Meat and meat products Processing

Level-III

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Module Title: - Operating Rendering and product processing

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Bishofitu, Ethiopia

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LG #63 LO #1- Operate metal detector

Instruction sheet

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

- Conducting pre-start checks and maintenance procedures
- Checking metal detector sensitivity
- Operating metal detector

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:

- Conduct pre-start checks and maintenance procedures
- Check metal detector sensitivity
- Operate metal detector

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, ask your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Conducting pre-start checks and maintenance procedures

1.1 Conducting Pre-start checks

The extent of pre-start checks to be carried out prior to start-up will depend on the circumstances of the shutdown; clearly if a detector has been shut down for only a short period of time following a detector trip, having previously operated satisfactorily, then fewer checks will be necessary than if the detector has been shut down for several weeks for extensive overhaul work.

a) How a Metal Detector Works

The most widely-used type of metal detector in the food industry functions on the principle known as the "balanced coil" system. This was first registered as a patent in the 19th century, but the first industrial metal detector was not produced in the UK until 1948.

The progress of technology has taken metal detectors from valves to transistors, to integrated circuits and more recently, into microprocessors. Naturally this has increased their performance giving **greater sensitivity**, **stability** and **flexibility**, as well as widening the range of output signals and information they provide. All the same, modern metal detectors are still unable to detect every particle of metal passing through them.

b) Understanding the Detector's Control Panel

The main components of the detector's control panel are as follows.

- The display panel
- The three (red, green, and yellow) indicator lights
- The green Go button
- The red Back button
- The four blue triangular-shaped navigation buttons

The detector's control panel looks like this.

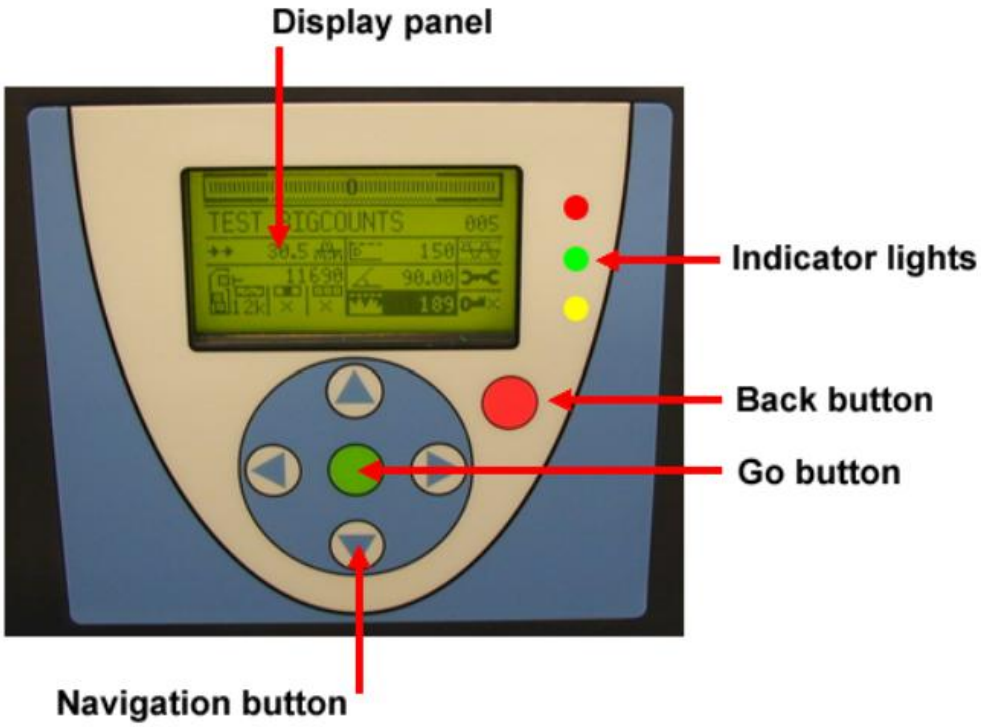


Figure: 1 detector control panel

i. The Display Panel

The display panel allows you to access all the detector's functions.

ii. The Indicator Lights

These give you a quick overview of how the detector is functioning.

- Red—flashing once indicates an excess product effect; steady indicates a fault.
- Green—Indicates a product is present in the detector's search head.
- Yellow—Indicates a contaminant has been detected in the product.

iii. The Navigation Buttons

These allow you to navigate around the detector's menus and sub-menus. When you press a navigation button, the display highlights an adjacent function (using a black background). You access the highlighted function by pressing the Go button. In addition, the four navigation buttons are used increase or decrease numbers and select characters and settings in various menus and input screens.

iv. The Go Button

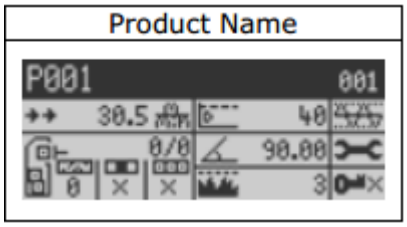
Press the Go button to select or start one of the detector's functions.

v. The Back Button

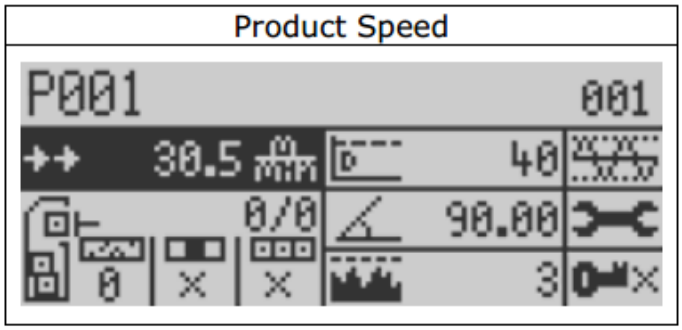
Press the Back button to stop one of the detector's functions or to return to the previous menu screen. Pressing the Back button repeatedly will always take you back to the detector's Main Menu.

1.1.1 **Pre-start checks how the metal detector operates**:

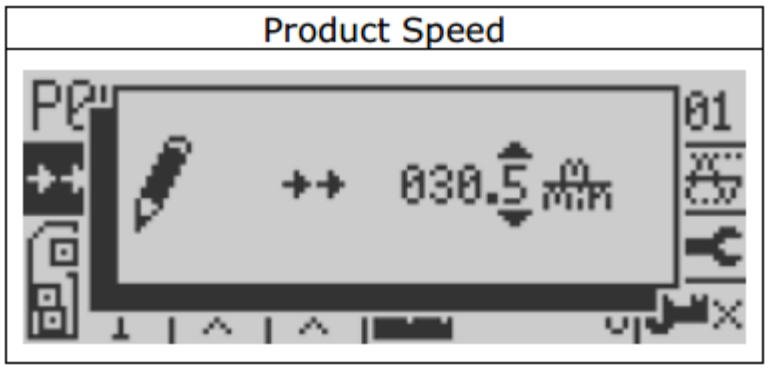
1) Make sure the detector's Main Menu is displayed.



2) Select the product speed menu.



3) Press the Go button and the product-speed input screen appears. (The figures: 1 in your screen, however, may be different, because the screen displays the last setting used.)



4) Use the navigation buttons to input the speed of the conveyor in meters per minute or feet per minute. Press the Go button to save the conveyor speed (and exit the input screen).
5) Note that the speed of the conveyor is now displayed in the product-speed section of the Main Menu.

Figure: 2 Metal detector balanced coil

The physical laws applied in the technology limit the absolute capability of the instrument. Consequently, as with any measuring instrument, metal detectors have restrictions on accuracy. These restrictions vary depending on the application, but the main criterion is the size of the detectable metal particle. Despite this, though, metal detectors perform a valuable and essential role in process quality control.

1.2 Preventing Metal Contamination by Maintenance and Cleaning Work according to workplace requirements

Your entire organisation's maintenance and cleaning staff should receive appropriate training on how important it is to prevent metal contamination. The maintenance of your factory equipment should be planned, so that wear and tear can be remedied before defects occur. Try to ensure that any maintenance work or installation of new plant is done outside production hours. If that is not possible, then the area must be properly screened from adjacent raw material production or packing areas

Repairs on production lines should be carried out by staff using an enclosed box for their tools. It helps if they use a small vacuum brush and magnet for cleaning down afterwards, where this is appropriate.

Under no circumstances must welding, riveting, drilling or soldering be done on plant being used for production, or on any plant immediately adjacent to it. Slicing or mincer blades, woven wire conveyors and sieves must be inspected every day for any signs of damage. This inspection needs to be clearly documented. Maintenance and cleaning staff that dismantle equipment should carry a suitable, clearly marked container for the safe storage of nuts, bolts, washers, etc.

Staff must avoid using tape or wire to make temporary repairs to plant. Missing or loose screws and damaged fittings need to be replaced or repaired promptly and permanently and sward, wire debris and any other potential contaminant disposed of safely and quickly. All welding should be continuous, and ground smooth. It's important that all equipment repaired in workshops or in the factory is cleaned down and vacuumed (not blown with compressed air), before being returned to the production area.

Workshop floors need to be swept and vacuumed at least once daily. Where workshops are within your factory building, a suitable trap should be fitted to the workshops exit, accompanied by a notice telling personnel to scrape their footwear before leaving.

Once repairs, maintenance activities and installations are completed, a member of the **Quality Control or Hygiene** team should inspect the plant and surrounding areas **before** production starts again.

Self-check 1	Written test

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

Test I Short Answer Questions

1. What are the main components of the metal detector's control panel?(4pts)

Test II Write true if the statement is correct and false if statement is incorrect

1. Mincer blades, woven wire conveyors and sieves must be inspected every day for any signs of damage. (2pts)
2. The most widely-used type of metal detector in the food industry functions on the principle known as the "balanced coil" system?(2pts)

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

Score = _____

Rating: _____

Operation Sheet – Conducting pre-start checks of metal detector machine

Objectives of conducting pre-start check of detector main menu, speed menu and button press;

- To identify all the main menu, speed menu and button press functional and sufficient enough
- To identify which menu, and button press needs maintenance

Procedures to ensure the job gets done safely and without delay

1. Select, fit and use personal protective clothing and/or equipment
2. Conduct pre-start checks
3. inspecting equipment condition
   a - Visual inspections of important features prior to starting the machine
   b - Visual & function tests while the machine is turned on but stationary
4. Follow isolation and lock out/tag out procedures as required to take process and related equipment off-line in preparation for cleaning and/or maintenance within level of responsibility.
5. Any scheduled maintenance has been carried out and that all safety guards are in place and operational.
6. Take corrective action in response to out-of-specification results
7. Maintain work area to meet housekeeping standards
8. Clean tools equipment and machinery
9. Make record and report to your supervisors

Information Sheet 2- Checking metal detector sensitivity

2.1 What is Sensitivity? How is it measured?

Sensitivity is the measure of a metal detector's ability to detect a specific type and size of metal contaminant. The better the sensitivity of the metal detector, the smaller the pieces of irregular-shaped metal it can detect.

Performance is usually expressed in terms of the diameter of a test sphere made from a specific type of metal, such as ferrous, non-ferrous, aluminum or stainless steel. Sensitivity should always be measured at the center of the metal detector's aperture, as this is the least sensitive point.

Figure: 3 metal detector aperture

2.2 Metal Detection Sensitivity

For optimum sensitivity, the search head must be of the size appropriate for the specified food product. It's important that the best attainable sensitivities are established and set for each product, relating to product size, type and packaging. This process should only ever be carried out in consultation with the manufacturer of your metal detector.

Table: 1 sensitivity guideline

Typical Guidelines for Sensitivity

Aperture Height	Dry Product	Wet Product	
	Ferrous & Non Ferrous	Ferrous	Non Ferrous
≤ 50 mm (2 In)	< 0.8 mm	< 0.8 mm	< 1.2 mm
≤ 125 mm (5 In)	< 1.0 mm	< 1.0 mm	< 1.5 mm
≤ 200 mm (8 In)	< 1.5 mm	< 1.5 mm	< 2.2 mm

Sensitivity adjustment controls must not be accessible to untrained employees. Access should only be given to nominated, fully trained staff and for additional security; the controls should be password-protected or kept locked.

2.3 How Metal Detector Sensitivity is measured

When measuring the sensitivity of a metal detector, a test piece must be reliably detectable when passed through the center of the aperture of the metal detector. However, there is a significant difference between the test piece's spherical sensitivity and the actual length of an irregular-shaped or wire-type contaminant that can be detected.

The sensitivity of a metal detector is affected by several factors of food products, those include:

- Product composition. For instance, a high content of salt in products like ham can make metal detectors give a false response (due to electrical conductivity). Also, blood and iron content in meat can affect sensitivity.
- Product characteristics, for example: in meat products, metal detection can be influenced by the type of product present either as whole muscle or emulsion. Product density also has an effect if metal is a present, denser product can give a different signal than less dense products.
- Temperature variation in food affects the signal even though metal is not present, causing misinterpretation of metal detected.

- Packaging material such as aluminum foil can produce a misleading signal due to metal composition of the packaging material. Your metal detector supplier should indicate the specific adjustments required to compensate for product effects to avoid false detection.

2.4 What Can the metal detector Sense?

The three main groups of metallic contaminants: -

- Ferrous
- Non-Ferrous
- Stainless steel

Detection depends on the magnetic or conductive properties of the contaminant.

Table: 2 types of metal contaminants

Metal	Example	Detection
Ferrous	Iron	Easy
Non-ferrous	Copper, lead	Relatively easy
Stainless Steel	304L (EN58E) grade	Relatively difficult

Keep in mind that metal detectors cannot find bones, plastic, glass and other dense non-metallic contaminants.

Ferrous is both magnetic and conductive so easily detected.

Non-Ferrous is non-magnetic but a good or excellent conductor so relatively easily detected. Stainless steel is the most difficult contaminant to detect as it is usually non-magnetic and a poor conductor. Sensitivity of metal detector checks how, when sees below etc.

2.4.1 How to test/check-up metal sensitivity? Minimum considerations:

- Center of aperture
- Consistent position
- Speed same as product speed
- Number of passes/tests

- Use product where feasible
- Test must include rejection device
- Safety of procedure

2.4.2 When to test check-up metal sensitivity? Minimum considerations:

- Shift change or shorter regular interval
- (i.e.: every 4 hours)
- Product change
- Application change (speed, reject position, etc.)
- After line maintenance
- Consider the logistics of a test failure

2.4.3 What to test with check-up metal sensitivity? Minimum considerations:

- Choose Sphere sizes that are reliably detectable
- Stainless Steel sample always;
- Ferrous & Non-Ferrous can be at lesser frequency
- Form of test sphere encapsulation should suit the application (size, colour differential)
- Certified test samples

2.4.4 Basic Test /check-up metal sensitivity Procedures?

1. Test sample should travel through the center of the aperture
2. Use 'real' product to carry the test sample whenever possible
3. The test sample must be allowed to be rejected and enter the reject bin
4. Record results

2.4.5 What to do with results/ check-up metal sensitivity? Minimum considerations**:**

- Manual record of each test event
- System of collection/storage of records
- Easy method to decide pass/fail

- Clear action upon test failure

Self-Check – 2	Written test

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

Test I: Short Answer Questions

1. What are the three metallic contaminants?(3pts)
2. List the factors that can affect the sensitivity of metal detector?(3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Sensitivity adjustment controls must be accessible to untrained employees (2pts)
2. Non-Ferrous is non-magnetic but a good or excellent conductor. (2pts)

Note: **Satisfactory rating – 1o points** **Unsatisfactory - below 10 points**

Score = _____

Rating: _____

Information Sheet 3- Operating Metal Detectors

3.1 Introduction

Why should a food processor consider a metal detector? Some of the reasons are:

- Product safety
- Equipment protection
- Contract (customer) requirement
- Regulatory compliance

Of the reasons listed, perhaps the most compelling is found in the Federal Register "Effective measures shall be taken to protect against the inclusion of metal or other extraneous material in food. Compliance with this requirement may be accomplished by using sieves, traps, electric metal detectors or suitable means. "Metal detectors will not guarantee a metal-free food product, but a properly designed, installed and maintained unit, along with a metal contamination control program, can be extremely effective. This fact sheet discusses the following topics regarding metal detection and removal.

- How a metal detector works
- What can be detected
- Product conditions
- Rejection mechanisms
- Metal detection program

3.1.1 How a metal detector works

Most metal detectors use a balanced, three-coil, system to detect small particles of non-ferrous and stainless steel. The coils are wound on a non-metallic frame, each parallel with the other. The center coil is connected to a high frequency radio transmitter. Coils on either side of the transmitter coil are receivers. As these two coils are identical and placed the same distance from the transmitter, they receive the same signal and produce an identical output voltage. When the coils are connected in opposition, the output is cancelled, resulting in a zero value. When a particle of metal passes through the coils of a metal detector, the high frequency field is disturbed under one coil, changing the

voltage by a few microvolts. The state of balance is lost and the output from the coils is no longer zero. It is this phenomenon that is used to detect metal. An important aspect of metal detector operation is the metal free zone, which is needed for proper operation. The zone includes a space on each side of the aperture that must be free from any metal structure such as rollers and supports. As a general rule, this needs to be approximately 1.5 times the aperture height for fixed structures and 2 times the aperture height for moving metal such as reject devices or rollers.

3.1.2 What can be detected

All metals are ferrous, nonferrous or stainless steel. The ease of detection will depend on their magnetic permeability and electrical conductivity. Table 1 shows metal types and their ease of detection. The size, shape and orientation (with respect to the detector coils) of the metal particle also are important. Since size, shape and orientation of metal contaminants is not possible to control, it is best to operate a metal detector at the highest possible sensitivity setting.

3.1.3 Food product conditions

Food product conditions can have a major effect on metal detection. Electrical conductivity in foods such as cheese, fresh meat, warm bread, jam and pickles can generate a signal in a metal detector even though metal is not present. This phenomenon is known as the “product effect.” It is best to be aware of this phenomenon and to work with your metal detector supplier or manufacturer to determine the best means to compensate for product effect.

3.1.4 Rejection mechanisms

The purpose of rejection mechanisms is to remove the contaminants from the product/process stream. The mechanism must be designed to remove 100 percent of the detected contaminants along with a minimum amount of salable product. The contaminants are removed and stored in a manner that eliminates any possibility of their being reintroduced into the product or process stream. Metal detectors are installed in

three basic configurations: pipeline, conveyor and free-fall. Pipeline detectors are used for any product conveyed in tubes or pipe. An example of a pipeline detector is shown in figure 2. A diversion valve is normally used to redirect materials containing detected contaminants into a separate vessel or container.

Conveyor detectors are by far the most common; examples are given in figure 3. Many variations of manual, semi-automated and fully automated rejection mechanisms are possible, such as air blow (figure 3a), push arms, retractable conveyor bed (figure 3b), reversible conveyor (figure 3c), slider gate, ink marker or coder, diversion conveyors and robotic grippers. Free-fall detectors are often found on dry product fillers and are useful for any material that can be dropped through an aperture. A fast-acting valve or deflector plate is used to divert detected material to a separate container

3.1.5 Metal detection program

A formal metal detection program will help to insure product quality. Metal detectors may be used in various phases of production. A combination of finished and bulk ingredient and product inspection gives the best performance. Detectors may need to be placed after certain process equipment (such as size-reduction) that are prone to breaking or chipping metal materials A sensitivity standard (or standards) should be set for the entire facility. An important aspect of this is to identify an agreed upon minimum particle type and size. For example, a typical detection

standard for finished product might be to remove all spherical, non-magnetic particles larger than 2.0-mm and all spherical, magnetic particles larger than 1.5-mm. Only detectors that meet these standards would be considered for purchase and installation. The conditions should be clearly marked on the side of any installed detector and samples of the correct diameters should be available for testing the unit.

Metal detectors should be operated at the maximum sensitivity setting for a given product. The maximum acceptable sensitivity setting will allow the detector to perform reliably for extended periods of time without excessive false rejects. Scheduled testing of the detector and reject device (with ferrous and nonferrous metal samples) will confirm

proper operation. Intervals between tests can be determined by the consequence of a failed test. Testing every two to four hours is typical. A testing procedure should be established and followed. A plan of action must be specified for failed tests. Every effort should be made to identify, document and correct the source of detected metal

3.2 Preventing Metal Contamination by Maintenance and Cleaning Work

Your entire organization's maintenance and cleaning staff should receive appropriate training on how important it is to prevent metal contamination. The maintenance of your factory equipment should be planned, so that wear and tear can be remedied before defects occur. Try to ensure that any maintenance work or installation of new plant is done outside production hours. If that is not possible, then the area must be properly screened from adjacent raw material production or packing areas.

Repairs on production lines should be carried out by staff using an enclosed box for their tools. It helps if they use a small vacuum brush and magnet for cleaning down afterwards, where this is appropriate. Under no circumstances must welding, riveting, drilling or soldering be done on plant being used for production, or on any plant immediately adjacent to it. Slicing or mincer blades, woven wire conveyors and sieves must be inspected every day for any signs of damage. This inspection needs to be clearly documented.

Maintenance and cleaning staff who dismantle equipment should carry a suitable, clearly marked container for the safe storage of nuts, bolts, washers, etc. Staff must avoid using tape or wire to make temporary repairs to plant. Missing or loose screws and damaged fittings need to be replaced or repaired promptly and permanently and sward, wire debris and any other potential contaminant disposed of safely and quickly. All welding should be continuous, and ground smooth. It's important that all equipment repaired in workshops or in the factory is cleaned down and vacuumed (not blown with compressed air), before being returned to the production area. Workshop floors need to be swept and vacuumed at least once daily. Where workshops are within your factory building, a suitable trap should be fitted to the workshops exit, accompanied by a notice

telling personnel to scrape their footwear before leaving. Once repairs, maintenance activities and installations are completed, a member of the Quality Control or Hygiene team should inspect the plant and surrounding areas before production starts again.

3.3 Every activity are performed by workplace information and hygienic design

All metal detection systems should be designed with due consideration of the environment in which they will operate. They should also be designed so as to take into account cleaning regimes likely to be encountered.

Hygienic design principles should be applied to every aspect of the system, with the aim of eliminating dirt traps and ensuring easy cleaning, so design features should include:

- Elimination of cavities/bacterial traps
- Sealing of all hollow sections
- Avoidance of ledges and horizontal surfaces
- Use of open-design continuous-welded frames for easy access and cleaning
- Hygienic management of electrical cables, trucking and pneumatic service

3.4 Health and Safety

Health and Safety is an important consideration, so design and build of metal detection systems should be certified as being in accordance with statutory regulations and standards in force at the time of sale.

Self-Check – 3	Written test

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

Test I: Short Answer Questions

1. Why should a food processor consider a metal detector??(3pts)

Test II: write true if the statement is correct and false if the statement is incorrect

1. Most metal detectors use a balanced, three-coil, system to detect small particles of non-ferrous and stainless steel.(2pts)
2. Metal detectors should be operated at the maximum sensitivity setting for a given product.(2pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

Score = _____

Rating: _____

LG #64	LO #2- Operate and maintain size reduction equipment

Instruction sheet

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

- Operating mincer
- Changing knives and plates
- Identifying and complying occupational health and safety (OHS)

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:

- Operate mincer
- Change knives and plates
- Identify and comply occupational health and safety (OHS)

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- Operating Mincer

3.1 Meat processing principles

- Mincing
- Milling
- Flaking
- Chopping
- Curing
- Tumbling
- Massaging
- smoking

1.2 Mincer or Grinder

A meat grinder is a machine used to force meat or meat trimmings by means of a feeding worm (auger) under pressure through a horizontally mounted cylinder (barrel).
At the end of the barrel there is a cutting system consisting of star-shaped knives rotating with the feeding worm and stationary perforated discs (grinding plates).
The perforations of the grinding plates normally range from 1 to 13mm.
The meat is compressed by the rotating feeding auger, pushed through the cutting system and extrudes through the holes in the grinding plates after being cut by the revolving star knives.
Simple equipment has only one star knife and grinder plate, but normally a series of plates and rotary knives is used.
The degree of mincing is determined by the size of the holes in the last grinding plate

Two different types of cutting systems are available**,** the “Enterprise System” and the “Unger System”:

- The “Enterprise System” is mainly used in smaller meat grinders with orifice diameters up to 98 mm and consists of one star knife, sharpened only on the side facing the disc, and one grinder plate. Hole diameters can vary from 13 to 5 mm.
- The “Unger System” is used in meat grinders with orifice diameters up to 440 mm and consists of the kidney plate, one or two star knives sharpened on both edges and one or two grinder plates.

1.2.1 Types of grinder

- manual grinder
- Stuffing grinder
- industrial meat grinders or mincer

Figure: 4 Meat mincers/grinders

1.3 Principles of size reduction:

Crushers and grinders are the equipment mostly used for size reduction. Small power input requirement per unit of product handled and. Easy and trouble free operation. Amount of power required to create smaller particles is one of the parameters of the efficiency of operation. Second parameter is the desired uniformity of size.

Large industrial meat grinders are driven by a three-phase electrical motor (400 V) and equipped with the Unger cutting system. The orifice cylinder diameter of this type of grinder ranges from 114 - 400 mm. Industrial grinders are either designed as stuffing grinders with either tray or hopper or as an automatic mixing grinder. The automatic mixing grinder has a big hopper and the meat falls automatically onto the mixing blades and the feeding worm (auger). The mixing blades and feeding worm can be operated independently with mixing blades rotating in both directions but the feeding worm only towards the cutting set. Most of the industrial meat grinders are also equipped with a device for separating tendons, bone particles and cartilage.

1.4 Cleaning operation

a) Cleaning (First use/ daily use)

You should clean the grinder when you first use it and also at the start of every day. This is important because it ensures the parts in contact with the food are hygienically clean – Remember to unplug the machine every time it is cleaned.

All the parts which have been dismantled should be cleaned by:

1) Use clean hot water to remove as much of the larger meat debris / contamination as possible
2) Clean with a brush and suitable detergent solution as approved for use with meat processing equipment.

   Note. This is to dissolve and remove the fats, oils and proteins which bacteria can feed on.
3) Rinse again with clean warm water to remove the detergent solution, oils, fats and proteins.
4) Product can be Air dried. Ensure all parts are dry before reassembly and mincing

Below is the disassembly steps should be followed up



1.Remove Meat Tray by twisting & lifting

2. Unscrew lock nut

3. Remove mincer plate

4. CAREFULLY removecutter the blade ,its edges are sharp

5.Pull out worm ,you can see a nylon washer on it,don't miss it .

6.Remove worm housing,holding the weight whilst undoing locking nuts

Figure: 5 mincer machine

b) Installation

After cleaning, assembly the parts should be as per following steps:

NOTE: When refitting the grinder worm its square drive socket must engage with the square drive on the grinder /mincer body

1. Refit the worm housing holding the weight whilst doing up the locking nuts do not over-tighten
2. Insert the worm - The worm must engage with the square drive on the mincer,
DO NOT forget to put on the nylon washer first .
3. CAREFULLY fit the cutter on to the worm shaft. Ensure, The squares are located
The edge of the cutter faces outwards, towards you
4. Refit the mincer plate It has a location slot which has to be inline with a pin at the top of the worm housing.
5. Fit the locking nut and hand tighten - Do not use excessive force or tools.
6. Push fit the Meat Tray on to the worm housing

Meat mincer/ grinder (5 blades) how to assemble the blades?

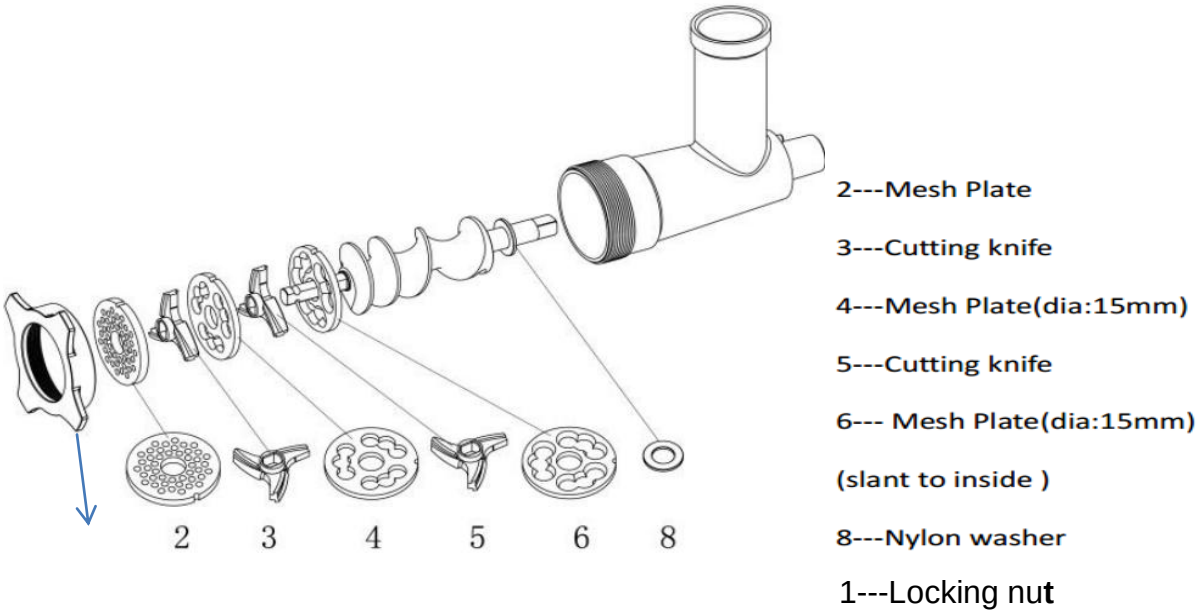
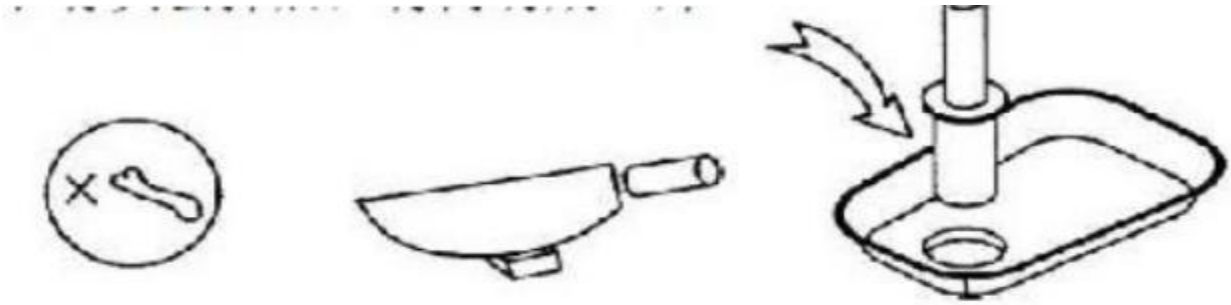


Figure: 6 mincer machine

1.5 How to use the Meat Grinder/Mincer

Once the mincer is cleaned and ready to use, plug the mains in (right mains power sources). Add the diced meat to the tray and gently feed into the hole with the plastic plunger, do not force the meat down, switch on the grinder Continue to push the product into the opening with the plastic plunger



When the entire meat product has been minced switch the mincer off immediately
If the mincer stalls, reverse the worm
NOTE**!** If this FAILS to clear the obstruction, switch off the mincer, remove the mains plug and clean the mincer.

c) Start-up (testing) and adjustment

After installation tests, a trial run of the device is carried out. Unscrew the lock nut of the grinder head assembly, remove the cutting tools with the auger/screw and sanitize the complete assembly, the lock nut, the auger/screw and the grinding set (knives and plates) - rinse with hot soapy water until the grease is completely removed, dry, grease with unsalted animal fatty substance

Align the grinder head assembly with the flange of the gearbox and threaded fasteners, fasten with clamps. Insert the auger/screw, grinding set, locking hoop/fixing ring and tighten with the lock nut. Adjust the gapping between the knives and plates with a lock nut in accordance with clause. Check and inspect the working mechanism of the device during its setting-up, operation, as well as during its sanitation only when the circuit breaker is turned off. Test the device idly for 1-2 minutes. The device should work smoothly, without wedging and unusual sounds (sharp noises, knocks, etc.)

d) Maintenance and Storage

1. Strictly according to the instructions to operate the equipment, will greatly prolong its service life. The manufacturer should not be responsible for the damage which caused by improper operation.

2. This equipment should be stored in clean and dry area does not expose this equipment to rain or moisture

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: Short Answer Questions

1. List two different types of cutting system? (2pts)
2. Write the three types of grinders? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Large industrial meat grinders are driven by a three-phase electrical motor (400 V) and equipped with the Unger cutting system. (2pts)
2. Crushers and grinders are the equipment mostly used for size maximizing (2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

Score = _____

Rating: _____

LAP test	Performance Test

Name…… ID……Date……

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **4** hour. The project is expected from each student to do it.

Task 1: clean meat mincer or grinder machinery

Information Sheet 2- changing knives and plates

2.1. Bowl cutter (bowl chopper)

The bowl cutter is the commonly used meat chopping equipment designed to produce small or very small (“finely comminuted”) lean meat and fat particles. Bowl cutters consist of a horizontally revolving bowl and a set of curved knives rotating vertically on a horizontal axle at high speeds of up to 5,000 rpm. Many types and sizes exist with bowl volumes ranging from 10 to 2000 liters.

The most useful size for small- to medium-size processing is 20 to 60 litters. In bigger models bowl and knife speed can be regulated by changing gears. Bowl cutters are equipped with a strong cover. This lid protects against accidents and its design plays a crucial role in the efficiency of the chopping process by routing the mixture flow. Number, shape, arrangement, and speed of knives are the main factors determining the performance of the cutter. Bowl cutters should be equipped with a thermometer displaying the temperature of the meat mixture in the bowl during chopping.

Figure: 7 bowl cutter

Modern large scale bowl cutters may have devices to operate under a vacuum, which helps to improve colour and texture of the meat products by keeping oxygen out of the meat mixes and avoid air pockets. Cutter knives should be adjusted to a distance of 1-2 mm from the bowl for optimal cutting (check the manufacturers recommendations for each model). Most of the large and high-speed bowl cutters are equipped with mechan-

ical discharger devices for emptying the cutter. The process of chopping in a bowl cutter is used for producing fine comminuted products such as frankfurters, bologna, liver sausage etc., and enables processors to offer a much wider range of products**.**

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: Write true if the statement is correct and false if the statement is incorrect

1. Modern large scale bowl cutters may have devices to operate under a vacuum, which helps to improve colour and texture (3pts)
2. The process of chopping in a bowl cutter is used for producing fine comminuted products. (3pts)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

Score = _____

Rating: _____

Information Sheet 3-Identifying and complying occupational Health and Safety (OHS)

3.1 Occupational Health & Safety (OHS)

Give instructions to workers about safe working procedures before they are allowed to start work

3.2 Safety Precautions

Improper usage of equipment can result in injure and damage. It should only be connected to right mains power sources. Please read the instruction thoroughly before using the equipment for safety, and keep it for future reference

a) <u>Warning:</u>

1. Never operate the grinder/mincer dry –no meat loaded
2. It is recommended that after 45 minutes of continuous use the grinder is switched off and allowed to cool it down
3. Remember to unplug the machine every time it is cleaned, Do not spray or use liberal amounts of water to clean machine
4. Improper installation of cutter and mesh plate can result in damage; you are requested to install them correctly
5. The following products must not be processed with this grinder/mincer, Non-food products, or products on the bone/skin.
6. Never feed meat products in to the grinder/mincer with your fingers or grab it whilst it is being minced - Always feed the meat products using the plastic plunger provided
7. Never switch on the grinder while debugging the parts that in grinder head
8. Take the Silicone off from the grinder before using the equipment.
9. The mincer must be mounted on a plain, horizontal, non-slip and stable work surface
10. The mains plug and the mains cable should be inspected for damage. Never operate the grinder if the plug or cable is damaged

11. The mains socket should be within easy reach of the operator for quick disconnection in case of emergency or when cleaning Replacement of the mains cable, plug or fuse must be done by a qualified electrical Engineer.

b) Reasons why workplace safety is important

- Well-maintained occupational safety saves money
- Occupational safety creates new opportunities
- Occupational safety affects company reputation and productivity
- Employees are more productive.
- Use tools appropriately and mechanical assistance
- Keep crisis exits which are easily accessible
- Reduce Workplace Environment Stress
- Wear the right safety equipment's
- Sit in a proper posture which increase work power
- A clean and healthy working environment reduces absenteeism.
- It's safer, cleaner and looks more professional.
- There is a decrease in insurance claims caused by workplace accidents.
- The organization will be able to retain more customers

3.3 Personal Protective Equipment (PPE) in Render Processing Plant

Employers have duties concerning the provision and use of personal protective equipment (PPE) at work. PPE is equipment that will protect the user against health or safety risks at work. It can include:

Figure: 8 personal protective equipment

- ✓ **Head protection** (hard hats, helmets, sun hats) shall be provided where there is a risk of injury to the head, such as a person struck on the head by a falling object, a person may strike his/her head against a fixed object, there may be inadvertent head contact with electrical hazards.


- ✓ **Eye protection** (goggles, safety glasses) shall be provided where a risk of eye injury exists. Typical hazards might include flying particles, dust, splashing substances, harmful gases, vapours, aerosols, and high intensity radiation from welding operations.

- ✓ **Hearing protection** (ear plugs, ear muffs) shall be provided where a risk of noise induced hearing loss exists. The need for hearing protection may be assessed through noise monitoring or surveys.


- ✓ **Respiratory protection** (respirators, face masks, cartridge filters) shall be provided where there is a risk of airborne contaminates. This will minimize the risk to of exposure to an atmosphere that is or may be injurious to health.

- ✓ **Hand protection** (gloves, gauntlets) shall be provided where there is an identified hazard associated with a potential for hand injury. A list of hazards shall be compiled for each workplace and suitable hand protection obtained to minimize risk.

- ✓ **Protective footwear** (safety boots, water proof foot wear, enclosed shoes) shall be provided where the nature of the work exposes the employee to a medium to high risk of injury to feet, eg occupations such as workshop/maintenance and gardening staff.

- ✓ **Body protection** (mesh aprons, protective boot covers, water proof clothing, aprons, and safety uniforms) shall be provided to minimize risk of injury occurring to the body. Examples may include those who are required to work outdoors and are exposed to the sun's rays for continuous periods in a day. Direct exposure of the skin to UV radiation from outdoor work shall be minimized by providing hats, long sleeves/trousers and an adequate supply of sunscreen.

- ✓ **Outer wear** (high visibility safety vests, reflective vests, coats, jackets) shall be provided to highlight the worker in the area often used where there is a risk of injury associated with working on or near roadways or near moving traffic or moving plant

Safe work is one of the fundamental rights of the workers. These days, workplace health and safety procedures are important for the well- being of both employees and employers because human loss is immeasurable and intolerable. As, such loss or injuries can employ major loss to the families.

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: Short Answer Questions

1. List ear protection equipment's? (2pts)

2. What are the main issues for wearing personal protective equipment? (2pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Safe work is one of the fundamental rights of the workers. (2pts)
2. Respiratory protection minimizes the risk to of exposure to an atmosphere that is or may be injurious to health. (2pts)
3. Improper usage of equipment's can result in injure and damage. (2pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

Score = _____

Rating: _____

LG #65	LO#3- Monitor pre-heating

Instruction sheet

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

- Performing start-up procedures in work place
- Monitoring feed rate
- Balancing in and out feed

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 start-up procedures in work place
- Monitors feed rate
- Balance in and out feed

Learning Instructions:

10. Read the specific objectives of this Learning Guide.
11. Follow the instructions described below.
12. 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.
13. Accomplish the “Self-checks” which are placed following all information sheets.
14. 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).
15. If you earned a satisfactory evaluation proceed to “Operation sheets
16. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
17. If your performance is satisfactory proceed to the next learning guide,
18. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Performing start-up procedures in work place

1.1 Modification of the start-up procedure

A typical start-up procedure of a steam cycle includes three basic steps. They are shown schematically in the figure 8. and listed below.

- Boiler start-up.
- Heating of the steam pipes.
- Turbine start-up.

This sequence depends on the availability of the steam. At the end of the first step the boiler already generates steam, although its temperature and pressure are much lower than the design, full load values.

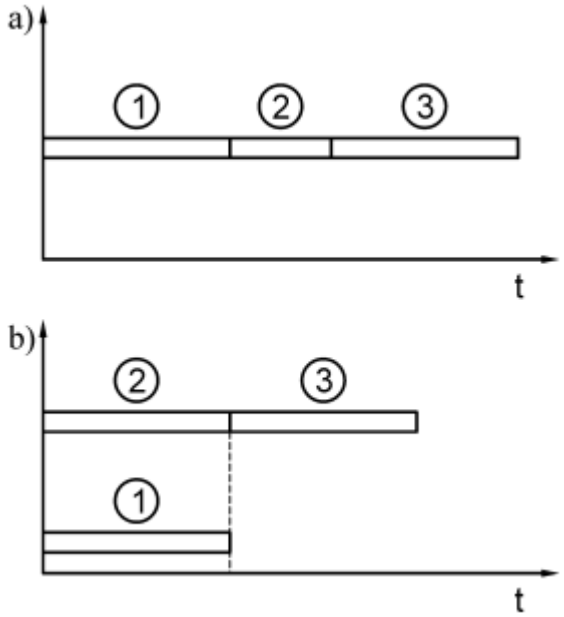


Figure: 9. Turbine start-up sequence: original (a), with a pre-heating (b)

The steam is then used to heat the pipes between the boiler and the turbine. In some turbines a small fraction of the steam is delivered into the space between the inner and the outer casing in the high pressure and the intermediate pressure sections of the turbine in order to heat up the casings and the rotor. Even though the rotor is not directly exposed to the steam at this point, it is running to avoid its deformation. The larger fraction of the steam bypasses the turbine through the pressure reduction valve and the

cooling system. In the start-up sequence described above the heating of the pipes and the turbine may not begin before the boiler starts to deliver the steam in the required amount.

The approach towards the optimization of the start-up begins with the observation that the heat source for the heating of the pipes and the turbine does not have to be the steam generated in the boiler. If the heat may be delivered from another source then the start-up sequence may be rearranged.

The suggested sequence of the start-up is shown in figure. 8b. the heating of the turbine may start at the same time, when the boiler begins its operation. This step is now called a pre-heating to distinguish it from the heating with the steam from the boiler. The whole period of the start-up becomes much shorter.

In the optimized procedure the heating of the turbine from an external source is independent of the available steam temperature from the boiler. It means that the heating process itself may be optimized. The key idea is to raise the temperature of the turbine during the preheating to such a level that allows the admission of the steam from the boiler at high temperature. If this is achieved then the cold start-up becomes similar to a start-up from a warm state, when the period between a proceeding shut-down and the start-up is less than 50 hours. The whole start-up becomes even shorter.

1.2 Heat source options

A very important issue is the choice of the external heat source for the pre-heating. There are several possible options described below.

a) Steam from an external source

The turbine parts may be exposed to the steam from a different turbine in the same power plant. The pressure and the temperature of the steam may be adjusted to the required levels through the throttling and the water injection.

Most power plants have several steam turbines and at least one is always running. It means that there is always steam available for the pre-heating. The usage of the steam from an external source is related to several issues that make the pre-heating process

problematic. First of all the pre-heating system involves two power generating units. One delivers the heat and the other receives it. This means that the two cycles must be adapted to both: the delivery and the reception of the heat. The application would involve the modifications of the cycles in two separate points each.

Secondly the heat delivery system would have to include at least one steam extraction. The temperature of steam for the heating must be relatively high (250 -400oC). This excludes a common pipe that is usually fed from each turbine in a power plant because of the low temperature.

b) Electric heating mats

A relatively fast temperature increase may be achieved if turbine parts are covered with electric mats. The pre-heating process may be conducted without any hot fluid.

c) Hot air

The use of the hot air eliminates the problems caused by the two previously described methods. The air flow may be arranged just like the steam flow. At the same time the problem of the steam condensation and the necessity of the water removal are significantly reduced. The air may be used to the direct heating of the casings and the rotor.

The hot air pre-heating is considered in the further analysis. The pre-heating system consists of an electric air heater and the compressor that provides a pressure level required overcoming the pressure losses in the pipes and the turbine. The process may be easily controlled. The two main parameters that are adjusted is the amount of the air and its temperature. The heating conditions may be matched to the requirements that depend on the thermal state of the turbine parts.

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: Short Answer Questions

3. What are the three basic steps of start-up procedure of a steam cycle? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. The pre-heating process may be conducted without any hot fluid. (2pts)

2. The air flow may be arranged just like the steam flow. (2pts)

Note: Satisfactory rating - 7 points Unsatisfactory - below 7 points

Score = _____

Rating: _____

Information Sheet 2-Monitoring feed rate

3.2 Monitoring feed rate

Feed grade fats are often stabilized blends of animal and vegetable fats. They are produced

- By rendering the tissues of mammals and/or poultry, and
- Through recycling cooking oils. Feed fats consist predominately of triglycerides of fatty acids and contain no added free fatty acids (NRA, 2003).

Products bearing a name descriptive of its kind or species origin must correspond thereto as beef, pork, or poultry. Poultry fat consists of fats derived from 100 percent poultry offal. Blended feed fat is a category that includes blends of tallow; grease, poultry fat, and restaurant grease/cooking oils. Blended animal and vegetable fats include blends of feed grade animal fats; poultry fats, vegetable fats, and/or restaurant grease/cooking oil. It may also include by-products such as soap stock. Fats within this category may be referenced as animal/vegetable blends.

Though specifications are clearly defined and guarantees specified under several references, including the Association of American **Feed Control** Officials (**AAFCO**), suppliers of feeding fats can provide products that are labeled and guaranteed outside the trading standards.

As with any feed ingredient; specifications should be thoroughly understood between supplier and purchaser. The following are common feeding fat guidelines:

1. Fats should be stabilized with an acceptable feed- or food-grade antioxidant added at levels recommended by the manufacturer. Stability tests can be performed to monitor.
2. No cottonseed soap stock or other cottonseed by-products should be included in fats for layer, breeder, or broiler rations.

3. Fats must be certified that polychlorinated biphenyls (PCBs) and pesticide residues are within the allowable state and federal limits.
4. The supplier should make every effort to provide a uniform fat structure in each delivery.

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: Write true if the statement is correct and false if the statement is incorrect

1. Blended feed fat is a category that includes blends of tallow; grease, poultry fat, and restaurant grease/cooking oils. (3pts)
2. Any feed ingredient; specifications should be thoroughly understood between supplier and purchaser. (3pts)

Note: Satisfactory rating - 6 points Unsatisfactory - below 6 points

Score = _____

Rating: _____

Information Sheet 3- Balancing in and out feed

3.1 Continuous Rendering

Continuous rendering generally defined as continuous in-feed and continuous out-feed with many still in use, there have been a number of continuous systems employed in the past. One of the first was the Anco Strata-Flow system. By connecting a series of modified batch cookers in a unique fashion, this became the first real continuous system.

a) Continuous Rendering Material Flows (Figure 9 above)

Material to be rendered is received for temporary storage in raw material bins (1). Raw material is conveyed from the bins by a raw material conveyor (2) and discharged across a magnet (3) to remove ferrous metal contaminants.

A raw material grinder (4) then reduces the raw material to a uniform particle size for material handling and improved heat transfer in the cooking step.

The ground raw material is fed at a controlled rate from a metering bin (5) into a continuous cooker (6). The continuous cooker is an agitated vessel generally heated by boiler steam. It brings the raw material to a temperature between 240º and 290ºF (approximately 115º to 145ºC), evaporating moisture and freeing fat from protein and bone.

Dehydrated slurry of fat and solids is discharged from the continuous cooker at a controlled rate. The discharged slurry is transported to a drainer conveyor (7). The drainer conveyor separates liquid fat from the solids, which are then conveyed from the drainer conveyor by a discharge conveyor (8). In the discharge conveyor, solids from the drainer conveyor are combined with the solids discharge from the settling tank and from the decanter-type centrifuge (10).

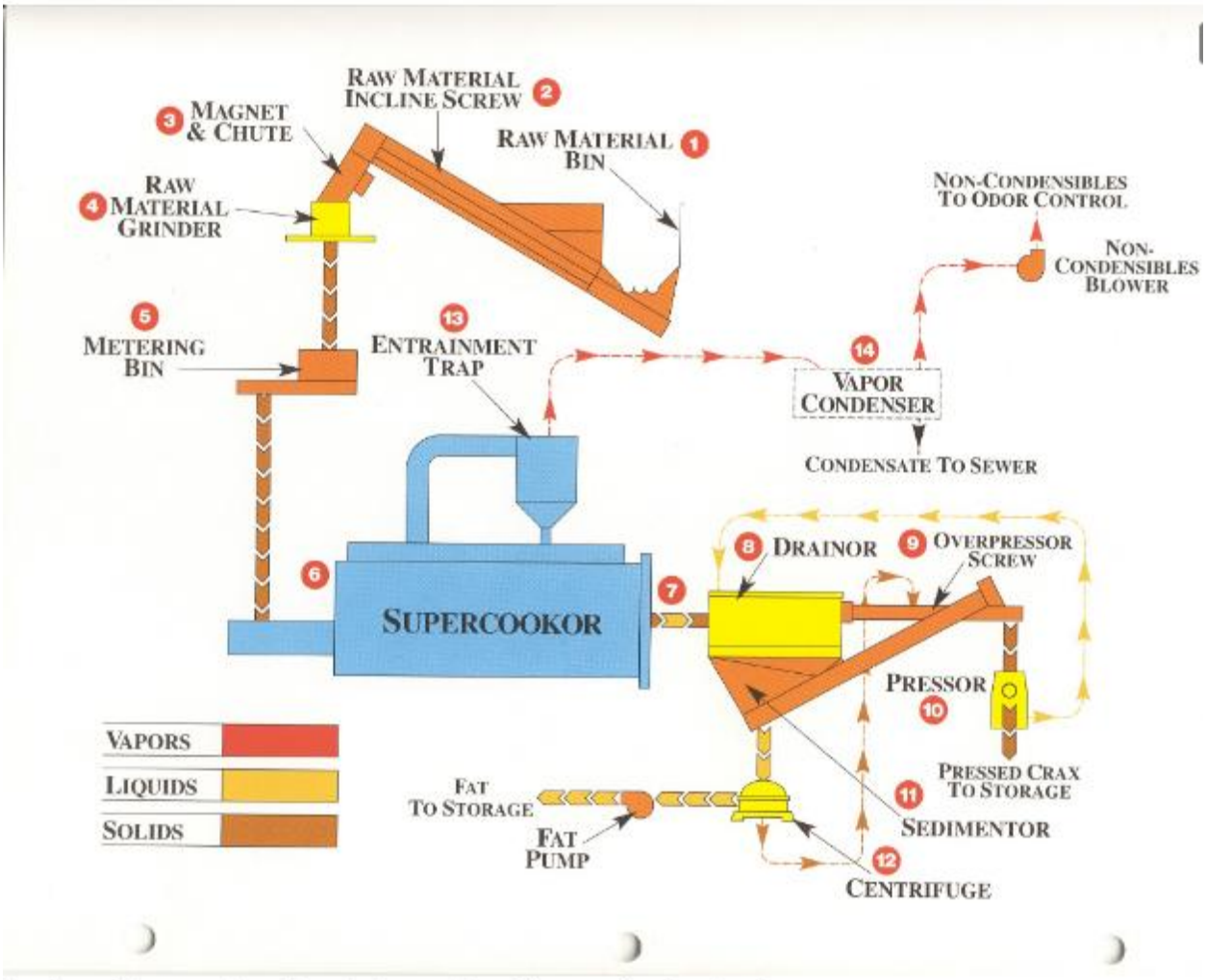


Figure: 10 rendering plant

The solids from the Discharge Conveyor go to the Screw Presses (9), which reduce the solids' fat content to about 10 to 12 percent. Solids that bypass the Screw Presses are recycled back to the Cooker. Solids discharged from the Screw Presses in the form of Pressed Cake goes to the Pressed Cake Conveyor for transport to further processing into meal. The fat removed in the Screw Presses goes to the Press Fat Conveyor (12), which separates large particles from the liquid fat and returns them to the Discharge Conveyor. The fat from the Press Fat Conveyor is pumped to the Settling Tank (10).

Fat discharged from the Drainer Conveyor (7) goes into the Settling Tank (10). In the Settling Tank the heavier bone and protein particles settle to the bottom, where they are discharged by screw conveyor into the Discharge Conveyor (8).

Liquid fat from the Settling Tank is pumped to the Centrifuge (11), which removes residual solid impurities from the fat. The solids from the Centrifuge go to the Discharge Conveyor (8). The clarified fat is transported to further processing or to storage as finished fat.

Water vapor exits the Continuous Cooker (6) through a vapor duct system that generally includes an entrainment trap to separate and return entrained particles to the Continuous Cooker. The vapor duct system transports the vapor stream to an Air Cooled Condenser (13), which condenses the water vapor. (Other forms of condensers, such as direct contact or indirect shell and tube units, may also be used.)
Non-condensable gases are removed from the Condenser by a non-condensable fan.
Odorous gases generated at various points in the process are collected by a ductwork system and are transported along with the non-condensable gases from the Condenser to an Odor Control System (not shown) for neutralization of odorous components

b) Raw In-feed

Condition of the Raw Material: Consider worst case scenarios. Type of Raw Material: A system can be modified if there are changes in materials (hard, soft, hair, blood, feathers, restaurant grease, other). Choosing a flexible system will reduce future costs

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: Short Answer Questions

1. What is the function of steam boiler? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. The continuous cooker is an agitated vessel generally heated by boiler steam (2pts)
2. Continuous rendering is continuous in-feed and continuous out-feed (2pts)

Note: Satisfactory rating - 7 points Unsatisfactory - below 7 points

Score = _____

Rating: _____

LG #66	LO #4- Monitor press or decanter and movement of solids to dryer

Instruction sheet

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

- Monitoring press or decanter
- Monitoring temperature

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:

- Monitoring press or decanter
- Monitoring temperature

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- Monitoring press or decanter

1.1 Press dewatering and wet pressing methods

Although under similar conditions, dry rendering systems use less energy than wet rendering systems, the energy conservation issue has forced renderers to seek new rendering processes that are even more energy efficient. A variety of methods have been suggested that use less heat while at the same time producing tallow and MBM of higher quality and quantity. In the press dewatering method suggested by Rendertech Limited (2002) the main processes are similar to continuous low temperature rendering (LTR) systems in that raw materials are heated until all the carcass fat is melted. After pressurizing the mixture with a double screw press, the solid protein and liquid portions are separated.

The fat layer is removed by disc centrifuge, and the main differences as compared to the batch and continuous rendering systems.

Because lower temperatures are used in the dewatering and wet pressing methods, they are sometimes called LTR methods.

The discharged slurry is transported to a drainer conveyor. The drainer conveyor separates liquid fat from the solids, which are then conveyed from the drainer conveyor by a discharge conveyor. In the discharge conveyor, solids from the drainer conveyor are combined with the solids discharge from the settling tank and from the decanter-type centrifuge.

The solids from the discharge conveyor go to the screw presses, which reduce the solids 'fat content to about 10 to 12 percent.

Solids that bypass the screw presses are recycled back to the cooker. Solids discharged from the screw presses in the form of pressed cake go to the pressed cake conveyor for transport to further processing into meal. The fat removed in the screw presses goes to the press fat conveyor, which separates large particles from the liquid fat and returns them to the discharge conveyor.

Figure: 11 centrifuge machine

The fat from the press fat conveyor is pumped to the settling tank. Fat discharged from the drainer conveyor goes into the settling tank. In the settling tank the heavier bone and protein particles settle to the bottom, where they are discharged by screw conveyor into the discharge conveyor. Liquid fat from the settling tank is pumped to the centrifuge, which removes residual solid impurities from the fat. The solids from the centrifuge go to the discharge conveyor. The clarified fat is transported to further processing or to storage as finished fat.

Water vapor exits the continuous cooker through a vapor duct system that generally includes an entrainment trap to separate and return entrained particles to the continuous cooker. The vapor duct system transports the vapor stream to a vapor condenser. Non-condensable gases are removed from the condenser by a non-condensable fan. Odorous gases generated at various points in the process are collected by a ductwork sys-

tem and are transported along with the non-condensable gases from the condenser to an odor control system for neutralization of odorous components.

The dry rendering system works by dehydrating raw material at a temperature of 240 to 290ºF (115º to 145ºC) in either a batch or continuous cooker.
It is no longer approved for edible grade fats by the USDA. The final temperature in the batch cooker varies from 250º to 275ºF (121º to 135ºC) and usually requires two to three hours of cooking time. After cooking, the product is drained, the solids are pressed (screw press or twin screw press), and the fat content is reduced from 25 percent to approximately 10 percent. The solids are then known as cracklings. The fat from pressing usually contains some fines that are removed by centrifuging or filtration. The continuous rendering system is really continuous cooking with raw material fed into one end of the cooker and cooked material discharged from the other end. The continuous system has higher capacity, occupies less space, and is more energy efficient. Other rendering processes include ring dryers, steam tube rotary dryers, and pressure cooking.

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: Short Answer Questions

1. Which rendering system requires less energy to separate the liquid from solids? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. The discharged slurry is transported to a drainer conveyor. (2pts)
2. In the settling tank the heavier bone and protein particles settle to the top, where they are discharged by screw conveyor. (2pts)

Note: Satisfactory rating - 7 points Unsatisfactory - below 7 points

Score = _____

Rating: _____

Information Sheet 2-Monitoring temperature

2.2 Monitoring temperature

Only rendering facilities that have minimum standards for elimination of the disease agent should be approved for use. Rendering processes are computer controlled in order to best achieve cooking time and temperature conditions for optimal microorganism thermal kill values. Criteria for disease elimination include:

- Material particle size - smaller pieces may result in more efficient cooking
- Temperature – the temperature of the material must be monitored continuously in the rendering vessel to ensure a minimum temperature is achieved (e.g., 260°F(127°C))
  - ✓ An alarm system must be in place to notify personnel if the operating temperature falls below the set point
  - ✓ The material must be reprocessed if the material temperature falls short
  - ✓ The final temperature of the cooker destroys harmful pathogens and produces usable end products
- Time - the material must remain at the required temperature for the appropriate time (e.g., at least 15 minutes for 260°F (127°C))
  - ✓ The input rate, relative to the size of the rendering vessel, must be monitored to ensure that the material is not processed too quickly
  - ✓ Monitoring information should be recorded for documentation purposes

Under-processing conditions will reduce the efficiency of the fat extraction and may generate contaminated products and byproducts that can spread diseases to soil, plants, animals, and people. The temperatures required for efficient fat removal are normally higher and for longer times than needed to kill common pathogens.

Figure: 12 Render cooker cylinders

2.3 Processing

Unprocessed animal by-products and mortalities contain large numbers of microorganisms, including pathogenic bacteria and viruses. Unless properly processed in a timely manner, these unstable materials provide an excellent environment for disease causing organisms to grow and potentially threaten animal health, human health, and the environment. If allowed to accumulate and decompose without restraint, these tissues would become a substantial biohazard, promoting disease, attracting and harboring rodents, insects, scavengers, and other disease vectors, and attract predatory animals into densely populated areas.

Processes and technology of rendering have changed over the years and continue to improve. Modern rendering facilities are constructed to separate raw material handling from the processing and storage areas. Process control is performed and monitored via computer technology so that time/temperature recordings for appropriate thermal kill values for specific microorganisms are achieved. Temperatures far in excess of the

thermal kill time requirements are unnecessary and avoided because they can lower nutritional values and digestibility.

Processes in North America generally do not incorporate cooking under pressure except for feathers and other high keratin containing tissues

Industry feed safety guidelines or codes of practice in both pre- and post-handling of ingredients and manufactured feed.

Table: 4 The Rendering system Destructed of Pathogenic Bacteria.

Pathogen	Raw Tissue % samples positive	Post Process % samples positive
Clostridium perfringens	71.4	0
Listeria species	76.2	0
L. monocytogenes	8.3	0
Campylobacter species	29.8	0
C. jejuni	20.0	0
Salmonella species	84.5	0

Source: Troutt et al., 2001. Samples from 17 different rendering facilities taken during the winter and summer

Low temperature separation is utilized for high product quality in finished meals and fat. The meals are still subjected to a long drying process, but the low temperature yields enhanced quality of fats due to a lower thermal stress.

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: Short Answer Questions

1. What are the quality parameters of render cooker? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Computer technology so that time/temperature recordings for appropriate thermal kill values for specific microorganisms are achieved. (2pts)
2. Low temperature separation is utilized for high product quality in finished meals and fat. (2pts)

Note: Satisfactory rating - 7 points Unsatisfactory - below 7 points

Score = _____

Rating: _____

LG #67 LO #5- Operate rendering products

Instruction sheet

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

- Identifying meat meal, blood meal, bone meal, tallow and lard products
- Processing meat meal, blood meal, bone meal, tallow and lard products

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:

- Identify meat meal, blood meal, bone meal, tallow and lard products
- Process meat meal, blood meal, bone meal, tallow and lard products

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- Identifying meat meal, blood meal, bone meal, tallow and lard products

1.1 Products Available From the Rendering Industry

Animal proteins are a valuable class of ingredients for animal nutritionists to use in feed formulas. The U.S. rendering industry manufactures products that are highly digestible, do not contain antigrowth factors, and are safe to use in livestock, poultry, pet, and aquaculture feeds. Conserved nutrients within rendered products help sustain animal agriculture and protect marginal lands from misuse.

The primary outlet that gives economic value to these products is as ingredients in animal feeds. Restricting feed use of rendered products may inadvertently result in severe economic and environmental problems, spread of disease to humans and animals, and a loss of valuable nutrients with consequential health risks for animals, especially young animals and those in intensive production (FAO, 2002).

The primary animal protein by-products are meat and bone meal (MBM), meat meal, blood meal, poultry by-product meal, poultry meal, feather meal, and fish meal. Using MBM as an example, AAFCO defines it as the rendered product from mammalian tissues including bone but exclusive of blood, hair, hoof, horn, hide trimmings, manure, and stomach and rumen contents.

MBM as defined by AAFCO must contain a minimum of four percent phosphorus with a calcium level not to exceed 2.2 times the actual phosphorus level. Ingredients of lower phosphorus content must be labeled meat meal. Rendered products that are industrial identified listed below:

i.Meat and Bone Meal

In addition to the above AAFCO description, MBM shall contain no more than 12 percent pepsin indigestible residue and not more than nine percent of the crude protein shall be pepsin indigestible.

ii.Blood Meal

Blood meal is produced from clean, fresh animal blood, exclusive of extraneous material such as hair, stomach belching's, and urine, except as might occur unavoidably in good manufacturing processes. A large portion of the moisture (water) is usually removed by a mechanical dewatering process or by condensing by cooking to a semi-solid state. The semi-solid blood mass is then transferred to a rapid drying facility where the more tightly bound water is rapidly removed. Blood products are the richest natural sources of both protein and the amino acid lysine available to the feed industry.

iii.Lard

Lard is defined as fat from pigs that is melted and strained from the cell wall tissues that encase it. The highest grade of lard is leaf lard, which is obtained from the fat around the kidneys. The next grade is from back fat and the poorest is from fat covering the small intestines. Lard is also classified by the method of preparation such as prime steam, rendered in a closed vessel into which steam is injected; neutral, melted at low temperature; kettle-rendered, heated with water added into steam-jacketed kettles; and dry-rendered, which is hashed and then heated in cookers equipped with agitators. Good lard melts quickly and is free from disagreeable odor. Pure lard (99 percent fat) is highly valued as cooking oil because it smokes very little when heated.

Unprocessed lard often has a strong flavor and a soft texture, but lard can be processed in many ways including separating it from the surrounding tissue by:

- heat,
- filtering
- bleaching, and
- Hydrogenation.

iv.Fats: or industrial Tallows:

Animal tissue containing fat is converted to tallow by a process called rendering. Basically, rendering is a procedure by which lipid material is separated from meat tissue and water under the influence of heat and pressure.

1.2 Major benefits of using animal protein meals are:

- They contain moderate to high levels of amino acids like lysine, methionine and threonine.
- If processed properly, the amino acids are highly available.
- They are rich sources of available phosphorus, calcium and trace minerals.
- Highly effective bypass protein for ruminants.
- They help sustain animal agriculture by transforming waste animal tissues into valuable products for further economic use.
- They are palatable when used in diets that are balanced for amino acids, especially lysine, methionine (and cystine), tryptophan, threonine and (for blood meal) isoleucine.

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: Short Answer Questions

1. Lard can be processed in many ways including separations, write the processing methods? (3pts)

Test II: Write true if the statement is correct and false if the statement is incorrect

1. Blood products are the richest natural sources of both protein and the amino acid. (2pts)
2. The U.S. rendering industry manufactures products that are highly digestible, and contain antigrowth factors (2pts)
3. Meat meal is the end product of rendering process used for pet food.(2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

Score = _____

Rating: _____

Information Sheet 2- Processing meat meal, blood meal, bone meal, tallow and lard products

2.1 Introduction

The process of converting dead animals or condemned meat into value added products like carcass meal is referred as rendering. Actually rendering in earlier days was referred to the process of recovery of fat from dead animals, but now- a-days, the definition also covers the production of carcass meal, meat meal and technical fat. You will be studying about the preparation of bone meal and blood meal in the next unit. By-products of poultry industry include everything from poultry farm or processing plant that may not be directly used as human food. Some of these are hatchery waste, feathers, blood, egg shell, offal, fat and manure**.**

Originally rendering means the recovery of fat from animal material by heating but with the advancement in the by-product industry, it embraces all the process leading to the conversion of slaughterhouse by-products into animal feeds, fats and fertilizers

2.2 Raw materials

Figure: 13 different raw materials

Processes and technology of rendering have changed over the years and continue to improve. Modern rendering facilities are constructed to separate raw material handling from the processing and storage areas

Figure: 14 storage bins

a) Storage bins

From a 25 kg hopper up to a 160 ton stand-alone unit. The materials used can vary from mild steel to stainless steel or a combination of both. The design can vary from single screw bins up to multiple screw bins. Our designs are based on knowledge gained from years of experience on industrial applications. Mavitec bins, hoppers and chutes are available in normal duty and heavy duty.

2.3 Preparation of Carcass Meal

For the preparation of meat cum bone meal or carcass meal, the process used is the thermal treatment i.e., rendering or sterilization. There are two types of technologies for utilization of carcass; they are dry rendering and wet rendering. Continuous low temperature dry rendering is used for producing better quality fats.

In case of large animals like cattle, buffaloes, there is a significant value of dead animals for their hide, hooves and horns and subsequent products such as meat meal,

bone meal and tallow. After separation of hide, horns and hooves, the remaining parts of the: carcass should be conveniently discarded and sometimes could be further processed.

The carcass rendering plant handles feedstock devoid of hide, Horn, hoof and rumen contents. The material contains protein, fat and water in different proportions and rendering is a process to recover proteins and fat while eliminating water. If rendering is not done, the material gets putrefied. The yield of the final product meat meal, bone meal and tallow depends largely on the weight and level of nutrition of the animal.

A) Wet rendering

The wet rendering method involves the use of pressure batch cookers in which the precut raw material is injected with live steam to a temperature of 140° C under pressure for 3-4 hours. After this time, the pressure is slowly reduced and the fat run out into a receiver and further purified by gravity or centrifugation to settle out the water and fines. The proteinaceous solids or greaves are emptied from the cooker, and the fat removed by pressure and solvent extraction. They are; then ground and dried. Bone meal preparation primarily involves the wet rendering process.

B) Dry rendering

The dry rendering process uses heat in the form of steam and water over a period of 1-2 hour at atmospheric pressure to drive out water indirectly from the fat in the cooker without loss of nutrients. Here no steam or hot water is allowed to pass into the cooking vessel, but the steam is allowed into the outer jacket only. Dry rendering yields 20 per cent more than the wet rendering process.

2.3.1 Pre rendering operations:

Raw materials originating on the killing floor should be processed with emphasis on speed and thorough cleaning, so that the end product of maximum value may be obtained. The raw materials should be prepared properly before placing it into the cooker. Head, feet, condemned carcasses from the killing floor and bones from the boning de-

partment are reduced or crushed to small pieces by shredders. Bones also can be reduced in size in machines called "pre breakers". Intestines and other soft tissue coming from the killing floor are dirty with full of feed or manure and therefore must be opened and cleaned as well as reduced in size before charging into the cookers in inedible rendering.

Table: 3 Comparisons between Dry Rendering and Wet Rendering

Wet Rendering	Dry Rendering
In wet rendering the material in its own water	In dry rendering the material is cooked in added water. Cooked
Temperature applied is about 1 10 OC and pressure of 40 psi, for 60 minutes followed by drying for about 3-4 hours	Temperature applied is about 130°C and pressure of 60 - 80 psi, for 3 - 4 hours. Better sterilization of material at higher Temperature.
The cooker is of vertical type.	The cooker is of horizontal type.
The recovery of fat is better than dry rendering. To produce good grade tallow, viscera must be cut and washed.	The recovery of fat is not better than wet rendering. Tallow is dark coloured. More tallow is lost in dry rendered meat.
Yield of carcass meal is less than dry rendering as 25 per cent of meat is lost in the gravy**.**	Yield of carcass meal is more than wet rendering

Blood meal: Unlike other products, blood meal has very high protein content, over 80 per cent and low in calcium and phosphorus. Good quality blood meal should have 85 per cent proteins and free from fat, fiber and phosphate of lime.

Meat and bone scrape, Meat and bone meal or Carcass meal: These are the terms used to describe a product whose protein content is less than 55 per cent and phosphorus content is higher than 4.5 per cent. Bones comprises of much of the proportion of the raw material for this product

Tallow or lard: Tallow is referred to as the rendered fat of cattle and sheep whereas lard is he fat from pig. otherwise the animal fat which has a titre of greater than 40°C is known as tallow and fat with a lesser titre is called lard. Titre is the temperature at which fat solidifies. It refers to the softness or hardness of tallow. Inedible tallow and grease are used in livestock or poultry feed as high energy additive. They also reduce the dust, improve colour and texture. Enhance palatability of animal feed. Fatty acids from tallow are also used in industrial. Chemicals like abrasive, lubricants, shaving cream, candles, cement additives, cleaners, cosmetics, paints, polishes, detergents, soap, plastics, printing inks, perfumes etc. Edible tallow and lard are used in oleomargarine and cooking fats.

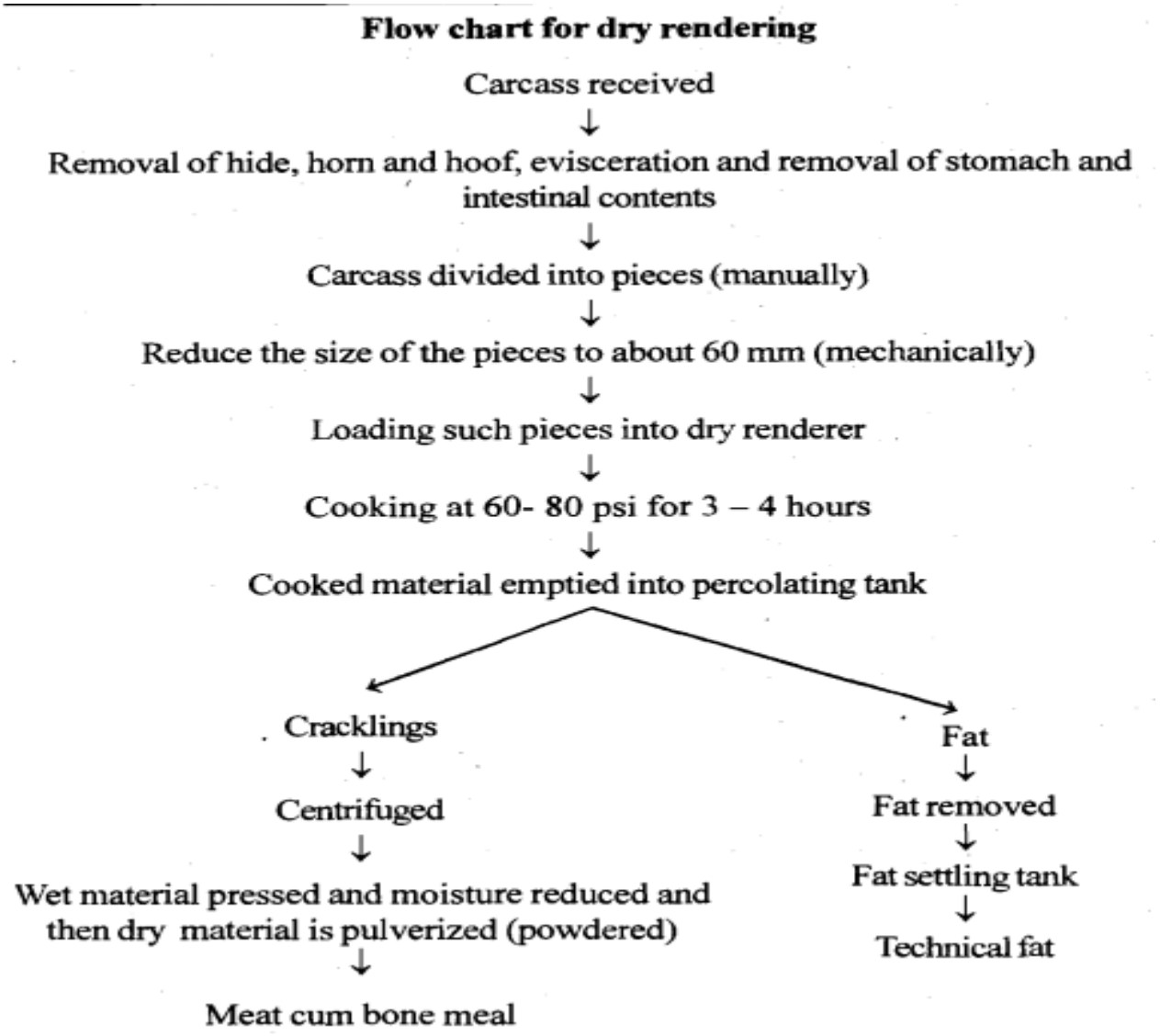


Figure: 12 -flow chart for dry rendering

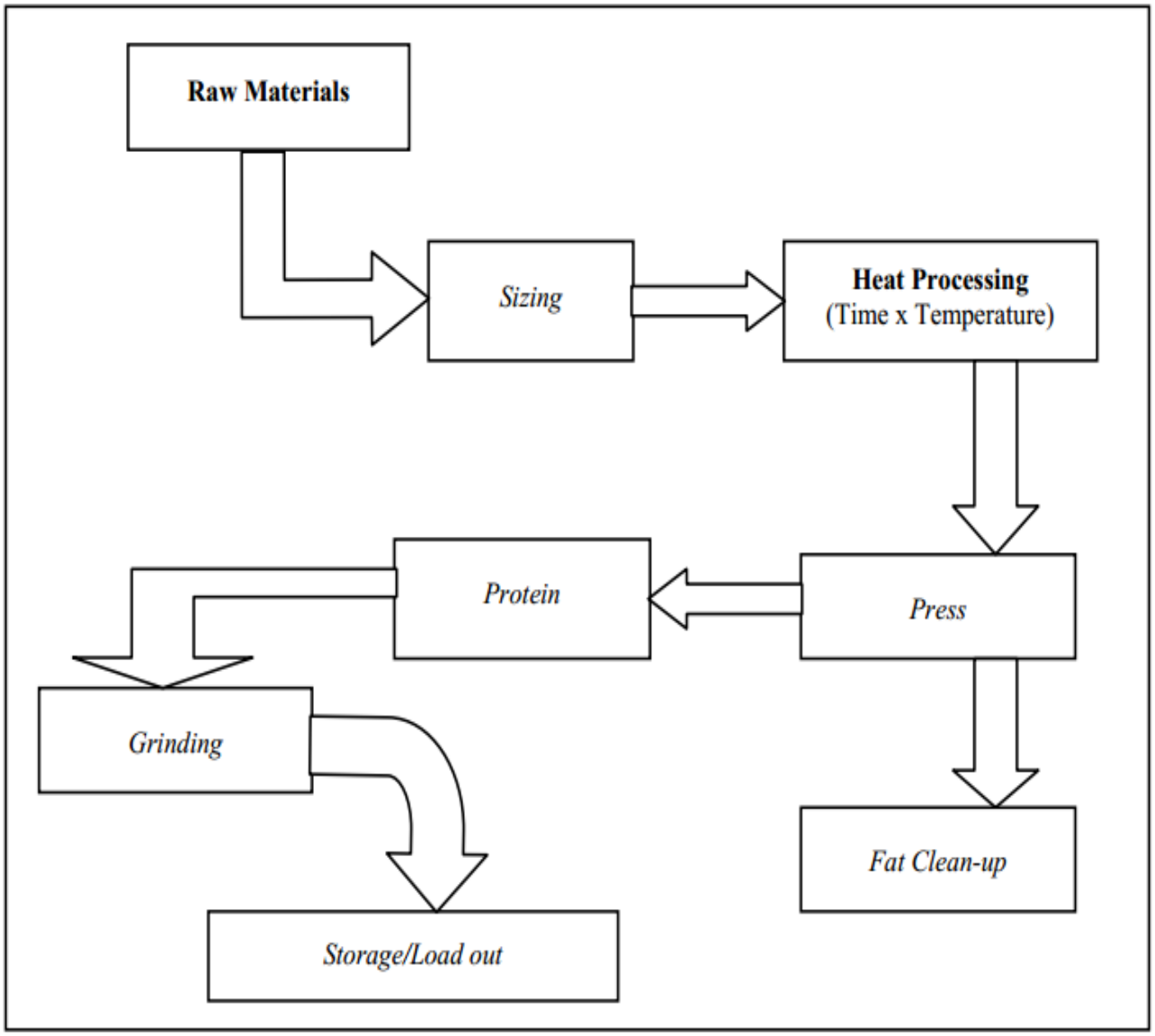


Figure: 15 render processing diagram

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: Short Answer Questions

1. Write at list four rendered meat products? (3pts)

Test II: choose the best answer from the given alternatives.

1. Animal tissue containing fat is converted to tallow by a process called__ (1 point).

A. Drying B. Boiling C. Rendering Separation.

2. Which one of the following is solid protein residue derived from the rendering process? (1 point).

A Meat meal B. Tallow C. Lard D. Bone meal

Test III: Write true if the statement is correct and false if the statement is incorrect

1. Blood meal is a finely ground protein residue derived from clean and fresh blood. (2pts)
2. Most importantly, cooking activates bacteria, viruses, protozoa, and parasites. (2pts)

Note: Satisfactory rating - 9 points Unsatisfactory - below 9 points

Score = _____

Rating: _____

Reference Materials

https://www.youtube.com/watch?v=acna2xeXMBg

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http://renderingisrecycling.com/

https://www.youtube.com/watch?v=lnCgA9l9eCY

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www.fortress Email: info-UK@fortresstechnology.com

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Answer Key

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Information-1

Test: I: 1-the display panel, the three (red, green $ yellow) indicator light, the green go button

Test II: 1. True 2. True

Information-2

Test I: 1. Ferrous, Non-ferrous, Stainless steel 2. Product composition, product characteristic and temperature variation

Test II: 1. false 2. True

Information-3

Test: I 1. Product safety, equipment protection and contact (customer) requirement

Test II: 1. True 2. True

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Information sheet-1

Test: I 1.Enterprise system and under system 2. Manual, stuffing and industrial meat mincer/grinder

Test: II 1. True 2.False

Information sheet-2

Test: I 1. True 2. False

Information sheet-3

Test: I 1. Ear plugs and ear muffs 2. Protect employees' safety and minimize hazards

Test: II 1.True 2. True 3.True

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Information-1

Test: I 1.boiler start-up, heating of the steam pipes and turbine start-up

Test: II 1.True 2. True

Information-2

Test: I 1. True 2.True

Information-3

Test: I 1. Continuous cooking

Test: II 1. True 2. True

Learning Guide 66. Information sheet-1

Test: I 1. Dry rendering
fat content

Test: II 1. True 2. False

Learning Guide #67. Information sheet -1

Test: II 1. Heat, filtration, bleaching and hydrogenation

Test: II 1. True 2. False 3. True

Information sheet-2

Test: I 1. Temperature, condensing capacity and

Test: II 1. True 2. True

Information sheet-2

Test: I 1.Tallow, lard, and meat $ bone meal

Test: II 1. True 2. False

Test: II 1. C 2. A