MANUAL

CONTROL OF SEED PROCESSING OPERATION

A Unit Standard for the Seed Industry

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## US: Control of seed processing operation

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UNIT 1: BASIC MANAGEMENT CONCEPTS

“A business stands or falls on leadership”
John Maxwell

Leadership and management skills are two virtues that a successful seed processing operator should have. The definition of management goes as follows: Management comprises directing and controlling a group of one or more people or entities for the purpose of coordinating and harmonising that group towards accomplishing a goal. Management often encompasses the deployment and manipulation of human resources, financial resources, technological resources, and natural resources. Management can also refer to the person or people who perform the act(s) of management.

There is a difference between management and leadership.

- **Management**: Normally it is power given to a person because of the position that person has in the company.
- **Leadership**: It is linked to the influence the person has and that gives him/her power.

1.1 Management

Management operates through various functions:

1. Planning
2. Organising
3. Leading/motivating
4. Coordinating
5. Controlling

**Planning**

It is a process of thinking about the activities and deciding what needs to happen in the future. This thought process is essential to the creation and refinement of a plan, or integration of it with other plans. It is different for every company.

**Organising**

Organizing is the act of rearranging elements following one or more rules and making optimum use of the resources required to enable the successful carrying out of plans.
Leading/Motivating

It is the way to exhibit skills in areas and getting others to play an effective part in achieving the plans.

Coordinating

Coordination is the act of coordinating, making different people or things work together to achieve a specific goal or end product.

Controlling

It is the monitoring or checking of progress against plans and deciding which may need modification based on feedback. Control (noun or verb) is used in a variety of contexts to express "mastery" or "proficiency. Monitoring generally means to be aware of the state of a system.

Operation management is the part of business that works with the production of goods and services for example seed processing, and the person in charge takes responsibility of ensuring that business operations are efficient and effective. It also includes the management of resources, the distribution of goods and services to customers, and the analysis of line systems. The production of goods and services are also part of operation management.

1.1.1 Operations Management Planning Criteria

Control by creating and maintaining a positive flow of work by utilizing what resources and facilities are available.

Lead by developing and cascading the organizations strategy/mission statement to all staff

Organise resources such as facilities and employees so as to ensure effective production of goods and services

Plan by prioritizing customer, employee and organizational requirements

Maintaining and monitoring staffing, levels, Knowledge-Skill-Attitude (KSA), expectations and motivation to fulfil organisational requirements

Performance Measures for the measurement of performance and consideration of efficiency versus effectiveness.
1.1.2 Management skills

In order to perform the functions of management and to assume multiple roles, managers must be skilled. Robert Katz identified three managerial skills that are essential to successful management:

- Technical skills
- Human skills
- Conceptual skills

**Technical skill** involves process or technique knowledge and proficiency. Managers use the processes, techniques and tools of a specific area.

**Human skill** involves the ability to interact effectively with people. Managers interact and cooperate with employees.

**Conceptual skill** involves the formulation of ideas. Managers understand abstract relationships, develop ideas, and solve problems creatively.

One can therefore say that technical skill deals with things, human skill concerns people, and conceptual skill has to do with ideas.

In an organisation a manager’s level determines the relative importance of possessing technical, human, and conceptual skills. Thus, in order to view the organization as a whole, top level managers need conceptual skills which are used in planning and dealing with ideas and abstractions. Supervisors need technical skills to manage their area of specialty and all levels of management need human skills in order to interact and communicate with other people successfully.
UNIT 2: SEED PROCESSING

Seed processing—also called seed conditioning—is an important part of the process of transferring improved genetic material from plant breeders to farmers. Seed received at a processing plant is usually not suitable to sell, plant or reproduce. The contents might contain damaged seeds and seeds infected by fungi. The seed will also not be uniform in size. The purpose of processing seed is to end with a product that will comply with certain standards. These include but are not limited to physical standards and batches of seed uniform in size. Keep in mind the equipment used by farmers to plant seed is preset and seed not sized and cleaned will cause major problems. It is important to realise that the genetic purity of the seed must be sustained throughout the process. It is therefore important to start with equipment that is thoroughly cleaned and vacuumed prior to use and which do not contain any other seed or contaminants that may compromise the purity of the seed.

All of this emphasises the importance of adhering to work site and statutory regulations. The operator must therefore obtain processing instructions according to procedures and select the appropriate equipment to proceed with seed processing. Also take note of the applicable safety procedures and PPE that must be worn.

Seed processing can involve seven steps: receiving, drying, pre-cleaning, fine cleaning, treating, bagging, and storing.
2.1.1 Drying

Seed lots received from the field are often at high moisture content. Seed processing is necessary in order to dry the seeds to a safe moisture level. If the seeds are very moist and cleaning is done by machines, it may be necessary to dry the seeds within the accepted range prescribed by the work site procedures and the statutory requirements. The complete drying process is covered in a separate Unit standard.
2.1.2 Cleaning

This is the removal of any debris or low quality, infested or infected seeds and seeds of other species, such as weeds, that are foreign to the sample. Debris and damaged seeds can spread infection. Therefore only good quality viable seeds should be dispatched to clients and damaged or non-viable seeds should be destroyed to prevent the spread of infection. Cleaning should be done in a way that causes the least damage to the sample and does not waste good seeds.

2.1.3 Chemical treatment

After they are cleaned, seeds may be chemically treated with fungicides and/or insecticides to combat diseases and pests. Chemical treatment destroys pathogenic organisms on the surface and in the seed; and protects the emerging seedling against insects and fungi in the soil. The seed treatment can be a powder, a liquid or a slurry treatment.

2.1.4 Processing equipment

Different equipment will be used on different seed types. Pre-cleaners will remove foreign material and different equipment can be used to separate the seeds into relevant fractions. Gravity tables are used to further improve quality when damaged seeds are removed. All this equipment needs constant monitoring to insure that quality is maintained throughout the process. Samples need to be analysed and equipment needs to be adjusted. Deviations must be communicated to the relevant parties according to work site procedures.

Dryer

Many different types of dryers are used to obtain the acceptable moisture levels.

Air-screen cleaner

This is the basic cleaner, usually with two air channels and, preferably, four screens. The first air channel (head aspiration) removes dust and light materials as the seed falls from the feed hopper. The second air channel (tail aspiration) removes light seed and materials after the seed passes through the last screen. Although screen configurations vary considerably, one or two top or scalping screens remove particles larger than the good seed, and one or two bottom or grading screens remove particles smaller than the good seed. Seed aspirators are machines used to separate seed from chaff.
The indented cylinder separates according to length. Since there are often impurities that are either longer or shorter than the crop seed, this machine is often needed.

**Separators**

A length separator is almost always used to clean wheat seed. By using the proper machine configuration, shorter or longer undesirable materials (such as broken grains, weed seeds, oat, barley, etc.) are removed. Broken grains and weed seeds, which are shorter than the good seed, are removed by using cylinders with smaller indents. Larger impurities can be removed by using a cylinder with indents that lift all good seed, but contaminants (wild oats, oats or barley grains and unthreshed glumes) remain in the cylinder.

Other screens can be used to separate seed by width and thickness. They are usually made of iron sheet and are perforated with round or oblong holes. Round perforation screens separate on width.

![Separator screens](image)

**Figure 2: Separator screens**

Air-screen cleaners also separate seeds according to their behaviour in an air stream. The most important characteristic is the weight. Lighter particles such as dust, chaff, empty or partly-filled seeds, husks and glumes will be removed and the heavier seed will fall down through the air stream.

**Gravity separator**

After the seed is cleaned by the air-screen cleaner and indented cylinder, it may be necessary to use a gravity separator. The gravity separator classifies a seed mixture mainly according to density or specific gravity. It can be used to remove unthreshed
glumes, stones and soil particles, which have similar sizes to wheat but different weights. Another application is the removal of weevil-infested grains from the seed lot and upgrading seed (in order to improve germination). Furthermore, wild oats and some barley may be removed from the wheat seed lots, but at the expense of substantial amounts of good seed and only after recycling the material a number of times on the gravity separator.

Even after the seed is cleaned in the air-screen cleaner and the indented cylinder, it may be necessary to obtain higher-quality seed. In such cases, the seed can often be passed over the specific gravity separator.

![Figure 3: Specific gravity separator](image)

**Spiral separator**

The spiral separator separates seed according to their rolling ability and surface texture. It consists of sheet metal strips fitted around a central axis in the form of a spiral.
Figure 4: Spiral separator

Magnetic separator

The magnetic separator separates according to the ability of the surface of some seeds to 'hold' iron powder. When the seed is treated with iron filings, rough seed will pick up the filings, while smooth seed will not. An example of this is the separation of dodder or other rough seeds from alfalfa, based on seed coat texture. A powder of iron is mixed thoroughly with a seed lot, and the mixture is fed into a magnetized mill that removes dodder, cracked seeds or other rough particles. It should be noted that both of these techniques are seldom 100 percent effective in removing dodder, and they also remove some good alfalfa seed.

Figure 5: Magnetic separator

Colour separator

Electronic colour separators can separate seed by differences in colour. The colour separator views each seed individually with photovoltaic cells. The colour of the seed is compared with a selected background or colour range; discoloured seed is blown out of the seed flow.
Treater

Seed should, if necessary, be treated with the appropriate fungicide to protect the seed and seedling after planting. Insecticides are sometimes applied to protect seed in storage and in the soil. Treatments may be applied to protect the seedlings or adult plants against pathogens carried on or in the seed.

Weighing

The final step is to weigh the proper amount of seed into the proper kind of bag. Seed bags should be of a size that:

- Fits local farmer needs (seed rates and field size).
- Is convenient for storage prior to final packaging.
- Is appropriate to whole sale seed business.

2.1.5 Personal Protective Equipment

Personal Protective Equipment (PPE) is specialised clothing or equipment worn by employees for protection against health and safety hazards. The equipment is designed to protect parts of the body, i.e., eyes, head, face, hands, feet, and ears. The different types of equipment used may differ from one company to the next. If you are responsible for wrapping and bulking of seed containers, you must be familiarised with the appropriate equipment worn at your workplace and the location of this equipment. For the purpose of this manual the most frequently used PPE will be discussed.

Hard hat

If there is any danger of falling objects or head injury, a hard hat should always be worn.

![Figure 6: Hard hat](image-url)
Gloves

When working with wooden pallets or any type of material which can cause injury to your hands, protective gloves must be worn. There are many different types of gloves, but you will be provided with those appropriate to your workplace. A special kind of resistant glove is also necessary when working with dangerous chemicals.

Gloves must be:

- appropriate to the material handled
- worn whenever there is potential for contact with corrosive or toxic materials
- worn whenever there is a possibility of injury to your hands, e.g. when lifting loads manually
- cleaned after use
- replaced periodically depending upon use and type of material handled

Hearing protection

Noise is a common problem in many workplaces. High levels of noise can gradually damage your hearing and this is unfortunately a permanent handicap. The following types of hearing protection equipment are available:

- Foam Earplugs
- PVC Earplugs
- Earmuffs

Safety shoes

If you work in and around a fabrication workshop there is always a possibility of heavy objects falling on your feet or sharp objects puncturing your foot. Hazardous liquids such as chemicals can spill into your shoes and boots. These hazardous materials can cause chemical and other burns. Heavy machinery, equipment, and other objects can roll over your feet often resulting in broken or crushed bones. Safety shoes are compulsory for all lifting and transferring equipment operators.
Safety glasses

Safety glasses are usually made from shatter-resistant plastic lenses to protect the eyes from flying materials. Although safety lenses may be constructed from a variety of materials that vary in impact resistance, certain standards suggest that they maintain a minimum 1mm thickness at the thinnest point, regardless of material. If chemicals splash in your face or eyes, flush skin and eyes with water for at least 15 minutes and then get medical attention.

Respirators / Dust masks

A dust mask should always be worn when working with harmful gases and in areas with a lot of dust. Special masks protecting the respiratory (breathing) canal must be worn when working with extremely dangerous gases or in areas with a high carbon monoxide concentration.

2.1.6 Restoring work area

During the process the sized seed must be weighed, the relevant documentation completed and the seed must be transferred back to the warehouse according to procedures. All unused material must be removed and samples of the processed seed must be obtained and submitted to the relevant parties. Work site procedures will prescribe relevant documentation to be completed and distributed.

During processing, strict attention should be paid to the cleanliness of the processing machines and any admixture should be avoided. Every processing plant should have a complete set of hand screens, a small air-screen cleaner and an indented cylinder to help determine the proper processing requirements. It is also essential to have an internal quality control laboratory attached to each seed plant with a small seed testing facility. This laboratory unit should constantly monitor the quality of the seed and the efficiency of processing operations.

Seed processing plants can only produce quality seed if high priority is given to cleanliness. Machines have to be cleaned between different crops and different varieties. Compressed air should be located throughout the plant to ensure that no mixing occurs; all inside parts of cleaning machines should be accessible so that hidden seeds can be removed. Brooms, blowers and vacuum cleaners should be available to clean machines and to remove spilled seed.
UNIT 3: TREATMENT AND ENHANCEMENT OF SEED

After the processing of seed which includes cleaning, it may be necessary to treat and enhance seed for different purposes such as:

➢ Disinfect or disinfestate seed to combat seed borne diseases and insects pests and protection of seeds against diseases and pests that may be present in the soil or in the air when seedlings emerge.

➢ Other specialized seed treatments such as coating and pelleting for specific purposes.

➢ Treatments to influence the metabolism of seed have been devised to enhance the germination of seed.

➢ Treatment which leaves no recognisable chemical on the seed e.g. hot water or running water.

Recent advances have dramatically improved the precision of applying seed treatments. Seed is alive and once the viability of seed is harmed, you cannot turn the clock back. Similarly, the effectiveness of chemicals in seed treatments depends on advanced formulation technology and precise application on the seed.

The turning point in the development of professional seed treatment was the high-tech advancements in the equipment that apply seed treatments and the transition to new polymer chemistry for binding and holding the treatment closer to the seed, while remaining water soluble and neutral to the seed itself.

These improvements mean that compared to a decade ago, professional seed treatments today are:

➢ more uniform on every seed,

➢ more accurate in rate of application,

➢ more diversified formulations that combine two or more active ingredients,

➢ More effective across a wider spectrum of diseases and insect pests.
3.1 Disinfection and disinfestation

This commonly refers to the application of pesticides to seed for the purpose of disinfecting seed, protection against pathogenic organisms and storage insect pests. Disinfection refers to the destroying of fungal spores found within the seed coat or inner tissue. Disinfestation is the destruction of surface organisms which have contaminated the seed surface.

3.1.1 Situations requiring treatment

- Seed suffering physical or mechanical injuries during harvesting or handling thereafter may have damaged coats providing opportunity for fungi infection. This may eventually harm or kill the seed.
- Seed may be infested during harvest or while being processed.
- It may be necessary to plant seed under unfavourable conditions which may favour the growth of certain fungal organisms. These infections can cause harm to the seed sown under these conditions.
- Seed must also be protected against organisms present in soil during germination and early establishment.
- Seed may also require treatment to enhance germination.

3.1.2 Seed treatment methods

Different seed treatment methods are available of which one or many may be used in your workplace. Seed treatment methods can be divided into three groups; mechanical, physical and chemical methods.

**Mechanical methods**

These methods are used to remove materials mixed with seed. Mechanical treatment can remove most pathogenic organisms from the seed surfaces if thoroughly cleaned but are however not free from pathogens and may require further treatment.

**Physical methods**

These methods are used primarily used to kill pathogens deep into the seed and include hot-water and water-soak treatments, ultraviolet, infrared, x-ray and other types of irradiation. Dry heat has also been used as a physical method. It is important to note that
physical methods do not protect seeds against organisms present in soil but only against those pathogens present on or in the seed.

**Chemical methods**

These methods are most commonly used due to its effectiveness and ease of handling. Organic and inorganic fungicides can be used, although organic fungicides are used more frequently. Fungicides can be applied as dusts, liquids, or suspensions. The recommended dosage may vary with the chemical, the specific crop, the storage period and the method of application.

The choice of chemical will depends on the type of the seed, nature of the pathogen, the condition of the seed, relative cost, availability of equipment and the weather conditions expected after seeding. The ideal chemical however will be selected keeping the following factors in mind:

- Effectiveness in controlling the pathogen
- Harmless to the seed
- Cost effective
- Easy to use and to apply
- Non-corrosive to equipment
- Stable for long periods
- Relatively harmless to animals and non-toxic to humans
- No interference during the planting process

Dosages will vary with the species of the crop to be treated and the chemical used. Your work site procedures will give exact quantities for each treatment to be conducted in the workplace. When seeds are treated with poisonous substances such as fungicides or insecticides, the law requires that the bag be labelled to indicate this treatment.

**Metabolic methods**

Processes that cause the seed to metabolise, change chemicals within the seed and repair cellular structures.
3.1.3 Seed treatment equipment

Slurry treaters

Slurry treatment involves the preparation of a suspension of wettable powders in water which is applied to the seeds. The material to be treated is accurately metered through a simple mechanism composed of a slurry cup and seed dump pump. The cup introduces a given amount of slurry with each dump of seed into a mixing chamber where they are blended together. The slurry treaters are adapted to all types of seeds and rates of treating. The small amount of moisture added to seeds does not affect seed in storage since the moisture is added to the seed surface and is soon evaporated.

Powders are the most difficult to handle and to mix, though they are easy to transport. Slurries and liquids are easier to mix, but may cause damage to the seed if not handled carefully. Most seed treatment machines are now designed to handle all forms of chemicals.

Direct treaters

An example of direct seed-treatment equipment is the Mist-o-matic which applies chemical as a mist to the seed. The machine is equipped with a large treatment tank, a pump and a return that maintains the level in the small reservoir from which the seed is fed.

Below is an example of a seed treater consisting of the following: frame, bunker, the adjustable measuring hopper of seeds, measuring hopper for the chemicals, the conveyor screw of the stainless steel, the system for the preparation of the chemicals, which consists of the tank, pump and chemical preparations.
3.2 Specialized seed treatment

In addition to the previously listed methods of seed treatment, seeds are also required to be treated for other specific purposes.

3.2.1 Seed coatings

The three most common seed coatings will be discussed. They are seed pellets, seed coating and film coating.

Seed coating

This is one of the most economical applications to improve seed performance. A seed coat is a substance applied to the seed that does not obscure its shape. Examples include fungicides, insecticides and micronutrients. An advantage of seed coating is that the seed enhancement material is placed directly on the seed, thus requiring fewer chemicals than if the chemical was broadcast or placed directly in the field.

Film coatings

Film coating are increasingly used by the seed industry. A film coating is a substance applied as a liquid to the seed that does not obscure its shape and increase the weight by more that 1 – 10%. Film coatings are so thin that the application of multi-layered film coats is possible with each layer containing a specific seed enhancement additive. Most film coating formulations are natural or synthetic polymers that contain a colorant that assist in monitoring planting accuracy during seeding. Film coating can also contain fungicides and insecticides. Another advantage of film coatings is that they have limited
dust-off problems making them safer to handle if a fungicide or insecticide has been included in the formulation. Film coatings can help to smooth the surface texture of winged and other appendaged seeds making them flow more evenly in seeding equipment.

**Seed pellets**

Seed pellets may be the most common seed enhancement in crop production because they improve seed plantability and performance. A seed pelleting substance is one that is applied to the seed and obscures its shape, thereby making flat or irregularly shaped seeds more rounded, small and light seeds larger and heavier thus enhancing precision planting and accurate placement by planters. Most seed are pelleted in a rotating drum. Pellets typically are composed of fillers such as clays, diatomaceous earth, graphite, powdered perlite, or combination of these and other materials. A binding or cementing agent is also applied at specific concentrations that facilitates adhesion of the filler to the seed, thereby adding durability. The filler materials, as well as the binder, can be modified to regulate the water-holding capacity of the pellet.

Hydrophilic or moisture attracting pellets are generally applied to seeds that require greater moisture availability for germination. The risks with such pellets are that there will be reduced oxygen availability for seedling growth if the media are watered excessively. Hydrophobic or moisture repelling materials can be included in pellets where excessive moisture conditions are likely to occur during germination. Seed technologists must understand that pellets vary in composition, and they should adjust their germination conditions accordingly.

### 3.2.2 Seed Hydration

Seeds are hydrated in order to decrease germination time, expand temperature ranges over which germination occurs and to achieve greater uniformity of stand establishment. Four seed hydration techniques will be discussed.

**Pre-hydration**

Soaking seed in water and drying them back before they germinate is the simplest approach to hydrating seeds. This technique minimizes the use of chemicals and avoids the discarding of materials that may be environmentally incompatible. A disadvantage of this approach is that seeds sometimes are not evenly hydrated. This fails to uniformly activate the physiological processes necessary to synchronise and improve seed performance. In addition, some types of seeds may actually be damaged by this method.
In this instance, recent innovation called drum priming slowly exposes seeds to precise quantity to water supplied either in a mist of metered directly to the seeds in a rotating drum. Unlike soaking, the drum priming technique offers a more precise method of regulating the rate of water uptake to a specific seed moisture content, thus avoiding potential excessive water absorption damage.

**Priming**

During priming the water content of seeds is controlled by soaking seeds in aerated salts or high molecular weight compounds such as polyethylene glycol (PEG). The amount of water the seed absorbs is regulated by the concentration of the PEG, the salt, or other osmotic agents. This is the most common seed hydration technique employed by the seed industry.

**Matriconditioning**

Another process to controlled seed hydration mimics the natural process of imbibition in the soil. Seeds are mixed into moist solid carriers such as granulated clay or vermiculite, rather than liquids as in priming. The surface of these compounds creates matric forces that hold the water that is gradually absorbed by the seed, hence the name matriconditioning. After matriconditioning, the solid carrier is sieved from the seed and the hydrated seed is dried. This technique is common in large-seeded crops.

**Pre-germination**

Pre-germination is characterised by a seed that possesses a protruded radical. This is accomplished using a standard priming technique; except that the seed is permitted to go further down the biochemical road toward germination before re-drying. The result is said to be a faster, more uniformly germinating seed compared to other types of seed hydration treatments.

### 3.2.3 Stratification

Seeds must be mature and environmental factors such as proper levels of water, oxygen, temperature, light and soil conditions must be favorable before germination can take place. Most seeds respond the best when water levels are enough to moisten the seeds but not soak them, when temperatures are slightly higher than room-temperature, and when oxygen is readily available; however this depends on the individual seed variety.

When a mature seed is placed under favorable conditions and fails to germinate, it is said to be dormant. The length of time plant seeds remain dormant can be reduced or eliminated by a simple seed treatment called stratification.
Stratification is a process of pre-treating seeds by simulating natural conditions that the seed must endure before germination. For seeds of trees and plants from temperate climates, stratification involves soaking or chilling the plants before sowing. Some seeds only germinate when high temperatures are reached i.e. after a forest fire.

The time taken to stratify seeds depends on species and conditions; in many cases two months is sufficient to break the seed dormancy. After undergoing the cool moist treatment the seeds are ready to plant and will usually sprout in a few days to weeks.
UNIT 4: PACKAGING OF SEED

Packaging is the last operation of the seed processing line after the seeds have been dried, cleaned and treated with suitable chemicals. Packaging is the placing of a counted or weighed sample of seeds into a container for storage. Seeds may be hermetically packaged to prevent absorption of water from the atmosphere after drying, to keep each batch separate and prevent contamination of the seeds from insects and diseases.

Packaging typically consists of the following operations:

- Filling seed bags to a specified weight,
- Placing leaflets in the bags with any relevant information that may be required,
- Attaching identification labels or any other seed certification tags to the bags, and
- Transportation or storage of the bags.

Hermetic seal must be effective

The packaging process must not compromise physical purity, germination and genetic status of seed. The packaging area and equipment therefore, must be thoroughly clean before a packaging process commences. The best time to package seeds is directly after the moisture content has been determined and found to be within the required limits for safe storage. Therefore interim bulk hermetic packaging is often necessary. Seeds will always show equilibrium between their moisture content and the relative humidity of the environment and therefore, if possible, seeds should be packaged into containers and sealed in the drying room or without delay on being removed from it.

Each kind of seed, the size of the packages that are to be produced and whether the unit of measure is mass count or volume, will determine what equipment is to be used. Empty packaging material, additional labels and seals, where required, must be obtained before packaging commences. Seed to be packaged must be compared with the documentation, which gives the instructions, to ensure that the correct seed is going to be packed into the packages.

Protective clothing and equipment must be obtained prior to packing, to ensure the health and safety of personnel involved. Special attention should be paid to poison treated seed, where latex gloves, goggles and masks may be required in addition to protective apparel. No loose clothing should be worn that could be caught in equipment and lead to injury.
Always ensure that proper preparations are made prior to packaging. Therefore any discrepancies or uncertainties must be conveyed to the relevant management and colleagues, who are concerned with packaging, the identity and quality of seed, and the legal requirements. It is equally important to obtain and understand answers that address the issues raised.

4.1.1 Seed Packaging Materials

Different packaging materials are available designed to protect most of the physical quantities of seeds, such as weight, size, colour, moisture content and purity. Some packaging materials are also designed to protect the physiological aspects of seeds such as viability, vigour and dormancy. A short description of the properties of typical seed packaging materials is provided below.

A. Cotton Bags

Cotton fabrics are produced in different sizes according to the specific packaging requirements. They can be coated and laminated to provide the required strength and protective properties. Although cotton bags provide good protection of the physical properties of seeds, they are not resistant to moisture, insects or rodents unless further strengthened.

B. Hessian Bags

Hessian is a low-cost fabric woven from a good quality jute fibre. It is tear resistant and has a strong tensile strength and can therefore withstand rough handling during storage and distribution. It is however not suitable for seed treated with highly poisonous pesticide. Laminated hessian bags are resistant to moisture transmission, insects and rodent infestation.

C. Paper bags

Bags made out of paper are extensively used for packaging purposes. The packets are designed to contain a measured amount of seed without loss, but they do not normally protect seed viability under unfavourable conditions. Many paper seed bags have plies or layers.

D. Elastic Multi-wall Paper Bags

The number of plies in multi-wall paper bags depends on the weight of the product to be packaged. Other bags are laminated with polyethylene or aluminium foil providing better protection against moisture. The paper can also be treated to repel insects and rodents.
E. Cellophane-polyethylene Laminate Bags

Cellophane is made from regenerated cellulose. In combination with various other substances such as pliofilm, polyester, polyvinyl, aluminium foil and polyethylene suitable bags for seed packaging are manufactured.

F. Annealed Aluminium Foil

Annealed aluminium foil has a high tensile strength and low moisture vapour transmission rate. Although aluminium foil on its own does not make a good seed packaging, combinations with paper or plastic films offer an effective barrier against moisture and gasses.

G. Polyethylene Bags

Polyethylene is the most extensively used thermoplastic film. With a tight closure and a heat seal medium-density polyethylene bags can be made completely insect proof. Polyethylene films can be laminated to themselves, other films, foil, paper, textile fabrics and fibreboard which can further improve the moisture barrier and other physical properties. Packaging material from polyethylene is ideal for providing sealed storage conditions in humid climates. Bags should be of adequate strength and thickness to avoid moisture entering through cracks.

H. Metal, Glass and Cardboard Containers

Metal containers provide an absolute barrier to moisture, gases, light and protect seeds from rodents, insects and harmful fumes if properly sealed. Glass containers provide the same protection as metal, but can break easily and are therefore not used extensively. Cardboard boxes on the other hand are used extensively. If laminated with polyethylene, aluminium foil or other materials they provide excellent protection against moisture transmission. Normally cardboard bins have metal lids and bottoms.

4.1.2 Apply identification on packaging material

Once the preparatory work is complete, it is necessary to place the identity of the seed on the packaging material. Methods vary from stencilling on polypropylene bags in advance of filling, to automatic laser printing of small packs as they pass through filling machinery. Labels are usually required in addition to the marking of the actual containers. The details written or printed on to the labels reflect:

- the identity of the seed,
- the seed quality, or as an alternative, the status of the seed e.g. pre-packed seed, as provided for in the Plant Improvement Act 1976; and

- The mass and/or number of seed in the package.

The labelling requirements of seed controlled by the Plant Improvement Act 1976 are clearly defined in the regulations and must be adhered to. The identities have to be stated, in both instances, in conformity with the seed legislation, especially the Plant Improvement Act 1976 and with the organisation’s requirements, which may exceed the scope of that which is legislated. Not all species are covered by the Plant Improvement Act 1976, nor are all the commercial requirements included.

Additional labels are required for official verification, as in the case of the South African Seed Certification Scheme and the OECD Seed Certification Scheme. It is the responsibility of specially designated persons to formally attach such labels and the requisite seals, but the packaging personnel are often required to do preparatory work to facilitate the official labelling. This work must be done according to worksite procedures and statutory requirements, especially with regard to accessibility of the containers.

![Figure 9: Labelling Machine](image)

Seed that has been treated with a poisonous substance must be labelled to that effect. Seed of varieties that are protected by plant breeders’ rights must be labelled indicating this. The number accorded to the variety by the Registrar of Plant Breeders’ Rights in the National Department of Agriculture must be stated. Seed that is sold for experimental purposes, prior to listing on the official variety list, must be labelled accordingly.
4.1.3 Fill and seal packages

Packages can be filled in many different ways and the specific method used must be clearly stipulated by the work site procedures. The equipment used may range from a simple scoop to a fully automatic filler. Most filling equipment has a measuring device, which may be controlled manually or automatically.

![Automatic counting and filling machine](image)

Figure 10: Automatic counting and filling machine

The level of accuracy of packaging is regulated in terms of the Weight and Measures Act as amended. Each organisation will have its own levels of accuracy, equivalent to or more exacting than the legislation.

The actual filling process requires constant attention. Personnel must ensure that the quantities are being dispensed according to any settings that will have been made in preparation. Attention must be given to the prevention of any spillages or leaks. Should these occur, the packing process must be stopped immediately. Before any work is done an equipment lock-out must be effected, to prevent injury to the personnel making the rectification.

Spilled seed needs careful evaluation by management regarding recovery or discard and may not simply be put back into the process. Final weighing in manual operations has to be done accurately on assized mass meters, with due regard to the tare mass of the containers. The actual mass may be adjusted upwards by the organisation per worksite procedures, to ensure that the contents are within legally and organisationally prescribed tolerances.
In mechanical operations, regular checks are required to verify that the dispensed quantities are correct. The same considerations regarding tare mass and allowances to meet tolerances apply.

Seed labelled by seed count may be packed in two different ways. It may be packed according to mass equivalent, as determined by seed laboratory analysis, or by actual count.

Packing by mass equivalent requires accurate grading of the seed into multiple fractions to ensure uniformity; otherwise seed will migrate, according to size, in the packaging process, rendering the labelling incorrect. Moisture content must remain unchanged between the time of seed laboratory count determination and the packing process. If there should be a change, the labels will not reflect the true contents.

Packing by actual count is slower and more expensive, but is often essential due to lack of uniformity in a seed lot. Electronic counting machines, in which seeds are individually counted as they pass over an electric eye, are required for large-scale production of packages by count.

Different containers and special equipment for sealing are available for the storage of seeds. Storage containers for base collections should be hermetically sealed and moisture-proof. Cans, bottles, and laminated aluminium foil containers are all acceptable for both base and active collections. The techniques used will vary with the type of container and the equipment that your company is using.

The sealing of containers may be by stitching or heat sealing, depending on the material, in the case of bags. Sealing is done by the rolling together of edges in the case of metal cans and by gluing or heat-sealing of bottles and small pouches. Whatever the sealing method, the seal must be effective against leakage. In terms of the Plant Improvement Act 1976, the seal must be such that the seed can be attributed to the organisation that packed the seed and no other.

In the case of hermetic (air tight) sealed containers, the seal must be moisture proof. The seed must not be exposed to ambient conditions for periods that would allow the seed to absorb moisture to the extent that the objective of the hermetic packing would be defeated.

Any deviations from the prescribed procedures, accidents or errors must be reported to management and colleagues concerned with the operation, quality control and legal matters.
1. After sealing, make a visual examination of each container to make sure that there is no obvious damage and that the seals do not leak.

2. Any containers that are below standard should be replaced immediately.

3. At regular intervals the containers should be checked to see that they remain in good condition and the seed moisture content should also be checked to ensure it remains within the acceptable range.

4. Remember that any containers removed from the cold store should be allowed to warm to room temperature before opening. This may take several hours especially with large volumes of seeds.

4.1.4 Complete seed packaging

Once packaged it is essential that the seed be distributed physically, out of the packaging area, to the correct destination within the organisation. Administratively, it must be accorded its new status and electronic destination in computerised systems.

After the packaging operation, the area must be thoroughly cleaned. Scrap must be accounted for, both seed and packaging material, explanations given and material be removed from the packaging area.

Records of the procedure must be written up physically and electronically, as required by the organisation and in compliance with the statutes, especially the Plant Improvement Act 1976, the Plant Breeders’ Rights Act and the Farm Feeds and Remedies Act 1936.

Any discrepancies, deviations, errors or suspected errors must be reported to management and colleagues concerned, as with the preceding stages in the process. The adage “prevention is better than cure” is most appropriate in this instance, as errors with seed have huge multiplying effects in terms of the ultimate damage that may arise.
UNIT 5: WRAPPING OR BULKING OF SEED CONTAINERS

The identity of seed must be preserved in wrapping and bulking of containers and not be prejudiced by inclusion of other seed packages. Convenience in storage, lot management, stock taking and picking for sale is greatly enhanced by good wrapping and bulking procedures.

In preparation for wrapping and bulking, the area in which the work is to be done must be thoroughly cleaned. All packages that are not intended for the process must be removed. No loose clothing should be worn that could be caught in equipment and lead to injury.

5.1.1 Wrap or bulk seed containers

It is of vital importance to the seed industry that materials are handled and stored efficiently. In addition to raw materials, these operations provide a continuous flow of material through the workplace and ensure that product is available when needed. Unfortunately, the improper handling and storing of materials can often have costly consequences.

Using mechanical equipment to move and store materials increases the potential for personnel injuries. Workers must be aware of both manual handling safety concerns and safe equipment operating techniques. You should avoid overloading equipment when moving materials by means of mechanical moving equipment. It is important to allow the weight, size, and shape of the materials being moved to determine the type of equipment used. All material-handling equipment has rated capacities that determine the maximum weight the equipment can safely handle and the conditions under which it can handle that weight. The equipment-rated capacity must be displayed on each piece of equipment and is not exceeded except for load testing.

Depending on the size of individual containers, wrapping may vary from placement of bags of agronomic and pasture seed on pallets and wrapping pallet loads in plastic, to placement of sachets of horticultural seed into shrink-wrap units and/or cardboard cartons. Palletisation and plastic wrapping requires forklift trucks, plastic sheet applicators, shrinking and strapping equipment. Bulking of seed packed in cans, bottles and self standing foil containers requires a range of cardboard boxes, stapling machines, adhesive tape dispensers and strapping equipment. Packing of foil and paper pouches requires a
range of cardboard boxes, stapling machines, shrink-wrap tunnels, adhesive tape
dispensers and/or strapping equipment.

Depending on the size of individual constituent containers, the size of the wrapped or
bulked units and the height to which they are to be raised above floor level, so the level of
danger will vary. Hard hats and capped boots are necessary for heavy units that are
hoisted into stacks or on to high shelving.

Before actual wrapping or bulking commences, the identity of the packages and the
numbers thereof must be verified as being in compliance with the instructions that have
been given. Bulk label for the wrapped or bulked units must be prepared and reflect the
total number of constituent packages, the size, lot numbers and any other identifying
feature that may be specified on the instructions. Wrapping and bulking then takes place,
using the equipment that has been obtained. The size of the wrapped entities in terms of
the number of constituent packs must tally with the instructions.

Where bulk packing into shrink-wrapped units and/or cardboard cartons is required, the
number of constituent packages per unit must be adhered to and the appropriate sizes
cartons used. Wrapping and cartons may vary depending on ultimate destination where
this is known. The instructions in this regard must be followed. In the event of deviations
from instructions, the management and colleagues concerned must be informed.

Packaging statutory requirements should not be defeated during the
wrapping process. It is important that the content of the wrapped
materials can still be identified after wrapping.

5.1.2 Pallet wrapping

In many workplaces pallets are used to transfer loads. Before attempting to lift a pallet,
the load must be stabilised by either interlocking the objects, or strapping or shrink-
wrapping them. The forks should be spaced as widely as possible and positioned evenly
between the pallet stringers. Never stack any load in front of doorways, fire exits, fire
hoses, staircases, and ladders. Different methods to wrap and strap bulk containers on
pallets are used in the industry in order to transfer and store material.

Extruded Pallet Wrap

Extruded Wraps are tough, rugged wraps designed for maximum containment.
Knitted Pallet Wrap

Knitted net is strong and lightweight. It is easy to handle and simple to dispose of.

![Knitted Pallet Wrap](image1)

**Figure 11: Knitted Pallet wrap**

Net Film

Net film works like regular film, but allows the product to breathe. Light weight yet strong, this elastic film will hold the load during transport and storage.

![Net Film](image2)

**Figure 12: Net film**

5.1.3 Pallet strapping

Plastic polypropylene

It is an economical plastic strapping that offers lower cost and easy handling. It is safe and easy to use and dispose of. The tensile strength or test is lower than metal.
Polyester Strapping (P.E.T.)

This is a premium plastic strapping that will not tear or split. This strapping stretches less than polypropylene under high heat. It is stronger and doesn't lose its strength due to moisture. Will replace steel in many applications because the cost is lower, it retains tension better than steel with products that compress during transit, it doesn't cut or snap like steel and is lighter for easier handling.

Steel Strapping

Steel strapping is best for extremely heavy and rugged loads. It does not stretch and assures that the load will not slip or shift.

5.1.4 Complete wrapping or bulking procedure

Having applied the identification of contents to the wrapped or bulk packed units, the relevant parties are to be informed, so that the seed can be distributed to the appropriate location. The work area must be restored to its original condition of thorough cleanliness. Any discrepancies or deviations must be reported as indicated above.

Ensure all wrapped seed containers are properly labelled.
ANNEXURE 1: STATUTORY REQUIREMENTS

Statutory requirements
ANNEXURE 2: REFERENCES

This document does not claim to be an original publication. Various sources of information and documents were used when compiling this document. Any neglect to make reference of any source, including an author, web site or publication is not through intent. Such omissions should be brought to the attention of SANSOR, who will gladly rectify the omission.

Plant Improvement Act (1976)
www.seedtest.org
www.aosaseed.com
www.seedburo.com
www.cisco-eagle.com
www.cdc.gov
www.ipgri.cgiar.org
www.wikipedia.org
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PURPOSE OF THE UNIT STANDARD
A learner who has achieved this unit standard will be competent in:
The control of the seed conditioning facility to deliver an acceptable product.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING
To enter a learning programme for this unit standard or to be assessed against this unit standard, the learner is assumed to have:

- Literacy, numeracy and communication skills at or equivalent to NQF level 3.
- Basic knowledge of the seed industry. Introduction to the workplace within the seed industry.
- General knowledge of safety in the workplace at NQF level 3.
- An understanding of supplier and customer relationships.
- General mechanical skills.
- Basic supervision skills.
- Computer literacy at NQF level 3.

UNIT STANDARD RANGE
The scope of this unit standard deals with the control of the processing operation. The specific outcomes as reflected in this unit standard are performed independently, but with access to work site procedures and operating instructions.

UNIT STANDARD OUTCOME HEADER
Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1
Coordinate the processing operation/s.

OUTCOME NOTES
- Obtaining the production sequence according to work site procedures.
- Obtaining the relevant seed lot/s to be processed according to work site procedures.
- Checking processing equipment in the plant and obtaining the necessary material and chemicals according to work site procedures.
- Prescribing the appropriate personal protective equipment (PPE) and safety procedures according to work site procedures and statutory requirements.

ASSESSMENT CRITERIA
ASSESSMENT CRITERION 1
Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes.

In this unit standard the following specific criteria should be used:
- Job instructions, oral or written, are accurately followed and adhered to.
Purpose of obtaining correct information for processing is explained.

Consequences of ineffective implementation of processing plan are explained. Consequences of not acquiring and maintaining appropriate equipment, materials and resources timely are explained.

Consequences of a lack of adequate communication are explained.

Importance of complete and accurate documentation is explained.

Purpose and importance of continuous monitoring is explained.

Importance of identifying deviations and implementing corrective action timely are explained.

Reasons for adhering to safety and quality procedures are explained.

SPECIFIC OUTCOME 2
Monitoring the processing operation/s.

OUTCOME NOTES

- Monitoring that equipment is operating according to work site procedures.
- Ensuring that the appropriate personal protective equipment (PPE) and safety procedures are applied according to work site procedures and statutory requirements.
- Performing ongoing quality checks on outputs at all levels according to work site procedures.
- Setting processing equipment and machinery as required, to obtain optimum seed recovery and quality according to work site procedures.
- Identifying and/or implementing corrective actions to be taken according to work site, quality and safety procedures.
- Informing relevant parties of deviations according to work-site procedures.
- Communicating with all relevant parties when changes are implemented.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1
Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes.

In this unit standard the following specific criteria should be used:

- Job instructions, oral or written, are accurately followed and adhered to.
- Purpose of obtaining correct information for processing is explained.
- Consequences of ineffective implementation of processing plan are explained.
- Consequences of not acquiring and maintaining appropriate equipment, materials and resources timely are explained.
- Consequences of a lack of adequate communication are explained. Importance of complete and accurate documentation is explained.
- Purpose and importance of continuous monitoring is explained. Importance of identifying deviations and implementing corrective action timely are explained.
Reasons for adhering to safety and quality procedures are explained.

SPECIFIC OUTCOME 3
Complete the processing operation/s.

OUTCOME NOTES
- Ensuring that offal material has been removed according to work site and quality procedures as well as statutory requirements.
- Ensuring that relevant input documentation and data input have been completed according to work site procedures and statutory requirements.
- Ensuring that the seed sampling has been done and distributed according to work site procedures and statutory requirements.
- Ensuring that seed is forwarded to the correct destination according to work site procedures.
- Performing a final check to ensure that the processing equipment and machinery have been properly shut down and cleaned.

ASSESSMENT CRITERIA
ASSESSMENT CRITERION 1
Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes.

In this unit standard the following specific criteria should be used:
- Job instructions, oral or written, are accurately followed and adhered to.
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- Consequences of a lack of adequate communication are explained. Importance of complete and accurate documentation is explained.
- Purpose and importance of continuous monitoring is explained. Importance of identifying deviations and implementing corrective action timeously are explained.
- Reasons for adhering to safety and quality procedures are explained.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS
An individual wishing to be assessed against this unit standard may apply to an assessor accredited by SETASA.

Any training provider offering learning that will enable achievement of this unit standard must be registered and accredited by SETASA.

Moderation of assessment will be done by SETASA in its ETQA capacity at its discretion.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE
Ability to train others, as required, for the operations process.
General supervisory skills.
Knowledge of relevant, appropriate legislation and industry standards inherent in the work site procedures.

Basic knowledge of the theory and methods associated with seed processing.

Appropriate computer operational skills.

UNIT STANDARD DEVELOPMENTAL OUTCOME

UNIT STANDARD LINKAGES

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING
Identify and solve problems when monitoring processing operations.

UNIT STANDARD CCFO WORKING
Work effectively with others when receiving information and giving instructions during monitoring of processing operations.

UNIT STANDARD CCFO ORGANIZING
Organise and manage oneself when coordinating and monitoring the processing operation.

UNIT STANDARD CCFO COMMUNICATING
Communicate with others during the process.

UNIT STANDARD CCFO SCIENCE
Use science and technology when monitoring the process.

UNIT STANDARD CCFO DEMONSTRATING
Analyse and evaluate the process.

UNIT STANDARD ASSESSOR CRITERIA

UNIT STANDARD NOTES

Values

All learners should demonstrate:

- An application of company ethics, values as well as general safety and customer care principles.

- An awareness of expectations and obligations of basic worker / management / customer relationships.