Spices and Herbs Processing

Level-II

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LG #65	LO #1- Prepare milling Process equipment for operation

Instruction sheet

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

- Receiving and availing raw materials.
- Confirming type and quality of materials.
- Confirming different milling operation.
- Identifying and confirming Cleaning and maintenance requirements.
- Locating milling, batch and mixing, and production areas
- Fitting and adjusting milling machine components and related attachments.
- Entering processing/operating parameters.
- Checking and adjusting Equipment
- Caring out pre-start checks.

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:

- Receive and avail raw materials.
- Confirm type and quality of materials.
- Confirm different milling operation.
- Identify and confirm cleaning and maintenance requirements.
- Locate milling, batch and mixing, and production areas
- Fit and adjust milling machine components and related attachments.
- Enter process/operate parameters.
- Check and adjust Equipment
- Carry out pre-start checks

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 1”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks 1” which is placed following all information sheets.
5. Submit your accomplished Self-check. This will form part of your training portfolio.
6. If you earned a satisfactory evaluation proceed to the next Information Sheet
7. Read the information written in the “Information Sheet 2”
8. Accomplish the “Self-check-2”
9. If you earned a satisfactory evaluation proceed to the next Information Sheet. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to “information sheet-2”.
10. Read the information written in the “Information Sheet 3”
11. Accomplish the “Self-check-3”
12. If you earned a satisfactory evaluation proceed to the next “Information Sheet”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to “information sheet-3”.
13. Read the information written in the “Information Sheet 4, 5, 6, 7, 8 and 9”
14. Accomplish the “Self-check- 4, 5, 6, 7, 8 and 9” respectively.
15. If you earned a satisfactory evaluation for each Self-check proceed to the next “Information Sheet”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to the previous “information sheet”.

Information Sheet 1- Receiving and availing raw materials

1.1 Introduction

Herbs are plants with savory or aromatic properties that are used for flavoring and garnishing food, for medicinal purposes, or for fragrances; excluding vegetables and other plants consumed for macronutrients. Culinary use typically distinguishes herbs from spices. Herbs generally refers to the leafy green or flowering parts of a plant (either fresh or dried), while *spices* are usually dried and produced from other parts of the plant, including seeds, bark, roots and fruits.

Herbs have a variety of uses including culinary, medicinal, and in some cases, spiritual. General usage of the term "herb" differs between culinary herbs and medicinal herbs; in medicinal or spiritual use, any parts of the plant might be considered as "herbs", including leaves, roots, flowers, seeds, root bark, inner bark (and cambium), resin and pericarp.

In botany, the term herb refers to a herbaceous plant, defined as a small, seed-bearing plant without a woody stem in which all aerial parts (i.e. above ground) die back to the ground at the end of each growing season

A spice is a seed, fruit, root, bark, or other plant substance primarily used for flavoring or coloring food. Spices are distinguished from herbs, which are the leaves, flowers, or stems of plants used for flavoring or as a garnish. Spices are sometimes used in medicine, religious rituals, cosmetics or perfume production.

Spices are primarily used as food flavoring. They are also used to perfume cosmetics and incense. At various periods, many spices have been believed to have medicinal value. Finally, since they are expensive, rare, and exotic commodities, their conspicuous consumption has often been a symbol of wealth and social class

1.2 There are different raw materials:

- Allspice
- Basil
- Cardamom
- Cayenne Pepper
- Cilantro
- Cinnamon
- Chive
- Cloves
- Cumin
- Dill
- Garlic
- Ginger
- Mint
- Nutmeg
- Oregano
- Parsley
- Rosemary
- Saffron
- Sage
- Tarragon
- Thyme
- Turmeric
- Red pepper
- Fenugreek
- Black, white and green pepper
- Advieh Baharat
- Berbere
- Bumbu
- Cajun
- Chaat masala
- Chili powder
- Curry powder
- Five-spice powder
- Garam masala
- Harissa Hawaij
- Jerk spice
- Khmeli suneli
- Masala Mixed spice
- Panch phoron
- Pumpkin pie spice
- Quatre épices
- Ras el hanout
- Sharena sol

Handling

A spice may be available in several forms: fresh, whole dried, or pre-ground dried. Generally, spices are dried. Spices may be ground into a powder for convenience. A whole dried spice has the longest shelf life, so it can be purchased and stored in larger amounts, making it cheaper on a per-serving basis. A fresh spice, such as ginger, is usually more flavorful than its dried form, but fresh spices are more expensive and have a much shorter shelf life.

Figure 1.1: spices powder

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 (4 point)

1. Which one of the following is not spice and herb plant?

   A. Ginger C. Garlic E. None
   B. Cardamom D. Wheat

2. From the given choose which one is personal protective equipment.

   A. Eye goggle C. Boot E. None
   B. Over all D. All

Test II: Short Answer Questions (6 point)

1. List at least 5 spices and herbs raw materials for milling operation (5 point)
2. Write down all the difference between spice and herbs. (5 point)

Note: Satisfactory rating ≥7 points Unsatisfactory <7 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Confirming type and quality of materials

There are different types of spice and herb milling or grinding materials available. So the quality of these materials must be checked based on the manufacturer specifications. After inspections the quality of each materials confirming whether they are free or not. There are two ways of confirming quality of spice and herb processed: using quality milling machine and using quality raw materials. Confirming type and quality of materials are used to reduce unnecessary costs to buy other materials and reduced contamination risks. The quality of spices and herbs is affected by:

- Origin of the spice and herbs
- Climatic conditions (space station)
- Growing conditions
- Harvested plant parts
- Harvest progress
- Transport
- Treatment
- Packaging
- Storage
- Processing
- Milling quality
- measurement,
- adding and mixing different spice blend and other additives
- sequencing of production to minimize transference and cross contamination,
- traceability procedures

Significant impact on quality

- level of crushing, yield, microbial purity, presence of dust and other contaminant
- Rarely used modern combine harvest-often is the harvest scythe and sickle
- Transport-weather, separation, pollution etc.

Limits: If we cannot used the quality raw materials and also standardized milling machines the quality of the final product will be reduced and negative effect for human

- Aflatoxins

- Cadmium (0.05 - 0.1 mg/kg)-Maximum residue levels for pesticides

Spices quality control

- In developed companies is on the first place prevention
- Detailed quality criteria are describe in specifications
- Insurance of raw material
- Regular
- Risk based
- Cover all stages of production
- Non-discriminatory
- Carried out without prior warning
- Sulphites in ginger
- Cellulose and sodium potassium and calcium salts of fatty acids in dried products
- Flow of the production process
- Quality characteristics and uses of finished spice and herbs
- Operating requirements and parameters and corrective action required where operation is outside specified operating parameters
- Methods used to monitor the process, such as inspecting, measuring and testing as required by the process
- contamination risks and related controls OHS hazards and controls, including dust, contamination and materials requiring special handling procedures and emergency assembly areas.

Figure 2.1: Pin miller

Pin Mill is suitable to grind crystal and brittle materials. The output fineness can be changed by replacement of the filtering-screen and adjustment of the rotor speed. With a wild range of applications to a variety of products, and the features of optional grind disc replacement for proper materials. Especially, this machine is easy to clean (water rinse) and do maintenance.

Figure 2.2: hammer miller

Hammer Mill use the cutting knife and the liner, material are crushed by the impact and cut force. If material size remains big, impact will exceed the centrifugal force, knives will recede (moving back and forth) to protect knife shaft and crushing efficiency remains the same.

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: Choose the best answer (4points)

1. What are the factors that can influence the quality of spice and herb milling?
   A. Packaging
   B. Processing
   C. Milling quality
   D. Appropriate measurement
   E. All
2. Which one of the following is a significant impact on quality
   A. level of crushing & microbial purity
   B. presence of dust & Rarely used modern combine harvest
   C. Transport and separation problem
   D. All
   E. None

Test II: Short Answer Questions (12points)

1. What is the advantage of confirm quality of materials?
2. Write down some of the spices quality control methods
3. What are the common causes of risks during the use of low quality spice processing?

Note: Satisfactory rating ≥8 points Unsatisfactory <8 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Confirming different milling operation

A mill is a device that breaks solid materials into smaller pieces by grinding, crushing, or cutting. Such comminution is an important unit operation in many processes. There are many different types of mills and many types of materials processed in them. Milling also refers to the process of breaking down, separating, sizing, or classifying aggregate material. When we perform the grinding/milling of ingredients of spices and herb generally included different operations such as:-

- Wearing PPE,
- Preparing raw materials,
- Cleaning,
- Sorting/grading,
- Drying,
- Adding different additives,
- Mixing well
- Adjusting milling machines or materials,
- Checking the functionality of materials,
- Milling/grinding of spices,
- Controlling milling environment (Temperature regulation),
- Receiving milled powder and clean after the completion of the work.

These improve digestibility, acceptability, mixing properties, palatability and increases the bulk density of some ingredient. It is accomplished by many types of manual and mechanical operations involving impact, attrition, and cutting.

There are different spices and herb milling operations are available but receiving and confirming the appropriate material is very crucial to increase the quality of the produces. Use precision measurement equipment within the scope of this unit setting up work using tools, techniques and equipment:

- Full Circle Hammer Mill
- Y-Series Cage Mill

- F-Series Cage Mill
- H-Series Cage Mill
- Cryogenic Grinders
- Ball Mill
- Mini Pulveriser
- Micro-Pulvariser
- Hammer mills:
- Grinders

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: Short Answer Questions (12 points)

1. _____ is a device that breaks solid materials into smaller pieces by grinding, crushing, or cutting
2. Mention different operations that we perform during grinding/milling of ingredients of spices and herb.
3. List types of milling machine.

Note: Satisfactory rating ≥ 6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4- Identifying and confirming cleaning and maintenance requirements

4.1. Confirming general cleaning

Cleaning to remove salt water, sand, mud, and other relatively harmless environmental contaminants is intended to reduce degradation to the equipment and improve comfort during the next use. In most cases soaking or rinsing in fresh water is sufficient, but detergents and occasionally scrubbing before rinsing can speed up the process. This basic cleaning may remove some pathogens and chemical contaminants, but it is not reliable for this purpose. This level of cleaning has traditionally been considered sufficient for equipment only used by one person in environments considered to be free of chemical and microbial health hazards. Clean-in-place (CIP) is a method of cleaning the interior surfaces of pipes, vessels, process equipment, filters and associated fittings, without disassembly.

a) Disinfection before use

Disinfection of equipment before use, or between users, is intended to remove biological contamination that would affect the next diver to use it. This is generally an issue when the equipment is not contaminated by substances or microorganisms which are harmful to the equipment, but could infect and cause illness in the next user, or in the special case of potable water diving, could contaminate the drinking water supply. If there is not sufficient time and facilities to adequately disinfect between users, equipment which could infect the user should not be shared.

b) Cleaning after use

Cleaning after use is generally intended to remove contaminants which may degrade the equipment, and which may be harmful to persons coming into normal handling contact with the equipment. It may be combined with disinfection suitable to prepare the equipment for use by another person, but the two aspects are not necessarily managed identically or together.

4.1.1. Factors affecting the effectiveness of the cleaning agents

a. Temperature of the cleaning solution. Elevating the temperature of a cleaning solution increases its dirt removal efficiency. Molecules with high kinetic energy dislodge dirt faster than the slow moving molecules of a cold solution.
b. Concentration of the cleaning agent. A concentrated cleaning solution will clean a dirty surface much better than a dilute one due to the increased surface binding capacity.
c. Contact time of the cleaning solution. The longer the detergent contact period, the higher the cleaning efficiency. After some time, the detergent eventually dissolves the hard stains/soil from the dirty surface.
d. Pressure exerted by the cleaning solution (or turbulence). The turbulence creates an abrasive force that dislodges stubborn soil from the dirty surface.

4.2. Maintenance

The technical meaning of maintenance involves functional checks, servicing, repairing or replacing of necessary devices, equipment, machinery, building infrastructure and supporting utilities in industrial, business, governmental, and residential installations. Over time, this has come to include multiple wordings that describe various cost-effective practices to keep equipment operational; these activities occur either before or after a failure. Maintenance functions are often referred to as maintenance, repair and overhaul (MRO) and MRO is also used for maintenance, repair and operations. Over time, the terminology of maintenance and MRO has begun to become standardized

- Any activity-such as tests, measurements, replacements, adjustments, and repairs-intended to retain or restore a functional unit in or to a specified state in which the unit can perform its required functions.
- All action taken to retain material in a serviceable condition or to restore it to serviceability. It includes inspections, testing, servicing, classification as to serviceability, repair, rebuilding and reclamation.
- All supply and repair action taken to keep a force in condition to carry out its mission.

- The routine recurring work required to keep a facility (plant, building, structure, ground facility, utility system, or other real property) in such condition that it may be continuously used, at its original or designed capacity and efficiency for its intended purpose.

The basic types of maintenance falling under MRO include:

- Preventive maintenance, also known as PM
- Corrective maintenance, where equipment is repaired or replaced after wear, malfunction or break down
- Predictive maintenance, which uses sensor data to monitor a system, then continuously evaluates it against historical trends to predict failure before it occurs
- Reinforcement

Preventive maintenance (**PM**) is "a routine for periodically inspecting" with the goal of "noticing small problems and fixing them before major ones develop. Main objective of PM are:

- Enhance capital equipment productive life.
- Reduce critical equipment breakdown.
- Minimize production loss due to equipment failures.

A. Planned maintenance

Planned preventive maintenance (PPM), more commonly referred to as simply planned maintenance (PM) or scheduled maintenance, is any variety of scheduled maintenance to an object or item of equipment. Specifically, planned maintenance is a scheduled service visit carried out by a competent and suitable agent, to ensure that an item of equipment is operating correctly and to therefore avoid any unscheduled breakdown and downtime

B. Predictive replacement

Predictive replacement techniques are designed to help determine the condition of in-service equipment in order to estimate when maintenance should be performed.

This approach promises cost savings over routine or time-based preventive maintenance, because tasks are performed only when warranted. Thus, it is regarded as condition-based maintenance carried out as suggested by estimations of the degradation state of an item. Predictive replacement is the replacement of an item that is still functioning properly. Usually it's a tax-benefit based replacement policy whereby expensive equipment or batches of individually inexpensive supply items are removed and donated on a predicted/fixed shelf life schedule. These items are given to tax-exempt institutions

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: Fill the blank space (12 points)

1. _____is a method of cleaning the interior surfaces of pipes, vessels, process equipment, filters and associated fittings, without disassembly.
2. _____is "a routine for periodically inspecting" with the goal of "noticing small problems and fixing them before major ones develop
3. _____involves functional checks, servicing, repairing or replacing of necessary devices, equipment, machinery, building infrastructure, and supporting utilities in industrial, business, governmental, and residential installations.

Test II: Short Answer Questions (6 points)

1. Discusses the Main objective of Primary maintenance.
2. List the basic types of maintenance falling under MRO.

What are the Factors affecting the effectiveness of the cleaning agents?

Note: Satisfactory rating ≥8 points Unsatisfactory <8 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 5- Locating milling, batch and mixing, and production areas

In order to produce quality of milled and processed spice and herbs, the milling, batch and mixing, and production areas of spice and herbs will be locating in appropriate conditions. The areas which are milling, batch and mixing and production of spice and herbs should include the following criteria's:-

- The areas which are suitable for operations
- Sufficient spaces for operations
- Availability of raw materials
- Accessibility of electricity
- Proximity to markets
- Convenient infrastructure like road, transport facilities
- Availability of packaging materials

5.1. Mixing location

In powder two different dimensions in the mixing process can be determined: convective mixing and intensive mixing. In the case of convective mixing material in the mixer is transported from one location to another. This type of mixing leads to a less ordered state inside the mixer; the components that must be mixed are distributed over the other components. With progressing time the mixture becomes more randomly ordered. After a certain mixing time the ultimate random state is reached. Usually this type of mixing is applied for free-flowing and coarse materials. Possible threat during macro mixing is the de-mixing of the components, since differences in size, shape or density of the different particles can lead to segregation.

5.2. Mixing

- Also referred to as blending
- Combines and disperses two or more components into one another to achieve and maintain a uniform mixture and/or an alteration to the functional or aesthetic qualities of the food product (e.g., texture)

- Type of equipment depends on the form of the food components—gas/liquid, liquid/liquid, liquid/solid, solid/solid

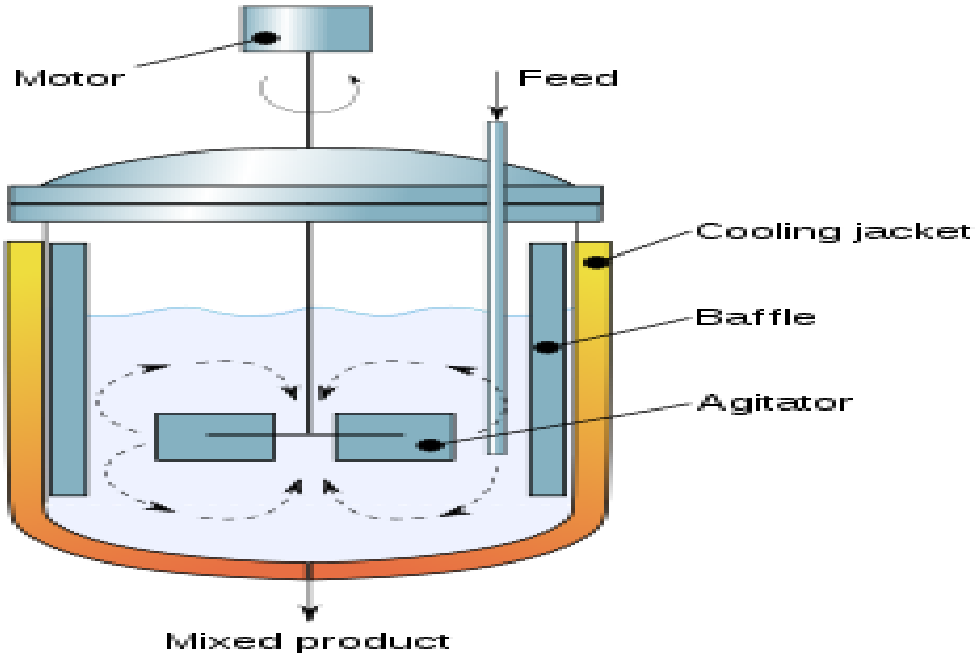

Figure 5.1: Spice mixing machines

Self-Check –5	Written test

Name…… ID…… Date…….

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

Test: Short Answer Questions (12 points)

1. What are the criteria's to choose suitable areas for milling, batch and mixing and production of spice and herbs?
2. What is the importance of locating appropriate conditions for spice and herbs milling and mixing?
3. What is the difference between convective mixing and intensive mixing in terms of location?

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 6- Fitting and adjusting milling machine components and related attachments

Every machines and equipments should be properly arranging, or adjusting and fitting based on their manufacturer specification. If not perform or adjust properly it is difficult to do any activities and causing of equipment injuries. Interchangeable parts are parts (components) that are, for practical purposes, identical.

- They are made to specifications that ensure that they are so nearly identical that they will fit into any assembly of the same type.
- One such part can freely replace another, without any custom fitting, such as filing.
- This interchangeability allows easy assembly of new devices, and easier repair of existing devices, while minimizing both the time and skill required of the person doing the assembly or repair.

A machine tool is a machine for handling or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing, or other forms of deformation.

- Machine tools employ some sort of tool that does the milling, mixing, cutting or shaping.
- All machine tools have some means of constraining the work piece and provide a guided movement of the parts of the machine.

Self-Check – 6	Written test

Name…… ID…… Date…….

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

Test: Fill the blank space (4 points)

1. _____are parts (components) that are, for practical purposes.
2. _____is a machine for handling or machining metal or other rigid materials, usually by milling, mixing, cutting or shaping.

Test II: Short Answer Questions (6 points)

1. What is the advantage of ensure interchangeability materials are must be nearly identical and the same type from the original?
2. What are the ill-effects or consequence of not adjusting or fitting of machine properly?

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 7- Entering processing/operating parameters

For processing of spice and herb the following comprehensive operational steps are considered, the pre- and post-drying steps of cutting, separating, drying and grinding the product before storage were also carried out under inert conditions. The influence of these pre-processing steps on the drying behavior is characterized by determining the transport properties. The quality of ground and the whole spice is mainly determined by its seasoning power. The stability of the quality of spice, during milling and storage is dependent on:-

- Contain and maintain its natural color i.e., carotenoid content,
- The particle size and water content.
- Selection of proper drying conditions
- Necessary to minimizing thermal stress,
- Adjusting Milling machine for specific spices, and
- Reducing over-drying and maintenance of relevant compounds which determine the quality parameters of the product.

Self-Check –7	Written test

Name…… ID…… Date…….

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

Test: Short Answer Questions (6 points)

1. What are the comprehensive operational steps are considered during the pre- and post-drying steps?
2. Mention the stability of the quality of spice, during milling and storage

Note: Satisfactory rating ≥3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers

Information Sheet 8- Checking and adjusting Equipment

Not only spice milling machines but also all tools and equipments must be regularly checking and adjusting before starting to the work and after the completion of the work. The advantages of checking and adjusting of milling machine before starting to the work is:

- Avoid the milling spices and herbs from contamination
- Prevent the materials from any injury
- Ensuring the materials functionality
- Give information for operator about the adjustment of the materials

The advantages of checking and adjusting of milling machine after the completion of the work is:

- Understanding which materials are required for maintenance
- Identifying the materials which needs repair
- Separating the normal materials from the un functional

Equipment Performance and Maintenance include:

- Proper design
- Preventative maintenance
- Contractor control
- Equipment calibration
- Temporary repair procedures

The equipment must have:

- Accurate metering to ensure the required quality is achieved
- The ability to mill the spice and herbs into a range of their specifications
- The ability to handle a range milled products with their pungent, aroma and flavors
- A range of easily adjustable machines to suit for operations
- Uniform milling/grinding stage

- Sufficient hopper capacity to maintain output

Making checks the documentation required by organization is Complete, clear and accurate. All activities that under taken in agricultural crop planting /sowing including the plan and the scheduling for planting must be documented and this data may be required by the organization or other regulating bodies. Hence as an expert you are able to give the document that is completed clearly and accurately during the progress of the planting process

Self-Check – 8	Written test

Name…… ID…… Date…….

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

Test: Short Answer Questions (12 points)

1. Write down the characteristics of equipment performance and maintenance.
2. What is the advantages of checking and adjusting of milling machine after the completion of the work?
3. The advantages of checking and adjusting of milling machine after the completion of the work?

Note: Satisfactory rating ≥ 6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 9- Caring out pre-start checks

An effective pre-start check program will make spice and herbs and equipment more reliable. Fewer breakdowns will mean less dangerous contact with machinery is required, as well as having the cost benefits of better productivity and efficiency. Some items of spice and herbs, and equipment may have safety-critical features where deterioration would cause a risk.

Before starting the work

- Decide if the work should be done by specialist experts. Never take on work for which you are not prepared or competent
- Plan the work carefully before you start, ideally using the manufacturer's maintenance instructions, and produce a safe system of work. This will avoid unforeseen delays and reduce the risks
- Make sure maintenance staff are competent and have appropriate clothing and equipment
- Try and use downtime for maintenance. You can avoid the difficulties in co-ordinating maintenance and production work if maintenance work is performed before start-up or during shutdown periods.

You must have arrangements in place to make sure the necessary inspections take place. But there are other steps to consider:

Visual inspection

- All tools, testing equipment and PPE should be visually inspected before each use for signs of damage.
- 'pre-start' visual inspection procedures in place to ensure that equipment such as, tools, PPE, rubber mats and LV rescue kits are in good working order before use.
- Testing equipment should be checked for damage to insulated leads and probes and needs to be confirmed as working before use.

Testing of equipment

Testing equipment should be tested regularly to ensure it provides the level of protection required. Testing intervals will depend on several factors including:

- the frequency of use
- the environment in which it is being
- manufacturer's advice

A. Match employee skill sets with assigned tasks

Once you identify and prioritize your equipment, move on to the skill set that's required for each maintenance task. By properly assigning tasks to the right level of trained employee or outside consultant, you'll maximize your labor investment. You may want to invest in ongoing training of this team, so they can perform the required maintenance tasks completely and effectively without fail.

B. Mindfully schedule work orders

The next step in implementing a preventive maintenance program is to set up efficient work patterns for your maintenance technicians. If you can minimize the time technicians spend traveling from one service project to the next, you'll find that your entire maintenance department will run more smoothly and efficiently. In addition, you can schedule maintenance tasks when production lines are naturally down instead of interrupting workflows. The time and travel component can be a big opportunity to save resources in a preventive maintenance program.

C. Weave recurring work orders into the daily schedule

Once you've established your maintenance schedule, be sure to incorporate frequent inspections before components of parts are expected to break down. Most manufacturers can provide recommended guidelines as a starting point. Don't forget to listen to your operators and document all tasks, repairs, and work completed, so that you'll have an accurate

D. Record for future reference

Follow your preventive maintenance schedule as closely as possible. One metric is to compare the number of projects that are scheduled to be completed with those that actually get finished in a particular period of time.

Self-Check – 9	Written test

Name…… ID…… Date…….

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

Test: Short Answer Questions (12 points)

1. What are the several factors that can influence testing intervals?
2. How to testing equipment regularly?
3. Which materials are done visual inspection?

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

LG #66	LO#2-Describe main risks to milling operations

Instruction sheet

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

- Explaining importance of dust control and procedures.
- Identifying additives milled together with spice and herbs
- Describing and explain typical pests and control procedures.
- Describing main risks to quality.
- Identifying environmental procedures for mill operations

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**:

- Explain importance of dust control and procedures.
- Identify additives milled together with spice and herbs
- Describe and explain typical pests and control procedures.
- Describe main risks to quality.
- Identify environmental procedures for mill operations.

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 1”. 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. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer

Information Sheet 1- Explaining importance of dust control and procedures

Airborne contaminants occur in the gaseous form (gases and vapours) or as aerosols. In scientific terminology, an aerosol is defined as a system of particles suspended in a gaseous medium, usually air in the context of occupational hygiene, is usually air. Aerosols may exist in the form of airborne dusts, sprays, mists, smokes and fumes.

Dust: small solid particles, conventionally taken as those particles below 75 µm in diameter, which settle out under their own weight but which may remain suspended for some time. According to the "Glossary of Atmospheric Chemistry Terms (IUPAC, 1990), "Dust: Small, dry, solid particles projected into the air by natural forces, such as wind, volcanic eruption, and by mechanical or man-made processes such as crushing, grinding, milling, drilling, demolition, shoveling, conveying, screening, bagging, and sweeping. Dust particles are usually in the size range from about 1 to 100 µm in diameter, and they settle slowly under the influence of gravity."

Examples of the types of dust found in the work environment include:

- **Mineral dusts,** such as those containing free crystalline silica (e.g., as quartz), coal and cement dusts;
- **Metallic dusts,** such as lead, cadmium, nickel, and beryllium dusts;
- **Other chemical dusts,** e.g., many bulk chemicals and pesticides:
- **Organic and vegetable dusts,** such as flour, wood, cotton and tea dusts, pollens;
- **Biohazards,** such as viable particles, moulds and spores
- Dusts are generated not only by work processes, but may also occur naturally, e.g. Pollens, volcanic ashes, and sandstorms.

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 (4 point)

1) Which one of the following are metallic dusts?

A. lead C. beryllium dusts E. None
B. nickel D. All

2). From the given choose which one is organic and vegetable dusts?

A. flour, C. cotton and tea D. pollens;
B. wood, dusts, E. All

Test II: Short Answer Questions (6 point)

1. _____ are generated not only by work processes, but may also occur naturally.
2. _____ is defined as a system of particles suspended in a gaseous medium, usually air.
3. Least at list 3 examples of dusts.

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Identifying additives milled together with spice and herbs

Spice additives

- Additives are substances added to food to preserve flavor or enhance its taste, appearance, or other qualities.
- Most additives are only permitted to be used in certain foods and are subject to specific quantitative limits. For instance in Europe, list should be used in conjunction with the appropriate European Union legislation.
    - ✓ Colors (E100 – E180)
    - ✓ Preservatives (E200 – E285)
    - ✓ Antioxidants (E300-E392)
    - ✓ Sweeteners (E400, E900)
    - ✓ Emulsifiers, stabilizers, thickeners and gelling agents (E300, E400)
    - ✓ Sodium Nitrate E251
    - ✓ Sodium Nitrite E250
    - ✓ Potassium nitrate E252
    - ✓ Potassium nitrite E249
    - ✓ 3.5 mg/kg of body weight, daily intake limit
    - ✓ NO (nitric oxide) is formed at the end of curing
    - ✓ They can react with amino acids and form nitrosamines, usually under very high temperatures

The following value-added spices and herbs products from developing countries:

- Crushed or ground spices and herbs, such as pepper, capsicum, vanilla, cinnamon, cloves, nutmeg, cardamoms, coriander seeds, cumin seeds and ginger.
- Curry mixtures (registered under code 0910.9105 in the Harmonized System (HS)) and mixtures of spices and herbs (whole spices and herbs mixtures and crushed/ground spices and herbs mixtures, registered under HS code 0910.9110 and HS code 0910.9190, respectively).
- Consumer-packaged whole, crushed, ground and mixtures of spices and herbs (such as Goya Seasoning with pepper from Latin America), which are not traded under a specific HS code.

These three categories form a subsequent chain of **value addition:**

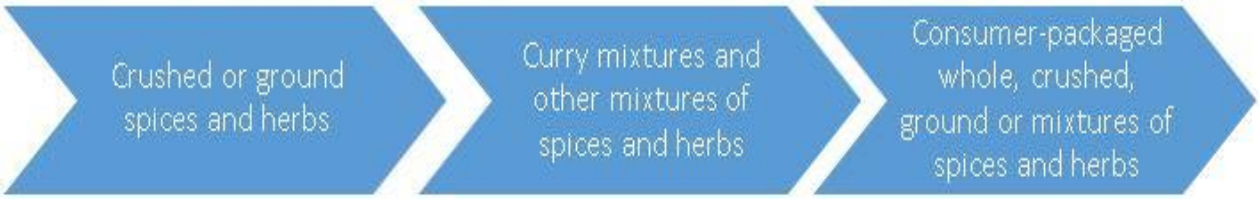

Figure 2.1: Three main steps in value addition for spices and herbs

Used parts of spices

- the roots and rhizomes
- peel
- leaves and whole plants
- the flowers, buds and other parts of the flower fruits and their parts, esp. seeds
- The underground parts of plants: ginger, turmeric, horseradish, etc.
- Tree bark: cinnamon
- Leaves and whole plants: bay leaf, marjoram, tarragon, savory, basil, oregano, thyme, mint and others
- Flowers and floral components: cloves, saffron, capers, and others
- Fruits: anise, fennel, cumin, pepper, paprika, allspice, etc.
- Seeds and seed components: mace, nutmeg, mustard

The turmeric content in curry powder blends ranges from 10-15% to 30%. Typical Indian curry powder for meat and fish dishes contains 20-30% turmeric, 22-26% coriander, 12% and 10% cardamom and cumin, respectively, 4% or 10% fenugreek, ginger, cayenne, cloves and fennel in proportions from 1% to 7%. Curry mixes for vegetarian dishes contain less turmeric, in the range of 5 to 10%, because of the bitter flavor it would impart to the dish.

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: Short Answer Questions (12 points)

1. What do you mean Additives?
2. Discus some important additives milled together with spice and herbs.
3. What is the importance of spice and herbs in terms of nutritional properties?
4. Mention the three main steps in value addition for spices and herbs

Note: Satisfactory rating ≥ 6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Describing and explain typical pests and control procedures

Pest control is an essential part of Good Manufacturing Practice in food processing from hygiene, economic and regulatory viewpoint. Pests can carry a wide range of diseases causing organisms, including bacteria, viruses, protozoa and helminths that can cause harm to consumers and staff of businesses processing and handling food. They can also cause physical contamination of ingredients and processed products from, for example, droppings, shed fur and feathers, body parts, nesting material and damaged packaging.

Top pest concerns for food processors: The range of pests found in spice and herb processing plants will vary according to climate, geography and food ingredients processed, but the most common ones are beetles, moths, rodents, cockroaches, and flies. **Stored product insects (SPIs):** One of the most expensive pests and it is a generic term that covers beetles, weevils, moths and mites (which are actually arachnids) infesting food in storage anywhere in the food chain from the farm to the kitchen. Common stored product pests and the foods they infest are:

Moths

- Indian meal moth: nuts, dried fruit and grain.
- Mill moth: flour.
- Tropical warehouse moth: stored cereal, nuts, dried fruit, oil seeds and oil cakes.
- Warehouse moth: cocoa beans, chocolate confectionery, dried fruit and nuts.

Beetles & weevils

- There is a very large number of species of beetle and weevil that feed on dried foods such as: cereals/grains, flour, seeds, nuts, pulses, dried fruit, chocolate, spices and processed products including pasta.

Mites

- Cheese mite: cheese, nuts, dried eggs, fruit, flour, tobacco.

- Flour or grain mites: spice and herbs, cereals, dried vegetable materials, cheese, corn and dried fruits.

Rodents

- The ship rat, which used to be more common, is generally confined to some port areas.
- Rats and mice are attracted by food supplies and do not venture far from their shelter or nesting sites, so in a large facility will nest close to accessible food stores.
- Rats and mice are capable of a rapid increase in population given an abundant food supply due to the number of litters they are capable of producing and the time to maturity, shelter from predators and benign environmental conditions inside a building.

The goal of the pest control program is to primarily prevent the entry of pests into the food plant, as well as, eliminate pests that do enter the facility. Pests include (but are not limited to): rodents, insects and birds. Stored product insect pests are controlled by using standard quality-control measures throughout the supply chain, such as

- fumigation and food hygiene practices,
- managing suppliers, logistics companies, incoming shipments,
- Storage of raw materials, processing, packaging and storage of final product.
- Pests caught in insects traps
- Control of rodents involves the elimination of harbourage in and around buildings and preventing access to food, water and shelter. There may be many points of entry to a building, such as cracks, vents, pipes, cabling, drains, doorways, and windows, screens, where measures can be taken to prevent access.
- Any rodents present must be controlled using traps or poison according to acceptable practices and legislation related to food processing
- The pest control activity can be carried out through a combination of pest control contractor and in-house involvement, which meets all regulatory requirements.

- The pest control practices that assist a company in maintaining a pest free environment include (but are not limited to): Regular inspections by a certified/licensed pest control company or employee. A process that eliminates pests and/or circumstances which permitted a pest presence, if pests are found.
- Follow-up to verify effective elimination of pests and circumstances that permitted a pest presence.
- Domestic and wild animals should be excluded from production and handling areas
- Utilization of approved chemicals and baits, according to written procedures.
- Thorough documentation of pest control activity.
- Analysis of trends to monitor and optimize performance of the Pest Control Program.
- On-going training program for company personnel to keep them up to date with regulatory and technical developments in pest control.
- Using Integrated Pest Management: Control of pests in food processing requires the implementation of an Integrated Pest Management program. This has three basic steps:
    - ✓ inspection,
    - ✓ identification and
    - ✓ Treatment but is a complex process that requires specialist expertise to implement to achieve accredited food standards and comply with legislation.

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: Short Answer Questions (10 points)

1. _____is an essential part of good manufacturing practice in food processing from a hygiene, economic and regulatory viewpoint Discuses the common Stored product insect control methods
2. List the most expensive pests and found in spice and herb processing plants.
3. Define the term Integrated pest management and list their steps

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4- Describing main risks to quality

Spice and herbs are needs intensive care for its quality, unless they are becoming toxic and produce aflatoxin that causes illness for human in different way. Risks are happen during different spice processing operations starting from post harvest handling up to delivering to the final consumers. Among the main activities milling or grinding is exposing to risks. Some common definitions of risk:

- Risk is a measure of the probability and severity of adverse effects.
- Risk is a situation or event where something of human value (including humans themselves) is at stake and where the outcome is uncertain.
- Risk is an uncertain consequence of an event or an activity with respect to something that human value.
- Risk refers to uncertainty of outcome, of actions and events.
- Risk is the combination of probability of an event and its consequences.
- Risk is equal to the two-dimensional combination of events/consequences and associated uncertainties.
- Risk is uncertainty about and severity of the consequences (or outcomes) of an activity with respect to something that humans value.

Different factors that can cause the quality of spice and herb processed products. Among these:

A. Environmental Hygiene

Source plants for spices and dried aromatic herbs should be protected, to the extent practicable, from contamination by human, animal, domestic, industrial and agricultural wastes which may be present at levels likely to be a risk to health. Adequate precautions should be taken to ensure that these wastes are disposed of in a manner that will not contaminate plants and constitute a health hazard to consumers of the final product.

B. Location of the production site

The proximity of production sites that pose a high risk for contamination of source plants, such as animal production facilities, hazardous waste sites and waste treatment facilities, should be evaluated for the potential to contaminate production fields for source plants for spices and dried aromatic herbs with microbial or other environmental hazards.

Consideration of production site location should include an evaluation of the slope and the potential for runoff from nearby fields, the flood risk as well as hydrological features of nearby sites in relation to the production site. When the environmental assessment of the site of production identifies a potential food safety risk, measures should be implemented to prevent or minimize contamination of source plants for spices and dried aromatic herbs at the production site.

C. Wild and domestic animals and human activity

Many wild and domestic animal species and humans that may be present in the production environment are known to be potential sources of food-borne pathogens. Domestic and wild animals and human activity can present a risk both from direct contamination of the crop and soil as well as from contamination of surface water sources and other inputs. The following should be considered:

- Domestic and wild animals should be excluded from production and handling areas, to the extent possible, using appropriate control methods. Methods selected should comply with local, regional, and national environmental and animal protection regulations.
- If animals are used in the harvest of source plants for spices and dried aromatic herbs, care should be taken to ensure that the animals do not become a source of contamination, e.g. by animal faeces.
- Production and handling areas for source plants for spices and dried aromatic herbs should be properly maintained to reduce the likelihood of pest attraction. Activities to consider CAC/RCP 42-1995 6 include efforts to minimize standing

water in fields, to restrict access by animals to water sources, and to keep production sites and handling areas free of waste and clutter

- Source plant production sites and handling areas for spices and dried aromatic herbs should be evaluated for evidence of the presence of wildlife or domestic animal activity (e.g. presence of animal faeces, large areas of animal tracks, or burrowing).

Controlling and Managing risk is very necessary in order to enhance and maintain the quality of the processed spices. Among the controlling techniques frequent assessment and evaluation is critical.

Figure 4.1: Risk management process

Figure 4.2: Quality standards

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: Short Answer Questions (12 points)

1. _____ is uncertainty about and severity of the consequences (or outcomes) of an activity with respect to something that humans value.
2. Discuses risk management process
3. Mention and discuss the factors that can cause the quality of spice and herb processed products.
4. What is the advantage of controlling and managing risk?

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 5- Identifying environmental procedures for mill operations

The Environmental Management can be classified based on four major elements which are:

- Good operating practices,
- Process changes,
- Substitution of materials and
- Source reduction.

However, the options generated are not definitely fully depending on these four elements. Good Operating or Management Practices can often be implemented with little cost. Waste reduction is more cost-effective and easier than recycling because it reduces the amount of item that needs to be collected, transported and processed.

Spices	Herbs
Harvest ↓ Drying ↓ Winnowing ↓ Transport ↓ Finish drying ↓ (Grinding) ↓ Packing ↓ Storage ↓ Distribution	Harvest ↓ Transport ↓ Sorting ↓ Washing ↓ Cutting ↓ Drying ↓ Winnowing ↓ Packing ↓ Storage ↓ Distribution

Figure: The general structures and procedures for mill operations of spice and herb.

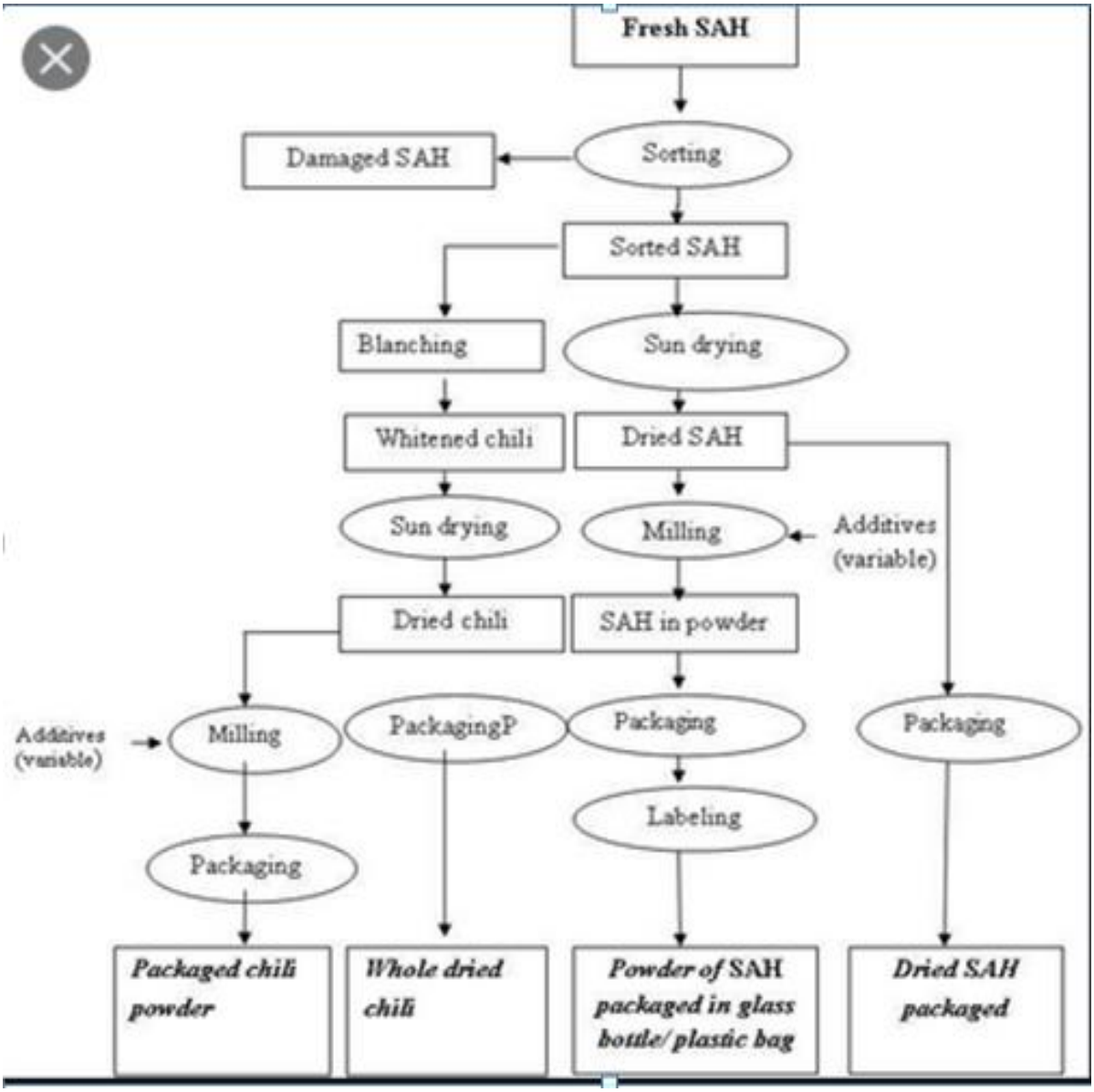

Figure: The main environmental procedures for mill operations of spice and herb

Self-Check –5	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 (10 points)

1. What are the major elements that used to classify environmental management?
2. Why waste reduction is more cost-effective and easier than recycling?

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

LG #67	LO #3- Perform milling operations

Instruction sheet

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

- Explaining grinding/milling operation for powder production.
- Controlling and monitoring grinding/milling temperature.
- Setting up and adjusting milling machine.
- Monitoring Equipment
- Holding or clamping work piece
- Performing milling operations
- Monitoring the process
- Identifying, rectifying and/or reporting out-of-specification product/process outcomes
- Maintaining workplace records

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**:

- Explain grind/mill operation for powder production.
- Control and monitor grinding/milling temperature.
- Set up and adjusting milling machine.
- Monitor Equipment
- Hold or clamp work piece
- Perform milling operations
- Monitor the process
- Identify, rectify and/or report out-of-specification product/process outcomes
- Maintain workplace records

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- Explaining grinding/milling operation for powder production

1.1. Grinding (Milling)

Grinding is a simple process involving cutting and crushing the rhizomes into small particles then sifting through a series of several screens. Spices can either be sold whole or ground into powder. Powdering (grinding) of dried and polished turmeric rhizomes were traditionally done with hand operated *chakki* (mill). Now grinding for commercial purpose done by grinding mills, in the earlier times, burr mill was used for grinding. However, there was a problem of accumulating rhizomes in feeding section. This problem was overcome by providing spiral splines having a pitch of 144 mm with 45^{o} pressure angle augmenting the feeding rhizomes towards the grinding zone. Now a days, hammer mills used for grinding. The powder obtained should be so fine that passes through 300 microns IS sieve. Grinding can be old and cold method. Old method is between grinding stones and increases the temperature, it means loss of aromatic substances. Cold method is liquid nitrogen - 85 °C, minimum loss of essential oils and costly process.

Depending upon the type of mill and speed of crushing, the spice may heat up, and volatiles may be lost. In turmeric, heat and oxygen during the process may contribute to the degradation of curcumin. Cryogenic milling under liquid nitrogen prevents oxidation and volatiles loss, but it is expensive and not wide spread in the Industry. Ground spices are size sorted through sieves, and the larger particles can be further ground. However there are other systems that use a different numbering and comparisons between specifications may be difficult. For example, the U.S.A. screen numbering goes from 4 to 80 mesh screens whereas Mill Screen by system goes from 4 to 55 meshes with different increments than U.S.A. system. The specifications of turmeric powder under Indian Agmark rules are also given in the table below. Turmeric powder is a major component (40 to 50%) of curry powder. It is spice mixture used for seasoning dishes containing vegetables, meat, fish, and eggs. In western countries also curry powder is used for seasoning dishes e.g. U.K. Australia and U.S.A

Table 1.1: Agmark standards of Turmeric Powder

Grade	Moisture (% w/w) max	Total ash (% w/w) max	Acid insoluble ash max (% w/w)	Lead Max (ppm)	Starch max (% w/w)	Chromate test
Turmeric powder						
Standard	10	7	1.5	2.5	60	Negative
Coarse Ground powder						
Standard	10	9	1.5	2.5	60	Negative

Grinding: Grinding can add value to the product, but it can also detract from the quality of the product. Many consumers are wary of ground spices since they are frequently contaminated or adulterated. There is no easy way to determine whether ground spices are pure or have been adulterated. In general, ground spices are made by grinding inferior and broken spices. Also, ground spice has a much shorter shelf life than the whole spice. Once it is ground, the flavour and aroma of spice soon deteriorate. It is better for the small-scale processor to sell whole spices. This also removes the need for moisture proof packaging materials and sealing machines.

For small-scale production (up to 100kg/day) manual grinders are adequate. Small Chinese or Indian models designed for domestic spice grinding are suitable. A treadle or bicycle could be attached to make the work easier.

For larger scale production a small, powered grinding mill is needed and models are available that can grind 25kg/hour. A grinding mill needs to be placed in a separate and well ventilated room because of the dust. Great care is needed to ensure uniform sized pieces/powders after grinding and also to prevent heating of spices during grinding.

Grain-and spice-milling-machine operators operate and monitor machinery used to crush, grind, blend and otherwise process grain, spices and related foodstuffs for human or animal consumption. Tasks include:

- Operating and monitoring machinery used for the production of flour, meal and animal feed and for processing rice;

- Operating and monitoring milling machines used for grinding grain and spices;
- Performing related tasks;
- Supervising other workers

Examples of the occupations classified here:

- Machine-operator, milling/grain
- Machine-operator, milling/rice
- Machine-operator, milling/spices

Grinders**:** reduce crushed feed to powder. The product from an intermediate grinder might pass a 40 mesh screen; most of the product from a fine grinder would pass a 200 mesh screen with a 74µm opening. An ultra fine grinder accepts feed particles no larger than 6 mm; the product size is typically 1 to 50µm. Cutters give particles of definite size and shape, 2 to 10mm in length. These machines do their work in distinctly different ways. Compression is the characteristic action of crushers.

Methods of grinding spices evolve over the years. Long time ago, when human beings started processing their food, they discovered that some plants can be stored longer and also tasted nicer if they were pounded with stones or grinded finely by batugiling. As for spices, for easy of transport, or as the recipe calls it, they are normally grounded. Methods for grinding spices for modern households normally include electric pepper grinder (for dry spices-like black pepper and cinnamon) or electric blender (for wet spices-like onion, ginger and chili paste).

Figure 1.1: Batugiling-the grinding stone

Figure 1.2: Grinding spices in Stone and Plate

In the old days methods of grinding spices are different. Before electric blenders, the spices were grounded manually. Every house had their own pestle and mortar made of undressed granite. This was used for grinding small quantities of spices for home-scale usage. Different types of modern milling machines used for spice and herb processing include:

A. Grinders

The term grinder refers to a variety of size reduction machines for intermediate duty. Product from a crusher is often fed to a grinder for further reduction. The grinding operation primarily consists of grinding mill and Pulvariser. Some of the commercial grinders are hammer mills, impactors, rolling compression machines, attrition mills, ball mill and tumbling mills.

Figure 1.3: commercial spice grinder

A. Hammer mills:

These mills all contain a high-speed rotor turning inside a cylindrical casing. Usually the shaft is horizontal. The spice and herbs dropped into the top of the casing is broken and falls out through a bottom opening. In a hammer mill, the particles are broken by sets of swing hammers pinned to a rotor disk.

Figure 1.4: spice hammer mill

B. Micro-Pulvariser

Pulveriser is a high-speed hammer and screen mill, which accomplishes size reduction by mechanically impacting process material. This method of size reduction is characterized by relative high energy and short residence time, minimizing heat buildup during the milling process.

Operating Principle

The feeding material to be crushed enters the mill through a gravity feed hopper having an adjustable slide to control the feed material. The material is crushed between the hammers/blades and secreted liners.

Figure 1.5: Micro-Pulvariser

The ground materials is continuously sucked by a powerful blower through a screen classifier and conveyed through the pipe into a Cyclone Drum for bagging. The blower maintains constant air flow in the grinding chamber in order to obtain a product and continuously cleans the screen. Particle size of ground material can be varied over a large range by using sieves with the desired opening.

C. Mini Pulveriser

Mini Pulveriser comprises of a heavy duty Mild Steel/Stainless Steel body, which comprises of a feeding hopper, with a feed regulator slide. The pulveriser body is inlaid with a delivery trough attached at the bottom, with a delivery trough attached at the discharged end. The rotor & beater are mounted on shaft, running in ball bearing

housing at a speed of 4500-6000 R.P.M. The whole unit is mounted on a strong steel channel stand.

Mini Pulvariser is widely used for grinding of dry/wet spices, green chilly, fresh ginger, garlic, fresh fruits, and vegetables. These machines can also be used as a fruit finisher. The Mini Pulveriser can also be used for the following dry applications like agricultural chemicals, broken biscuits (hi-fat/low fat), custard powder coffee, charcoal, dhal, dyes & pigments, fillers, henna leaves, herbs, leaves and roots instant foods insecticides and pesticides, kaolin moulding powders, pharmaceuticals, plastics, poultry feed & marine feed, resins, sugar (biscuit grade/icing grade), tea etc.

Figure 1.6: mini pulverizer

D. Ball Mill

A mill of this kind contains balls of different sizes, all of which wear and become smaller as the mill is operated. New large balls are added periodically. As the shell of such a mill rotates, the large balls move toward the point of maximum diameter, and the small balls migrate toward the discharge.

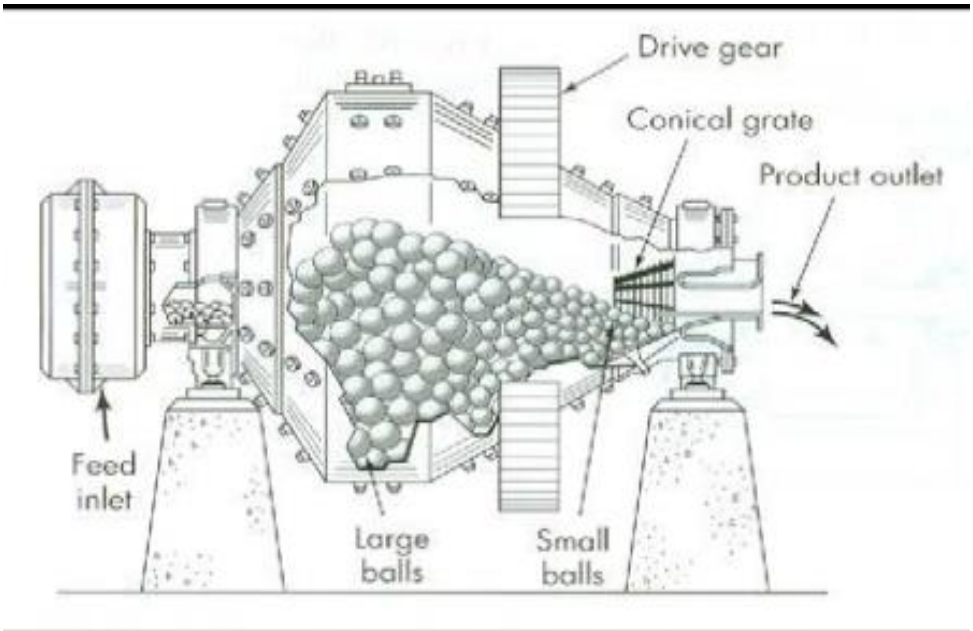

Figure 1.7: Conical ball mill

The initial breaking of the feed particles, therefore, is done by the largest ball dropping the greatest distance; small particles are ground by small balls dropping a much smaller distance. The amount of energy expended is suited to the difficulty of the breaking operation, increasing the efficiency of the mill. In a ball mill or pebble mill, most of the reduction is done by impact as the balls or pebbles drop from near the top of the shell. When the mill is rotated, the balls are picked up by the mill wall and carried nearly to the top, where they break contact with the wall and fall to the bottom to be picked up again. Centrifugal force keeps the balls in contact with the wall and with one another during the upward movement. While in contact with the wall, the balls do some grinding by slipping and rolling over one another, but most of the grinding occurs at the zone of impact, where the free falling balls strike the bottom of the mill.

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: Fill the blank space

1. _____is a high-speed hammer and screen mill, which accomplishes size reduction by mechanically impacting process material
2. _____ a kind of milling machine contains balls of different sizes, all of which wear and become smaller as the mill is operated.
3. _____ is widely used for grinding of dry/wet spices, green chili, fresh ginger, garlic, fresh fruits, and vegetables
4. _____ is a high-speed hammer and screen mill, which accomplishes size reduction by mechanically impacting process material.
5. _____refers to a variety of size reduction machines for intermediate duty.
6. _____is a simple process involving cutting and crushing the rhizomes into small particles then sifting through a series of several screens.

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Controlling and monitoring grinding/milling temperature

Spices play an important role in enhancing the flavor and taste of the processed foods. These spices are also used in the medicines because of their stimulating and digestive properties. These properties are enhanced by the process of grinding an age-old technique like grinding of other food materials. The main aim of spice grinding is to obtain smaller particle size with good product quality in terms of flavoring and color. In the normal grinding process, heat is generated when energy is used to fracture a particle into a smaller size. This generated heat usually is detrimental to the product and results in some loss of flavoring and quality. The fat in spices generally poses extra problems and is an important consideration in grinding. During grinding, the temperature of the product rises to a level in the range of 42-95°C which varies with the oil and moisture content of the spices, but spices lose a significant fraction of their volatile oil or flavoring components due to this temperature rise. The losses of volatile oil for different spices have been reported to be 37% for nutmeg, 14% for mace and 17% for cinnamon. The loss of volatile oil during grinding of caraway seed has been reported to be 32% with an increase in grinding temperature from 17°C to 45°C.

One key process in this procedure is the particle size reduction. A low particle size distribution means great taste and beautiful color. However, if the temperature increase during processing is too great, the taste and color of the spice suffer. Especially for such sensitive products you must be develop some special machines, which enable high grinding efficiency combined with a very low temperature increase.

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: Give Short answer (12 points)

1. What is the importance of heat for the normal grinding process of spices?
2. What is the level of the temperature range during grinding of the spices?
3. What is the effect of temperature increase during processing?

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Setting up and adjusting milling machine

Setting-up of milling machines means the preparation of the milling machines for milling. Proper setting-up and operation of the milling machine are prerequisites for carrying out the milling operation successfully. Errors, such as the selection of an unfavorable way of clamping or sequence of the individual steps, will result in defects in quality of the work pieces machines. The amount of work will be considerably increased. Any defects found with the milling machine are to be reported immediately to the serviceman in charge to arrange for immediate repair. So the following milling machine should be setting up and adjust properly with their components.

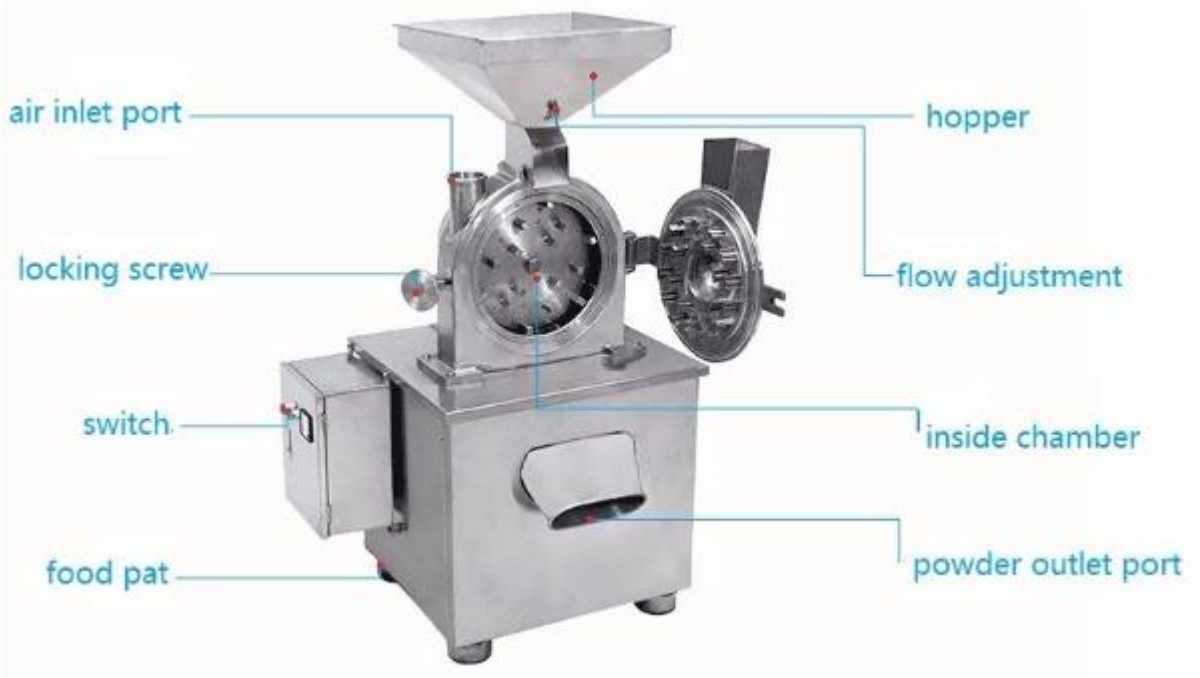

Figure 3.1: Turmeric powder mill and spice powder milling machine (150-200kg/hr)

Figure 3.2: Spice grinder milling machine

Figure 3.3: Manual Spice Grinder

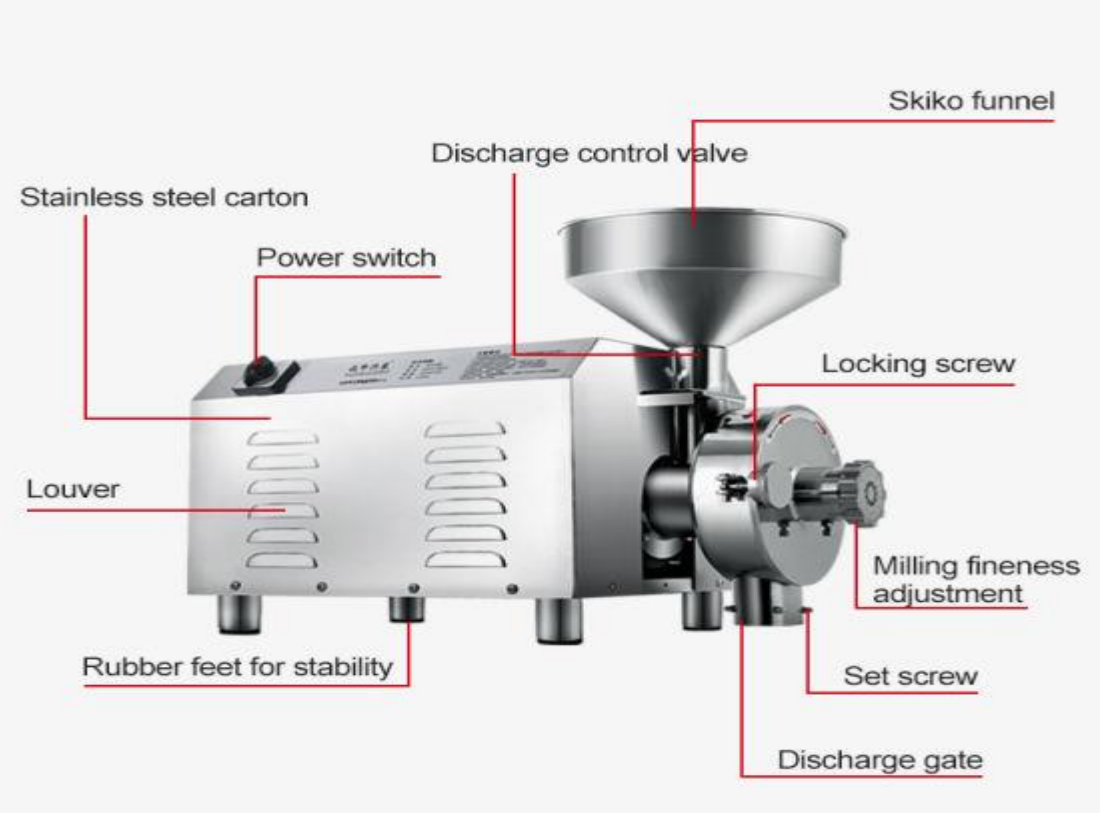

Figure 3.4: Electric Pulverizer Machine Herb Grinding

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: Short answer question (10 points)

1. Discuss why proper setup and adjustment is required for milling machines.
2. Sketch and illustrate components of turmeric milling machine.

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4- Monitoring Equipment to identify variation

Monitoring equipment and systems process variables and performance is a condition-monitoring technique that predicts problems by monitoring changes in any combination of these variables such as: pressure, temperature, electrical power consumption, fuel consumption and equipment/system power production or capacity. By collecting time associated with the operation, unavailability and maintenance, and costs associated with labor for operation, maintenance, repair, and spare parts procurement and storage, for the equipment and systems additional performance measures may be assessed and trended. This data can be used to assess additional aspects of performance such as specific fuel oil consumption, mechanical or thermal efficiency of targeted equipment, equipment availability, milling capacity and performance, system availability and revenue generation and costs associated with maintenance and repair and investments.

Monitoring task is a scheduled task used to detect the potential onset of a failure so that action can be taken to prevent such failure. Condition-monitoring tasks may be applied to any equipment and machinery systems for which they are applicable. Condition-monitoring tasks are scheduled activities used to monitor machine condition and to detect a potential failure in advance so that action can be taken to prevent that failure. Condition monitoring involves the regular measurement of parameters such as vibration, temperature and sound in and around machines and equipment. Defective components in running machines can cause considerable damage and downtime. In condition monitoring the equipment, also known as condition-based maintenance, component defects are recognized at an early stage and the remaining runtimes of bearings, shafts, etc. are utilized to the maximum. This helps prevent costly downtime. Moreover, costs are saved due to the complete utilization of the runtimes of important machine components. Thanks to the intelligent sensor technology used in many of today's condition monitoring practices, condition-relevant machine parameters such as machine vibration, temperature and sound are measured directly at the source and analyzed by software designed to employ proven mathematical methods.

In the grinding process, materials are reduced in size by fracturing them. The mechanism of fracture is not fully understood, but in the process, the material is stressed by the action of mechanical moving parts in the grinding machine and initially the stress is absorbed internally by the material as strain energy. When the local strain energy exceeds a critical level, which is a function of the material, fracture occurs along lines of weakness and the stored energy is released. Some of the energy is taken up in the creation of new surface, but the greater part of it is dissipated as heat. Time also plays a part in the fracturing process and it appears that material will fracture at lower stress concentrations if these can be maintained for longer periods. Grinding is, therefore, achieved by mechanical stress followed by rupture and the energy required depends upon the hardness of the material and also upon the tendency of the material to crack-its friability.

Tool condition monitoring system (TCMs)

The major constraint for manufacturing industries is to reduce the cost and improve the production. Manufacturing industries used computer numerical control machines with automatic tool changers and mainly focused on tool changing procedures. During 1980's to 1990's, the cutting tool was replaced based on wear of the cutting tool. Conventionally, a cutting tool was replaced for other machining process to meet new process requirements. To replace a cutting tool when the tool was dull, online tool wear monitoring was required. The demand for monitoring in a manufacturing process includes monitoring the machine and dynamics of machining process, work piece and machine tools to assure optimal performance. Hence, the objectives of TCMs can be considered as:

- Early detection of cutting tool wear,
- Maintaining a machining accuracy by providing a corrective action for tool wear
- Prevention of cutting tool from breakage.

Without TCMs, the deficiencies like, excessive power consumption, dimensional inaccuracies, poor surface roughness of work piece and failure of cutting tool may

occur. To a greater extent, research was conducted regarding to the growth of consistent TCMs. A number of factors have obstructed the progress in the development of TCMs including improper selection of sensors and their operation.

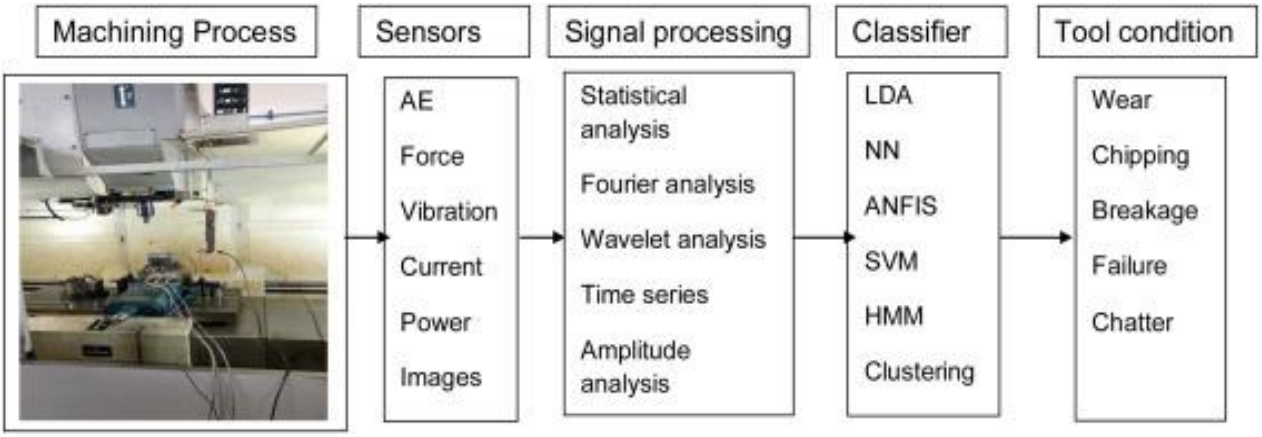

Figure: The frame work of TCMs

KEY: AE-Acoustic emission
SVM-Support Vector Machine
HMM-Hidden Markov Model
ANFIS-Adaptive Network based Fuzzy Inference System
NN-Neural Network

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: Short Answer Questions (10 points)

1. What are the objectives of TCM?
2. Why monitoring milling equipment and machines?

Test II: Choose the best answer (4 points)

1. Machines/equipments such as dryers and systems for which monitoring surveys may be required on a routine basis include the following items, except.

   a. Temperature b. Fan Systems c. Heat condition d. All e. None

2. Which one is not condition-relevant machine/equipment parameter among the following?

   a. Vibration b. Temperature c. Sound d. All e. None

Note: Satisfactory rating ≥7 points Unsatisfactory<7 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 5- Holding or clamping work piece

Clamp is a device designed to bind or constrict or to press two or more parts together so as to hold them firmly**.** A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. There are many different methods that machinists use to hold a work-piece to a milling machine table So that machining operations and Statistical measuring processes can be performed on the work-piece. Most milling machine tables have T-shaped slots that traverse the top of the table. Those Slots accommodate a variety of different clamps, fixtures, grips and T-shaped bolts that are used to hold a work-piece firmly in place.

Locating the work piece is the first basic function of a jig or fixture. Once located, the work piece must also be held to prevent movement during the operational cycle. The process of holding the position of the work piece in the jig or fixture is called clamping. Pressure largely depends on the work piece, it varies from one work piece to other. It is very simple and reliable clamping device. The clamping force is applied by spring loaded nut. These are made of rectangular plates and act like levers.
What is the purpose of clamping? Clamps are versatile tools that serve to temporarily hold work securely in place. They are used for many applications including milling, carpentry, wood working, furniture making, welding, construction and metal working.

Quick-acting clamps are universal, flexible clamping devices which are reassembled from individual components and yet always make up a complete unit. Thanks to their compact design, these clamps can be placed very close to the work piece, so that the full surface area of the machine table can be used.

Self-Check –5	Written test

Name…… ID…… Date…….

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

Test: Short answer questions

1. What is clamping?
2. What is the purpose of holding or clamping workpiece?
3. State the word quick acting clamp?

Note: Satisfactory rating ≥7.5 points Unsatisfactory <7.5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 6- Performing milling operations

Raw spices are first cleaned and dried. This dried material then is grinded in pulverizer. The milling and grinding of dried seed, fruit, root, bark, or vegetative substance can create high quality spices. However, the milling of these substances can often prove problematic, with the generation of heat and moisture often a concern for manufacturers. Stedman's quality equipment can efficiently and expertly process six or seven tons of products every hour. There are different types of Stedman Machine's or equipments used to milling of spice and herbs among them the following are very important.

- H-Series,
- F-Series cage mill,
- Y-Series cage mill, and
- Full circle hammer mills deliver the power and performance you need for grinding and milling herbs and spices.

A. H-Series Cage Mill

The Stedman H-Series Multi Cage Mill pulverizes, grinds and crushes abrasive and non-abrasive materials-wet, sticky or dry. The H-Series model works more efficiently than other types of pulverizers and provides a finer, more uniform grind.

Use the H-Series cage mill to crush herbs and spices, aglime, animal feed, corn, fertilizer and agricultural gypsum.

- **Reliable**: Can handle up to 240 tons per hour
- **Durable**: Reversible for extended wear and operates at or near-peak efficiency longer
- **Versatile**: Can produce various gradations by changing mill specifications
- **Practical**: Hydraulically-operated, quick-opening housing allows for easy access for inspection and to service

B. F-Series Cage Mill

The F-Series Cage Mill Crusher features a unique flared discharge opening, efficiently reducing the wettest and stickiest of materials without clogging and decreasing downtime for cleaning.

Use the F-Series cage mill for moist material.

- Flared housing eliminates corners that trap material, reducing clogging
- Capable of multi-stage reduction
- Variable mill speed
- CE and TUV compliant

C. Y-Series Cage Mill

Stedman's screen-less, hammer-less grinders are guaranteed to reduce your maintenance time and expense. This economical Cage Mill Grinder has no hammers or screens to replace and an open discharge that won't plug. With 1/2 to 70 TPH capacities, it features a low-profile modular design and can quickly change from coarse to medium grind gradations.

The Y-Series is a multi-cage mill designed for sizing thousands of minerals and agglomerates. For less abrasive materials where large capacity, high-yield, and uniform particle size are required, Y-Series models are a perfect choice. Y-Series cage mills offers non-abrasive reduction to the size of salt. Features and Benefits

- Open discharge minimizes plugging
- No screens required
- Easy bearing and motor access
- CE and TUV compliant
- Capable of producing a variety of product gradations, by changing the mill speed

D. Full Circle Hammer Mill

In a hammer mill, rectangular pieces of hardened steel are attached to a shaft and rotate at high speed inside the milling chamber. The grain then encounters a changeable screen with a "close tolerance" gap between it and the rotating hammers. Finally, the grain passes through a screen before exiting the mill. Hammer

configuration, rotation speed and screen sizes can be varied to process different grains, and each component can be changed individually.

Use Stedman's full circle hammer mill to grind herbs and spices.

- Capacities up to 35 tons per hour
- Higher throughput due to greater screen area
- Compact size means a small footprint
- Easily accessible doors
- Quick release screens
- Reversible
- Externally adjustable intake

Self-Check – 6	Written test

Name…… ID…… Date…….

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

Test: Short answer question

1. What are different types of Stedman Machine's or equipments used to milling of spice and herbs

Note: Satisfactory rating ≥3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers.

Operation sheet 1- Grinding and milling of spice (turmeric)

Steps / Procedures to grind and mill of spice (turmeric)

Step 1: First select turmeric and other spice which are free from any pests or diseases and inert matters

Step 2: Checked the spices which are well dried

Step 3: Mixing the spices with the required additives

Step 4: Cleaning of milling machine before used to reduce any contamination or other unnecessary spices

Step 5: Add the spice and herbs in to milling machine

Step 6: The spice and herbs dropped into the top of the casing is broken and falls out through a bottom opening.

Step 7: In a hammer mill, the particles are broken by sets of swing hammers pinned to a rotor disk.

Step 8: Operating and monitoring machinery used for the production of flour for processing turmeric or other spices

Step 9: Operating and monitoring milling machines used for grinding of spices;

Step 10: Receiving the milled turmeric powder in to the bottom parts

Step 11: Performing related tasks

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 1 hour. The project is expected from each student to do it.

Task: Perform milling of turmeric and other dry spices using hammer mill machines

Information Sheet 7- Monitoring the process

A **monitoring process** is a special kind of integration process that you use as part of business activity monitoring (BAM). You use a monitoring process to monitor the milestones in a business process. The business process can be distributed across multiple applications.

Monitoring process: define that alerts are triggered if particular events occur or deadlines are missed. Furthermore, you can define conditions for creating alerts. Typical Structure: A monitoring process usually comprises the following elements:

- One event message that starts the process
- Further event messages that the process subscribes to by means of correlations.
- Conditions that evaluate the events and create corresponding alerts

Monitoring and control processes continually track, review, adjust and report on the project's performance. It's important to find out how a project's performing and whether it's on time, as well as implement approved changes. This ensures the project remains on track, on budget and on time.

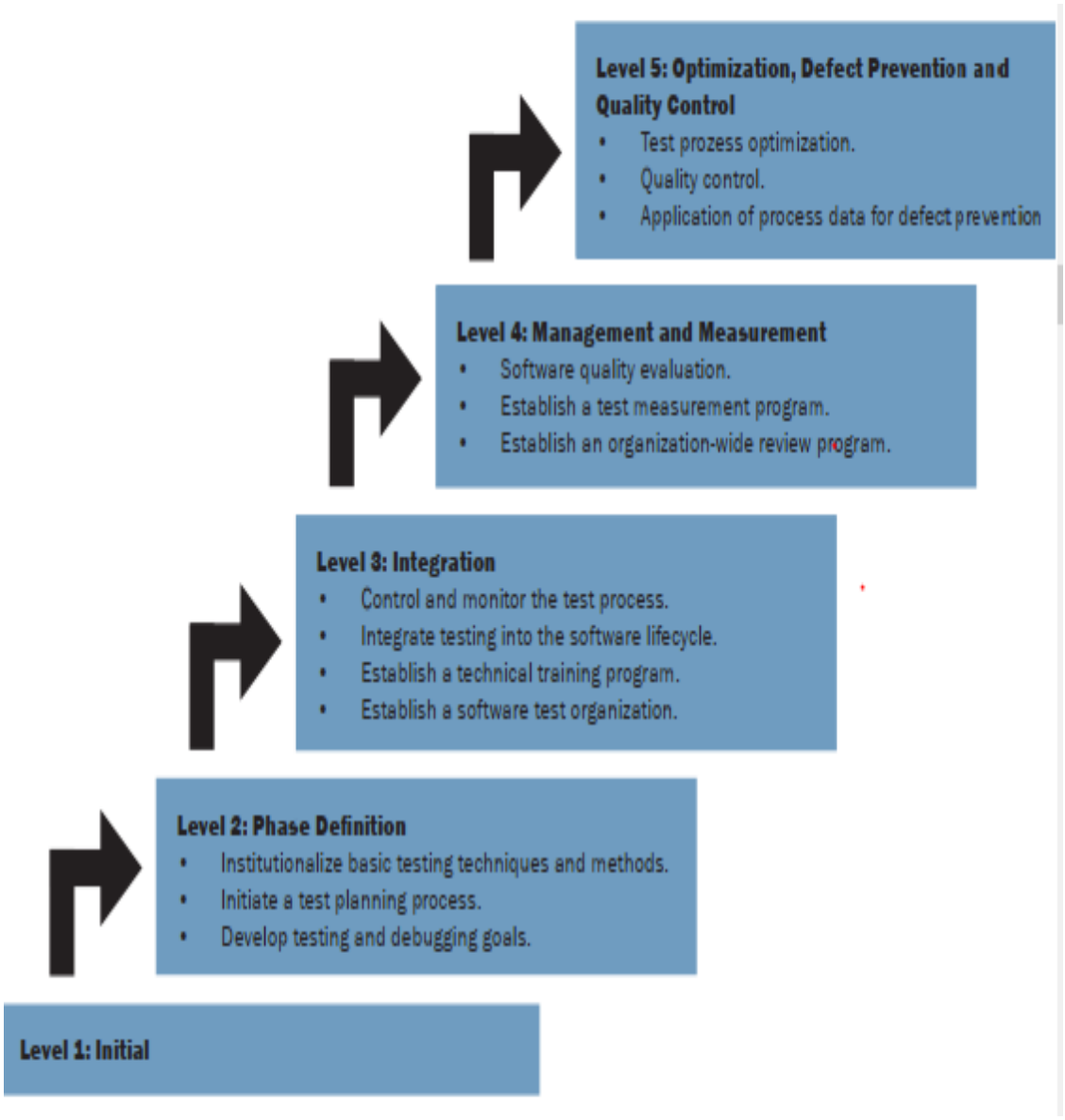

Figure 7.1: Level of process monitoring

Self-Check –7	Written test

Name…… ID…… Date…….

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

Test: Short answer question

1. What are elements that a monitoring process usually comprises?
2. Write the levels of process control.

Note: Satisfactory rating ≥3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 8- Identifying, rectifying and/or reporting out-of-specification product/process outcomes

The term **OOS** (**out of specification**), is defined as those results of in process or finished product testing, which falling out of specified limits. All out-of-specification test results (i.e. suspected test results that fall outside the established specifications or acceptance criteria) shall be investigated. When an Out-Of-Specification test result is generated/ suspected, the analyst shall inform to the QA Manager immediately about the test results. Out of specification is the comparison of one result versus predetermined specification.

Table 8.1 : ESA quality minima for some spices

Turmeric product	Total Ash (% w/w) max	Ash Insoluble Ash (% w/w) max	Moisture (% w/w) max	Volatile oil (v/w) min
Turmeric whole	8	2	12	2.5
Turmeric ground	9	10	10	1.5
Rosemary	8	1	10	1
Ginger	8	2	12	1.5
Fenugreek	7	2	12	-
Cinnamon	7	2	14	0.4
Cloves	7	0.5	12	14
Garlic powder	6	0.5	7	-
Chilli	10	1.6	11	-

Extraneous matter and foreign matter should not exceed 1% and 2% for spice and herb, respectively. Should be free from live or dead insects, insect fragments and rodent contamination visible to the naked eye(corrected if necessary for abnormal vision). Salmonella must be absent in (at least) 25 g of material. Yeast and mold: 10^5/g (target), absolute maximum: 10^6/g. E. coli: 10^2/g (target), absolute maximum: 10^3/g. The European Union has fixed limits for aflatoxin, which should not exceed 10 ppb (total aflatoxins), and 5 ppb for aflatoxin B1. In the United States, aflatoxin B1

should not exceed 20 ppb. So powders that have out of the specification should be identified, rectified and reported accurately and timely. If required the corrective action should be implemented immediately after testing.

Self-Check –8	Written test

Name…… ID…… Date…….

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

Test: Short Answer Questions (10 points)

1. How out of specifications can be identify?
2. Discuss about the ASTA cleanliness specification and ESA quality minima.

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 9- Maintaining workplace records

Work place records included when performing milling operation are: milled spice and herb, milling machine, quality and quantity of powder, maintenance activities, spare parts replaced, temperature, etc. Ways to manage your inactive records are:

- Use a Third Party Manager. The most obvious is that you outsource your record storage and access to record Grabber.
- Keep Inactive Records Offsite.
- Organize by Active and Inactive.
- Handling Digital Older Records.
- Why is it important to document and file information such as current usage?
- Filing means keeping documents in a safe place and being able to find them easily and quickly. A filing system is the central record-keeping system for an organization. It helps you to be organized, systematic, efficient and transparent.

For disposition purposes, records are divided into two types:

i. “Permanent” records are those records with special significance and enduring value.
ii. “Temporary”

Make sure you keep track of these five types of records for your business.

- Accounting records.
- Bank statements.
- Legal documents
- Permits and Licenses.
- Insurance documents

The importance of record keeping: Any record keeping system should be accurate, reliable, easy to follow, consistent as to the basis used and be very simple. Good record keeping is vital in regards to meeting the financial commitments of the business and providing information on which decisions for the future of the business

can be based. An accurate written record detailing all aspects of patient monitoring is important, not only because it forms an integral part of the of the provision of care or nursing management of the patient, but because it also contributes to the circulation of information amongst the different teams involved in the patient's .

The purpose of record keeping: Records contain information that is needed for the day to day work of government. Their purpose is to provide reliable evidence of, and information about, 'who, what, when, and why' something happened. In some cases, the requirement to keep certain records is clearly defined by law, regulation or professional practice. Records can be documented in the form of books, paper, electronic records, photographs, videos, sound recordings, databases, and other data compilations that are used for multiple purposes, or other material, regardless of physical form or characteristics.

The 8 Principles of record keeping are the “Principles” of good management of Records are listed below:

- Accountability,
- Transparency,
- Integrity,
- Protection,
- Compliance,
- Accessibility,
- Retention and
- Disposition.

Self-Check –9	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 (12 points)

1. What are the data records in milling operation?
2. Mention the principles of record keeping?
3. What are the two record types?

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

LG #68	LO #4- Check components for conformance with specifications

Instruction sheet

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

- Checking components

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**:

- Check components

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- Checking components

Before starting and after the completion of the work or any simple or complex different operating tools, equipments and machine and their components should be checked whether the functionality of each are good or not. Operating requirements and parameters and corrective action required where operation is outside specified operating parameters. Methods used to monitor the process, such as inspecting, measuring and testing as required by the process.

The machines will be evaluate for their performance in chili grinding with a view to recommending the suitable machine or machinery combination for the Sri Lankan spice processing industry. Their performance will be evaluated in terms of:

- Particle size obtained after grinding;
- Color of ground chili or other spices;
- Pungency level after grinding;
- Fat content,
- Moisture content, and
- Fiber content of ground chili and
- Energy consumption per kilogram of processing chili powder. The pin mill performed best as a single machine in terms of particle size of ground product among two types of spice processing machinery.

The milling machine main parts are:

- Column & Base. Column including base is the main casting that supports all other parts of milling machine.
- Knee. It is a casting that supports the saddle and table. ...
- Saddle and Swivel Table
- Power Feed Mechanism
- Table
- Spindle
- Over Arm / Overhanging Arm
- Arbor Support.

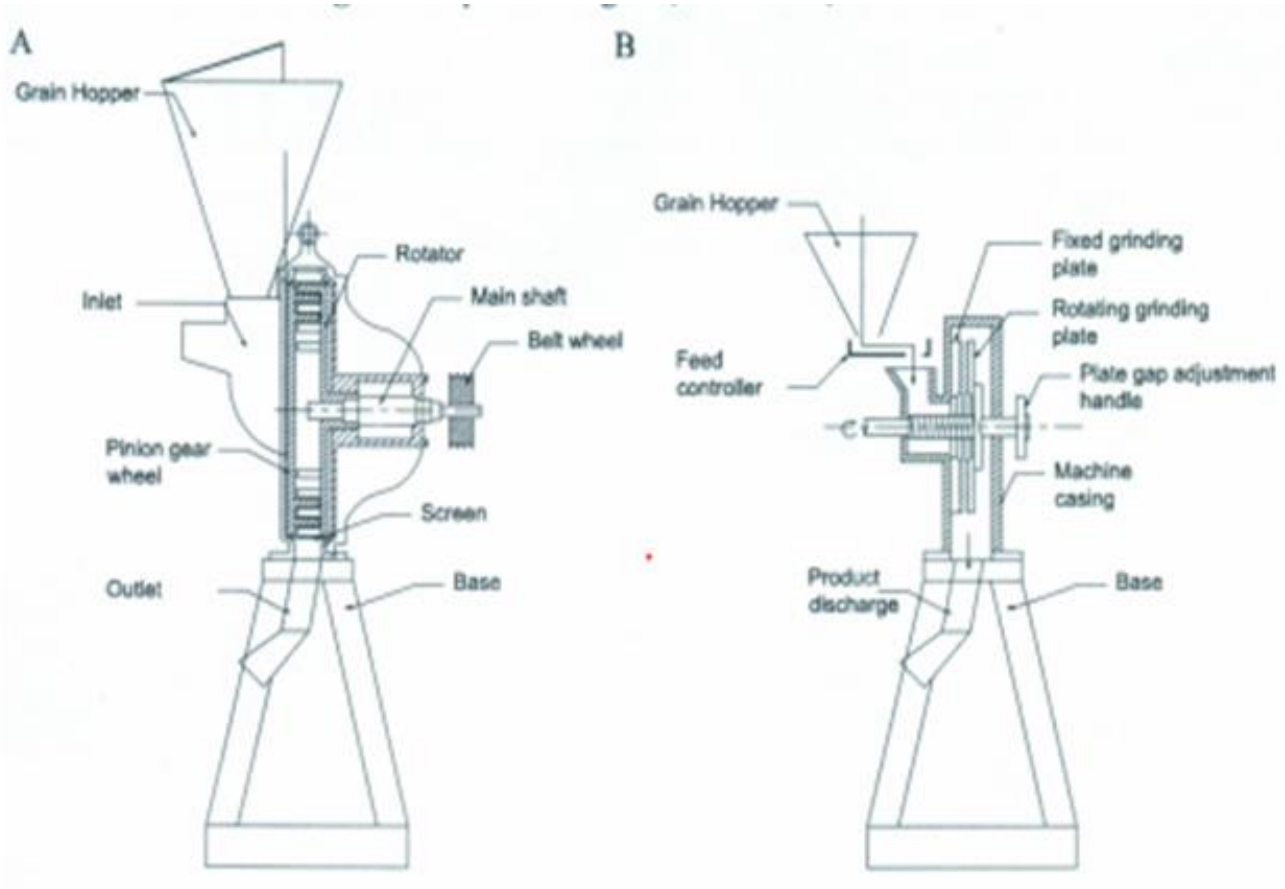

Figure 1.1: component diagram, A pin mill, B plate mill

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: Short Answer Questions (8 points)

3. How chili grinding machine can be evaluated?

4. What are the main parts of milling machine?

Note: Satisfactory rating ≥4 points Unsatisfactory <4 points

You can ask you teacher for the copy of the correct answers.

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