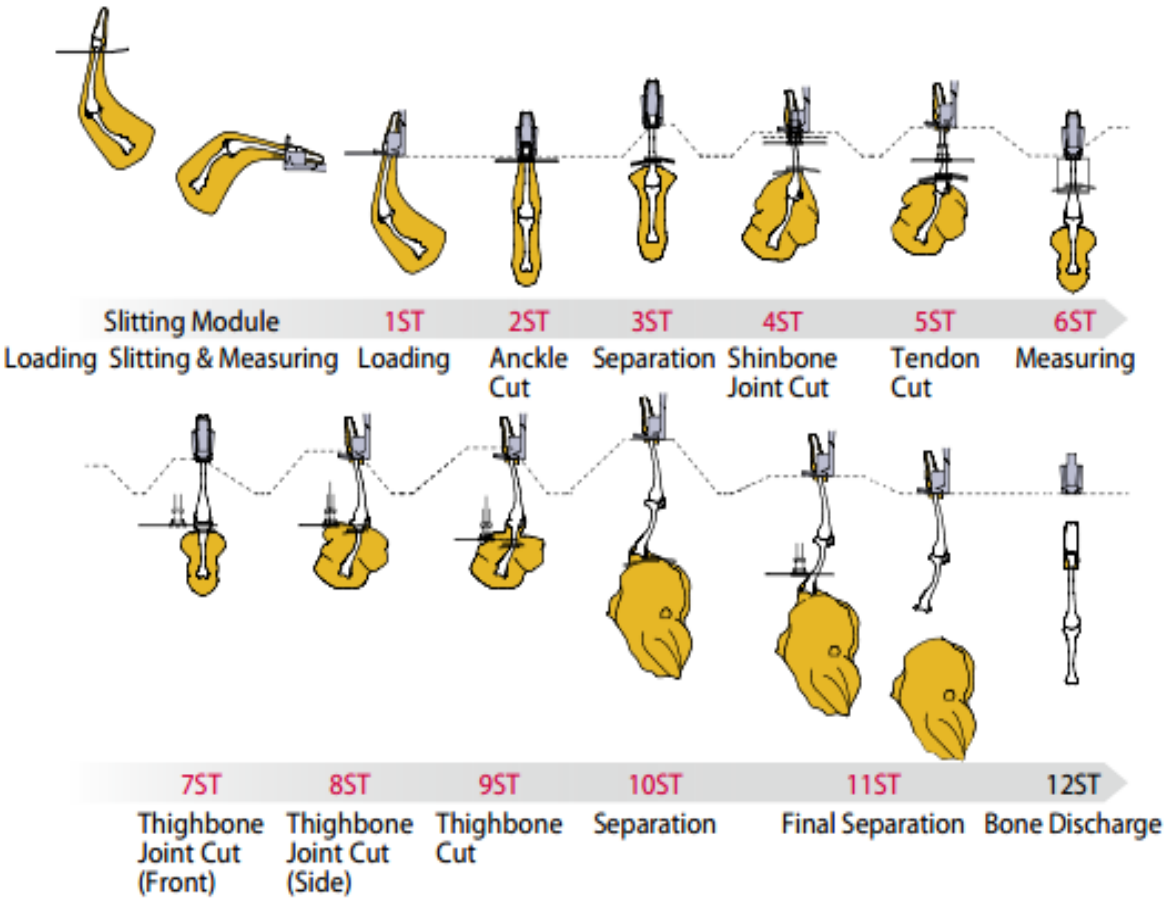

Figure 3.5. leg deboning steps image

3.5. Pig leg deboning

i) Peripheral Cutting Around Ankle

A round cutter is used to make a peripheral cut around the ankle directly below the clamper. This step is discussed in **LG#2** Information Sheet **#3-** Make Preparatory cuts prior to mechanical boning.

Automated deboning process- the following describes the detailed functions of the fully-automated deboning process for removing both hind shank bone and leg bone.

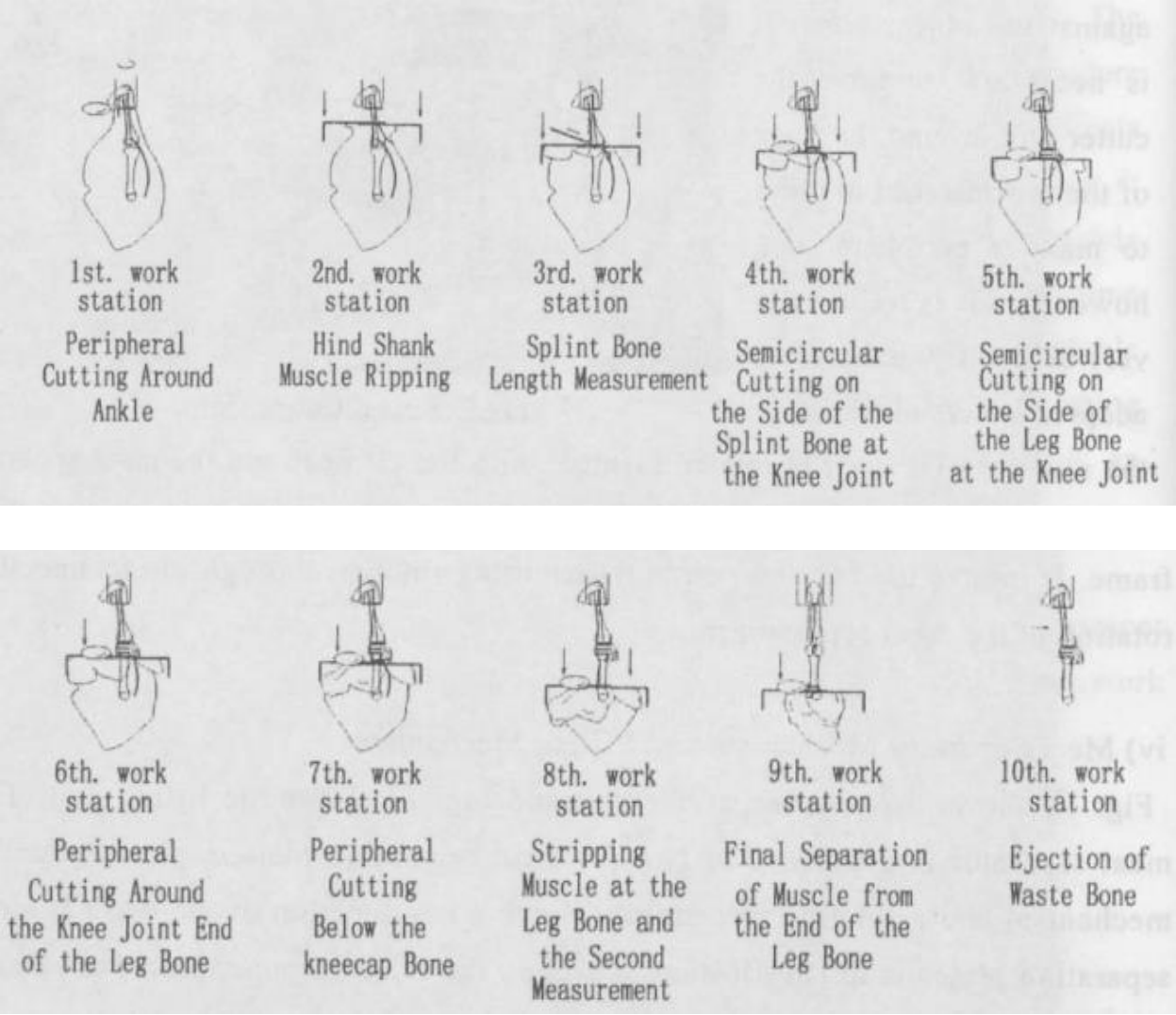

Figure 3.6. Fully-automated Deboning Process

ii) Hind Shank Muscle Ripping Procedure

This is the procedure for ripping off muscle from the hind shank bone. The work station is composed of a lifting unit and a meat separator unit. The two (2) meat separation plates pinch the hind shank bone at the point where peripheral cutting is carried out and then rip off the muscle. The meat separator rips off muscle to the empirically determined lifting high, which ends up to be just before the root of the splint bone near the knee joint. If the muscle is ripped off beyond the root of splint bone, the meat separator may damage the splint bone and the measuring device may fail to detect the end of this bone. Since each

hind shank bone has an individual deviation in length, the clamper cannot be lifted to the exactly required height without measuring the length of the splint bone. The meat separator therefore stops ripping off the muscle at the empirically determined lifting height, which never exceeds the root of the splint bone. The exact length of the splint bone is measured at the following work station. As mechanical removal of all muscle between the tibia bone and the splint bone is very difficult, there remains approximately 15 grams of muscle attached between these bones.

iii) Splint Bone Length Measurement

This work station is composed of a lifting unit, a measuring unit and a meat separator unit. The meat separator is first positioned at the position of the first cut and a measuring plate is pushed toward the surface of the splint bone. A spring-tensioned scraping plate on the meat separator removes muscle remaining on the surface of the splint bone while the measuring plate detects the shape of this bone.

The measuring plate comprises two (2) plates, one of which is a fixed plate and the other of which is movable, being connected to an encoder device which detects the recess on the bone surface based on the deviation of the two (2) plates. When a predetermined deviation from a fixed value is detected, the distance which the raw material is lifted is registered as the particular measurement of the particular raw material.

iv) Semicircular Cutting on the Side of the Splint Bone at the Knee Joint

This work station is composed of a rotation unit, a lifting unit, a meat separator unit a cutter unit. The cutting unit incorporates two round cutters in combination, which can prevent cutting too deeply into the muscle. After the meat separator pinches the hind shank bone at the first cut position, the raw material is lifted to a predetermined position and the extended sinews around the bone are cut away. This cutting is carried out in a semicircular arc so that only the tendons on the side of the joint are cut away. Since no cutting is performed on the kneecap bone, it remains intact on the knee joint. This reduces the work required in the follow-up manual trimming process.

v) Semicircular Cutting on the Side of the Leg Bone at the Knee Joint

This work station is composed of a rotation unit, a lifting unit, a meat separator unit and a cutter unit. The cutting procedure is essentially the same as that used on the side of the splint bone at the knee joint, however, the cutting device incorporates only one round cutter blade.

vi) Peripheral Cutting Around the Knee Joint End of the Leg Bone

This work station is composed of a rotation unit, a lifting unit, a meat separator unit and a cutter unit. Peripheral cutting at the knee joint end of the hind shank bone is important in exposing the root of the knee joint for the next work station. This part has a highly constricted bone from the diameter of the knee joint, causing poor muscle stripping results much like those for the meat between the tibia bone and the splint bone. Correct cutting allows for easy muscle stripping at the next work station and achieves a better yield rate.

vii) Peripheral Cutting Below the Kneecap Bone

This work station is composed of a rotation unit, a lifting unit, a meat separator unit and a cutter unit. Peripheral cutting is carried out around the leg bone to facilitate muscle stripping together with the membrane at the next work station. If peripheral cutting fails to cut the muscle together with the membrane around the bone, the yield rate as well as the quality grade of the muscle is reduced.

viii) Stripping Muscle at the Leg Bone and Second Measurement

This work station is composed of a lifting unit by means of a pneumatic cylinder, a measuring encoder and a meat separator unit. The result of the first measurement is no long reliable for determining the optimum cutting position on the leg bone so it is necessary to carry out additional measurement to establish the basic starting position. The purpose of this work station is to strip off the leg muscle, however, a fixed lifting height cannot be applied because of the significant deviation in leg bone length. Taking advantage of the muscle stripping resistance during the lifting process, the actuation of the pneumatic cylinder is stopped at a predetermined resistance Value. The measurement calculates the distance between the halted position and the bone head of the leg bone and creates a new basic value for determining the cutting position at the end of the leg bone.

lx) Final Separation of Muscle from the End of Leg Bone

This work station is composed of a lifting unit, a meat separator unit and a cutter unit. Muscle cutting is carried out at the position obtained by the second measurement. The position of the cutter is empirically calculated; however, it should be as close to the end of the leg bone as possible in order to ensure the highest yield rate. Due to the individual deviation, the cutter may come in contact with the bone and fail to cut off the muscle. In this case, additional cutting is applied with a lift of predetermined height.

x) Ejection of Waste Bone

In order to eject the waste bone from the clamper the hook is unlocked and a pusher pushes the bone out of the clamper. The waste bone then drops onto a discharge conveyor. Here, the leg bone, hind shank bone and kneecap bone are discharged from the system. Since no joint cutting is applied to the knee joint, all waste bones are connected each other as a monolithic form.

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: match the right answer from column B o A (9 point)

A

1. Leg Positioning System-
2. X-Ray Measurement System
3. J-Cut Station
4. Drum Tendon Cutting Station
5. Drum Scraping Unit
6. Knee-joint Cutting Station
7. Thigh Scraping
8. Meat Cutting Station
9. Bone Unloading Station

B

a. Shackle height shackle position
b. Ensuring a precise cut along the kneecap.
c. To ensure optimal deboning
d. A specially designed unit makes a precise cut
e. leaving the pin bone attached to the drum bone.
f. Specially designed scraping unit
g. Cut the tendons precisely around the kneecap
h. High yield with no damages to the thigh bone
i. Cuts the meat just underneath the thigh bone
j. Bone is unloaded from the shackle

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Operation sheet-1	Operate legbone machine

Deboning leg

Step 1: checking legbone machine

Step 2: Selecting leg

Step 3. Washing the leg

Step: 4 Inspecting leg

Step 5: Fixating the leg.

Step 6: Four (4) spring loaded knives cut tendons of the drum, while rotating the product.

Step 7: After cutting the tendons the drum meat is scraped downwards.

Step 8: The thigh meat is scraped in an upward motion.

Step 9: The knee joint is released from the leg fillet by a ringed shaped cutting blade.

Step 10: The processed whole leg fillet is automatically discharged.

Step 11: Finally, the leg bone is removed from the product carrier and the product carrier is ready for a new cycle.

Step 12: An inspection table, which is an option, completes the set up.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 1 hours.

Task 1. Debone using legbone machine

LG #39	LO #3- De-bone legs

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Securing Legs safely.
- Identifying and following OHS.
- Disposing Bones
- Complete Workplace housekeeping

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Secure Legs safely.
- Identify and following OHS.
- Dispose Bones
- Complete Workplace housekeeping

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Securing Legs safely.

Ejection of Bone

In order to eject the waste bone from the clamper the hook is unlocked and a pusher pushes the bone out of the clamper. The waste bone then drops onto a discharge conveyor. Here, the leg bone, hind shank bone and kneecap bone are discharged from the system. Since no joint cutting is applied to the knee joint, all waste bones are connected each other as a monolithic form. After the bone is separated from the meat the next steps are putting the meat and bone separately. The meat goes to the next process and the leg bone also collected and putted in clean bin or chute and disposed safely.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I. give short answer for the following question. (2 pts)

1. Notify how to eject bone from the deboning machine.

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Information Sheet 2- Identifying and following OHS.

2.1. The main causes of injuries within the meat sectors

The following list highlights those injuries most reported in the meat sector:

- Being struck by an object - mostly by hand tools including knives, especially during boning out, and suspended carcass,
- Handling and lifting - especially lifting heavy weights, carcass, pushing/pulling trolleys and contact with sharp edges
- Slips - mostly on wet or greasy floors
- Machinery- such as bandsaws, deriders, skinning machines, conveyors and packaging machinery.
- Transport - including lift trucks, vehicles
- Injury by an animal

2.2. Types of PPE used in the meat industry

2.2.1. Eye and Face Protection

The main types of eye and face protection are safety spectacles, goggles and face shields. Safety spectacles can be fitted with prescription lenses if required, but only offer protection to the eyes against certain types of hazard. When liquids or dust are the hazard, goggles (of which there are several categories) or a face shield will usually be required. Goggles give the eyes protection from all angles as the complete rim is in contact with the face. Face shields protect the face and most types can be worn over prescription glasses. Hazards that require eye and face protection include liquid or chemical splash, including biological agents and contaminants, working with cleaning chemicals and vapor or liquid mist and particles from high pressure cleaning tools or some types of powered cutting equipment, e.g. hand-held circular saws.

2.2.2. Hand Protection

Gloves of various designs can be providing protection against a wide range of hazards including cuts, abrasions and stabs, extremes of temperature, skin irritation and dermatitis, contact with chemicals and other hazardous substances including biological hazards.

2.2.3. Hearing Protection

Food Business Operators should provide hearing protection for visitors and ensure that it is worn in all designated ear protection areas even for short periods of exposure. The type of protection should be suitable for the level and duration of exposure.

2.2.4. Protective Footwear

The safety boot or shoe is the most common type of safety footwear. They normally have steel toe caps, but may also have other safety features including slip resistant soles, steel midsoles and insulation. Wellington boots, usually made of rubber, protect against water and wet conditions and are suitable for washing and disinfection to maintain hygienic conditions. Visitors are often provided with “slip on shoe covers” but these are not suitable if the plant has foot baths or abrasive floor surfaces. If conventional boots or shoes are provided for visitors use, it is important that a full range of sizes are provided as mis-fitted footwear can create an additional safety hazard. If the same footwear is reused for visitors it is recommended that a disposable liner is supplied.

2.2.5. Head Protection

There are several types of head protection available including industrial safety helmets or “hard hats” which protect against falling objects or impact with fixed objects, and bump caps that protect against bumping the head (eg walking into a fixed object). Bump caps do not offer adequate protection where there is a risk of falling objects or moving or suspended loads.

The key points to note are to use an adjustable chinstrap, if fitted, to ensure the helmet does not fall off, to check regularly for damage and to replace it after significant impact. The helmet should be worn properly – do not wear it back to front as protection will be greatly reduced. Visitors are often only provided with hairnets to reduce the risk of

contamination but it is important that suitable protective headwear is also provided as visitors often visit storage areas and pass under rails and conveyers.

2.2.6. Respiratory Protection

Respiratory protection equipment (RPE) is designed to protect the wearer against inhalation of hazardous substances in the workplace air. Respirators (filtering devices) use filters to remove contaminants in the air and are available with a range of different face pieces. Masks and other tight-fitting face pieces rely on having a good seal with the wearer's face in order to be effective, whilst loose fitting face pieces (e.g. hoods, ventilated visors and helmets) rely on clean air being provided to the wearer by a fan to prevent contamination leaking in.

2.2.7. Thermal Protection

Many workers in the meat industry work in temperature-controlled areas. Protective clothing and gloves play an important part in protecting the health, safety and welfare of workers at low temperatures. Selection of thermal protection must also take account of food hygiene requirements. In many workplaces appropriate thermal protection will be required and it is important to make sure it is suitable to be worn under the outer layer designed to protect the meat product from contamination.

The type of thermal protection required for visitors must be assessed on the basis of the temperature level and the exposure time. If it is decided that thermal protection is required by visitors it is important that a full range of sizes is provided.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: give short answer

1. List required protective equipments during working in meat plant (4 pts)

a._____

b._____

c. _____

d. _____

2. Notify at least three main Couse of injury in meat industry. (3 pts)

   a._____

   b. _____

   c. _____

Note: **Satisfactory rating - 5 points** **Unsatisfactory – below 5 points**

Information Sheet 3- Disposing Bones

3.1. Slaughter house wastes

Slaughter house wastes are any discarded materials generated during production and processing of meat from live animals, it may be solid, liquid, and semi-solid material. These wastes are to be disposed of appropriately so as to prevent contamination of the environment and the serious consequences such as spread of diseases, foul smells and unaesthetic view. A major part of the waste generated from the slaughter houses constitutes the byproducts which are handled by the animal by-products industry to produce many valuable products such as leather, casings, catgut, bone meal, meat meal, gelatin, Neat's foot oil, ornamental items.

The following are summary of animal waste disposal

Rendering: This is the preferred means of disposal offering a relatively safe and integrated system that complies with the fundamental requirements of environmental quality and disease control.

Landfilling: If rendering capacity is exceeded or suspended, permitted landfilling offers the next best environmental solution.

Burial: On-site burial is the least desirable and environmentally safe alternative. This alternative applies only to on-site burial of waste that on the owner's property and that will be buried on the same property.

Composting: If the condition of the carcasses precludes transportation to the landfill.

Bone Yield- average-15% of the weight of a dressed carcass. This amount varies with breed, age, state of nutrition. It may be as low as 12% in beasts of top condition, and as high as 30% in emaciated cattle. The bones of sheep and goats average from 20 to 30% and of pigs from 12 to 30%.

After deboning take place the bone should be inspected and trimmed off if meat is left on it. Bone is processed for different products such as bone meal and gelatine.

Composition

- 50%-water
- 15%-red and yellow marrow
- 12%-organic matter
- 23%-inorganic matter

3.2. By-products of bones

Gelatine

The Operator must have a verifiable system in place to ensure only eligible bones are collected for gelatine production. The system must ensure there is no possibility that ineligible bones, accidentally or otherwise, end up in the transport trailer designated for collection of bones for gelatine production.

Maximum Storage time for Bones

Bones intended for gelatine production may be stored at ambient temperature for no longer than 24 hours after production. In the case where transport containers are filled during the course of the day, the 24-hour time is to be calculated from the time the first bones of the day are produced in the boning hall.

Gelatine is: -

- Gelatine can be obtained by boiling ossein or by boiling degraded bones in water acidified with Hydrochloric acid, which separates the gelatinous substances
- Edible and inedible (technical) uses.
- Edible gelatine is manufactured from fresh bones
- It swells in cold water absorbing 5 to 10 times

Glue

- It is low-grade gelatine with comparatively dark color and has only inedible uses.
- Glue is used as an important adhesive in plywood, furniture, sand paper, gummed tape, etc.

Bones may by collected from; -

- Abattoirs where large quantities of bones are available.
- In the field where bones may be collected from eating houses, refuse dumps or from carcasses.
- Skull and jawbones are non-gelatine-yielding bones.
- Gelatine manufacturers grade the bones in five different groups as Grade I, II, III, IV and V.
- Only long bones are selected not the flat bones.

Bone meal

- Bone pieces of less than 2 mm size constitute bone meal.
- Sterilized bone meal a good source of phosphate.
- It should be noted that sterilization of such bones is a must.
- The yield of bone meal is one third of that of raw bones (1:3).

The average composition of bone meal is

- Calcium: 30.5%
- Phosphorus: 15.5%
- Protein: 7.0%
- Fat: 1.0%

Uses of bone meal

Used as mineral supplement in stock feeding or as phosphate fertilizer.

Steps in during preparation of bone meal

Self-check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: say true if the sentence is correct or false if it is not correct. (3 pts)

1. Bone account 15% of the weight of a dressed carcass.
2. The amount of bone varies with breed, age, state of nutrition.
3. The bones of sheep and goats average from 20 to 30%

Test I: Choose the best answer (4 point)

1. List the composition of bone

2. Notify at least two by products of bone

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Information Sheet 3- Complete Workplace housekeeping

3.1. Workplace housekeeping

Housekeeping is relevant in all workplaces-whether at the meat industry, office, other factory, shipyard, construction site and storage facility. Effective housekeeping can eliminate many workplace hazards and help get work done safely and properly. A clean and tidy workplace also enhances a company's image and provides immediate visible evidence of its commitment towards workplace safety and health (WSH).

Housekeeping is not just about the cleanliness of a workplace. It is also about keeping workplaces in order. Workplace housekeeping may be defined as activities undertaken to create or maintain an orderly, clean, tidy, and safe working environment.

Good housekeeping entails the effective organization of the workplace and it contributes to better WSH performance, increased productivity and better-quality control. It also includes good workplace traffic management, proper storage of raw materials and finished goods, neat and tidy work areas as well as adequate workplace illumination. With good housekeeping practices, workplaces can be kept safe from potentially dangerous objects or substances present in the work environment. An organized and clutter-free work area also makes it easier to respond to or evacuate in the event of an emergency.
Good housekeeping can result in:

- more effective use of space
- better inventory control of tools and materials
- reduced handling to ease the flow of materials
- more efficient equipment clean-up and maintenance
- reduced equipment and property damage through better preventive maintenance
- more hygienic workplace conditions that would lead to improved workers' health
- improved overall look and feel of work environment; and
- improved staff morale and wellbeing.

Poor housekeeping, on the contrary, creates workplace hazards that can lead to various accident types like cut by machine, Slips, Trips and Falls (STF), Caught In-between Objects (CIBO), Struck by Falling Objects (SBFO), Struck by Moving Objects (SBMO), Cut/ Stabbed by Objects (CSBO) and Struck against Objects (SAO). Additionally, poor housekeeping may create fire hazards that inevitably lead to increased fire risk.

The job of a sanitation worker is one of the most hazardous jobs in the meat processing industry. Sanitation workers may work a regular production shift, or they may be part of a special sanitation or cleaning crew.

The focus of sanitation workers who work a regular production shift is cleaning the machinery and floors. They move product to allow cleaning and use high pressure water hoses and squeegees to clean the floors. This type of job is frequently an entry-level position. Workers who hold these jobs do not have the experience needed to be familiar with the many hazards of the equipment and the environment in which they work. They need extensive training.

For instant, In the united states the daily sanitation or clean-up crew has the responsibility of cleaning all product contact surfaces throughout the plant to comply with requirements of the Food Safety and Inspection Service (FSIS), U.S. Department of Agriculture. If the clean-up crew has not done a satisfactory job, the FSIS inspector will not allow the plant to begin a production shift.

When the sanitation crew must remove guards or components to effectively clean processing equipment, and this action (or any other action) exposes crew members to hazardous energy, the equipment must be isolated from its energy source(s), and the energy isolation devices must be locked out or tagged out. In some situations, the equipment must be re-energized for a limited period of time for testing or repositioning purposed. During the testing or positioning period, a sequence of steps must be followed to maintain the integrity of employee protection, and alternative protection, such as removing workers from the machine area, must be provided to prevent employee exposure to machine hazards. Once the testing/positioning activity is completed, the

equipment again must be de-energized and locked or tagged out and before undertaking further cleaning activities.

Processing plants undergo a daily routine of cleaning and disinfection together with equipment repairs after normal operations have been discontinued. During this span, the risk for injury can increase, particularly with both functions operating at the same time. Repair personnel need to have equipment locked out and guards removed while they make repairs, while sanitation personnel may need equipment running to more thoroughly clean various moving mechanisms. Furthermore, sanitation personnel, frequently use temporary perches (such as ladders or equipment ledges) to gain a cleaning angle needed to hose down a device, which increases the risk of falls. In response to these and other unique challenges the industry has assembled training materials that discuss the unique risks poised by third shift sanitation and maintenance and proper safety protocols to use to minimize that risk.

Self-check 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: say true if statement is correct and false if statement is in correct. (1 pts)

1. Housekeeping is not just about the cleanliness of a workplace, also about keeping workplaces in order.

Test II: give short answer (3 point)

1. List at least three results of good housekeeping

Note: **Satisfactory rating - points** **Unsatisfactory - below 5 points**

Reference Materials

WEB ADDRESSES

1. https://foodmateus.com/dark-meat-deboning-systems/ultimate-whole-leg-deboner/.
2. https://www.tarheeldistributors.com/distributor-category/meyn-equipments/.
3. https://www.facebook.com/drobtech/videos/used-marel-amf-bx-semi-automati.
4. https://foodmate.nl/opti-ltd-whole-leg-deboning-system/.
5. https://www.mayekawathailand.com/Files/Name2/CONTENT545067946aa4eed0224a8bcf5211194190461103.pdf.

AKNOWLEDGEMENT

We wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this curriculum.

We would like also to express our appreciation to the TVET instructors and respective industry experts of Regional TVET bureau, TVET college and poly technique college/ Institutes, and Federal Technical and Vocational Education and Training Agency (FTVET) who made the development of this curriculum with required standards and quality possible.

This learning guide was developed on September 2020 at Bishoftu, Federal Management Institute.

The trainers who developed the learning guide

Name	Qualification	Educational background	Region	e-mail
Tamirat Chanyalew	B	Animal Science	04	tamiratgeletac@yahoo.com
Eden H/Mariam	B	FTPE	10	hayilemariameden@yahoo.com
Ewunetu Bekele	A	Animal Production	04	esewunetu@gmail.com