Grading, sampling, determination of moisture, undesirable and harmful substances, stones and poisonous seeds in maize are regulated by the Agriculture Product Standard Act 1990 (Act 119 of 1990) and is stipulated in Government Gazette No R473 of 08/05/2009

1. GENERAL DEFINITIONS

For the purpose of this Regulation, the following words or expressions will have the following meaning:

1. "Consignment"

1.1 It is a quantity of maize of the same class, which belongs to the same owner, delivered at any one time under cover of the same consignment-, delivery-, or receipt note or delivered by the same vehicle or bulk container, or loaded from the same bin of a grain elevator or from a ship's hold; or

1.1.2 in the case where a quantity referred to in paragraph 1.1 is subdivided into different grades, each such quality of the different grades.

2. "Container"

It means a bulk container or bag.

2.1 bulk container is any vehicle or container in which bulk maize is stored or transported;

2.2 bag means a bag manufactured from jute or phormium or a mixture of jute and phormium; or

2.3 bags manufactured from polypropylene that complies to SABS specification CKS 632.

3. "6.35 mm round-hole sieve"

Means a sieve with a flat metal bottom of 1,0mm thickness perforated with round holes of 6,35 mm (± 0,05 mm) in diameter that are arranged with the centers of the holes at the points of intersection of an equilateral triangular grid with a pitch of 8mm;

of which the upper surface is smooth;

the frame of which is at least 40 mm high;

with the inner width of at least 200 mm and the inner length of at least 300 mm or, in the case of a circular sieve, the inner diameter of at least 278 mm;
with a minimum area of 600 cm^2 and a maximum of 750 cm^2 and that fits onto a solid bottom and must be at least 20 mm above the bottom of the tray.

4. "Insect"

Any live insect which is injurious to stored grain irrespective of the stage of development of the insect.

5. "Poisonous seed"

Means seed or part of seed of plant species, that may represent a hazard to human- or animal health when consumed.

6. "Representative sample"

This sample is taken in accordance with the Regulations as specified in Regulation 10 of Government Gazette R 473 dated 08/05/2009.

7. "Working sample"

This is a sample that is obtained by dividing a representative sample of the consignment according to the ICC 101 (approved 1960) method.

8. "Multiple-slot divider"

The multiple-slot divider consists of a dividing apparatus and three hoppers. The dividing apparatus must have at least twelve slots with a width of between 25 and 30 mm and not less than 100 mm in length. Every two successive slots must empty in opposite directions. The divisions between slots must not be more than 3 mm thick. At the top, the group of slots will be surrounded by a wall, high enough to prevent grain from overflowing - when a sample is poured into it for dividing. The apparatus must be provided with legs of sufficient length to enable grain to fall freely into any of the two hoppers, placed underneath the opposite outlet slots. The length or breadth of the hoppers, must be as such that all grain from the outlet slots is caught in the hoppers.

2. GRADING OF MAIZE

2.1 OBJECT OF GRADING

It facilitates the grain trade because:

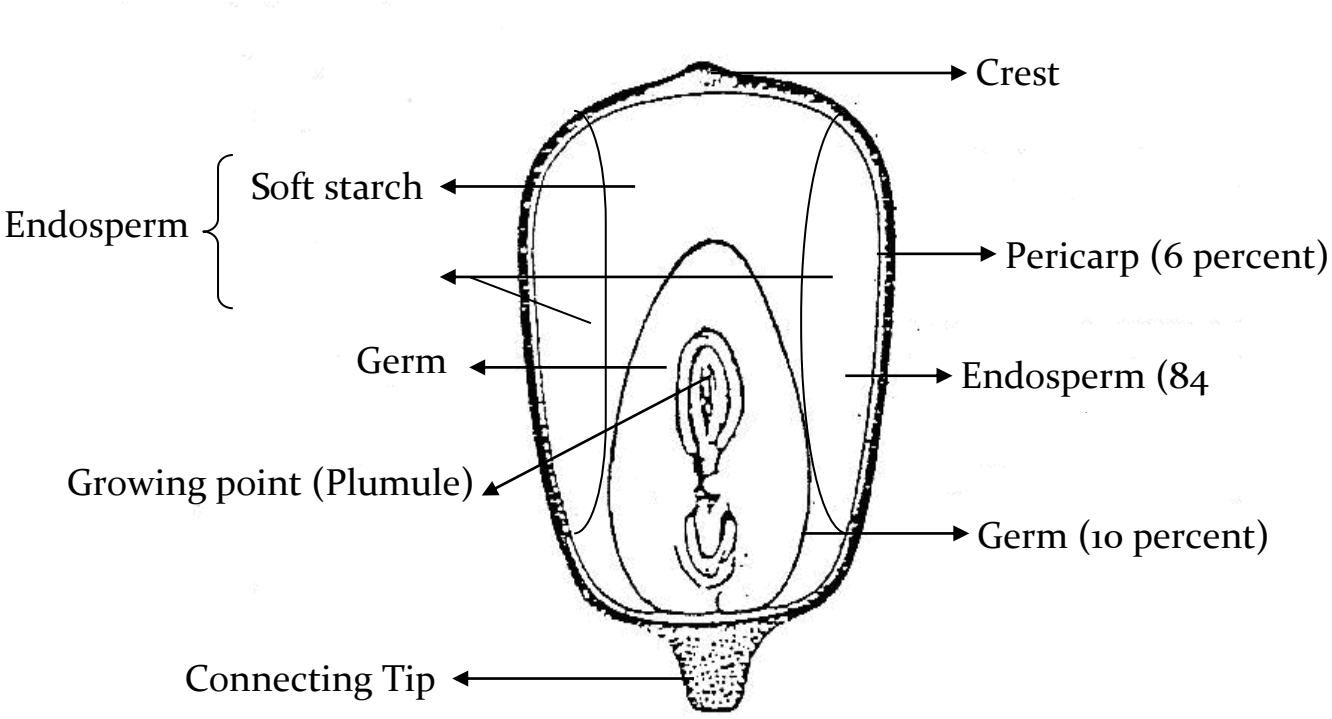
1. It lays down a standard which is understood by local- as well as international grain traders;

2. It eliminates the necessity of contracts between buyer and seller;

3. It eliminates the red tape and the time wasting procedure of buying on sample; and

4. The Grading Regulations are based to some extent on the commercial requirements, to which grain must conform for a certain purpose.

DIAGRAM OF A MAIZE KERNEL



2.2 CLASSIFICATION OF MAIZE

From an agricultural point of view, maize is classified in the following 3 groups:

2.2.1 Group 1 is maize commonly produced and stored by the grain handlers, in silos/grain depots.

2.2.1.1 **Dent maize (Zeal mays indentation)**
The types belonging to this group are easy to identify by the dent or dip at the crest of the kernel. The soft starch of the endosperm extends up to the crest of the kernel, whereas the horny starch is only found at the sides. The dent which ever form it takes, is caused when the soft starch of the endosperm shrinks in drying; and

2.2.1.2 **Flints (Zeal mays indurate)**
The kernels are round, hard and clearly without any dents on the crest. The white starch is surrounded by the horny endosperm. In some cases, this horny endosperm is a relatively thin layer over the crest, making the lower white endosperm easily visible.

2.2.2 Group 2 is sub species that are normally planted under contract:

2.2.2.1 **Bread maize (Zeal mays amylacea) (White above the sieve)**
Kernels of bread maize are not easily distinguishable from flint maize, since there is a degree of similarity in the form of the kernel. Bread maize however, has a dull colour and the entire endosperm consists of soft starch;

2.2.2.2 **Sweet corn (Zeal mays saccharata) (White or yellow above the sieve)**
The kernels of sweet corn are easily distinguishable on account of their transparent- and shriveled appearance;

2.2.2.3 **Popcorn (Zeal mays everta) (White or yellow below the sieve)**
Popcorn has small-, round- and flinty kernels. The white- and yellow kernels look the same, but there is a slight colour difference;

2.2.2.4 **Waxy maize (Zeal mays ceratina) (White or yellow above the sieve)**
Kernels of waxy maize are not easily distinguishable from dent maize, since there is a degree of similarity in the form of the kernels. Waxy maize however, has a waxy appearance. To distinguish waxy maize from other classes, a small cut should be made on the crest of the kernel and the kernel immersed in an 0,1% iodine solution. The kernel will be coloured brown, whereas ordinary maize assumes a blue colour; and

2.3 Group 3 is the lesser known variety such as dwarf-, dog-, pubescent- and striped maize.

3. REGULATIONS RELATING TO THE GRADING OF MAIZE

Application of the Regulations means:

3.1 "Defective maize kernels"

Means maize kernels and/or pieces of maize kernels, irrespective of colour in the sample:

1. that pass through a 6,35 mm round sieve;

2. that are shriveled, obviously immature, frost damaged, heat damaged, water damaged, mouldy or chalky;

   that are discoloured by external factors such as water and sun; provided that

   discolouration on both sides of the maize kernel limited to less than a quarter from their bottom tip of the maize kernels shall not be considered as defective, oxidation stained maize kernels, coffee stained maize kernels, and pinked maize kernels shall not be considered as defective;

3. that have sprouted including kernels of which the shoot (plumule) in the germ is visibly discoloured.

4. that have cavities in the germ or endosperm, caused by insects or rodents;

5. that are visibly soiled (smeared) or contaminated by smut, fire, soil, smoke or coal-dust.

6. that are subspecies other than Zeal mays indentation or Zeal mays indurate i.e. popcorn, sweetcorn, bread maize and waxy maize;

   Provided that:

   irregularity of shape and size of maize kernels shall not affect the grading thereof and chipped or cracked maize kernels or pieces of maize kernels which are in a sound condition and which appear in a sample of maize, but which do not pass through a 6,35 mm round-hole sieve, shall not be regarded as defective maize kernels under these regulations.

3.2 Definitions of defective kernels:

"**Mouldy**" means kernels or pieces of kernels that are –

visibly infected by fungi and are characterized by black, blue, green, yellow or white fungi growth anywhere on the kernel, or are characterized by fungi growth
underneath the bran layer of the kernel - that are infected by ear-rot and are characterized by red, pink, or brown discolourations. The kernels are partially to be completely infected.

"**Heat damaged**" means -

kernels that are as a result of external heat or internal fermentation affected by excess moisture and have at least one of the following characteristics:

Kernels or pieces that are amber, brown, dark-brown or black discoloured;

Kernels of which the germ has dark-brown too black discolouration.

"**coffee stained maize kernels**" mean -

maize kernels with a shiny brown colour that occurs anywhere on the pericarp of the maize kernel;

"**oxidation stained maize kernels**" mean -

maize kernels with a shiny light brown colour that are discoloured at the back and sides of the kernel. Discoloration does not appear in the germ of the kernel).

"**frost damaged**" means -

maize kernels that are covered with wrinkles on both sides of the kernel to the crown and have a pearl-like appearance. Maize kernels of which the bran is flaking is considered frost damaged if signs of frost damage are present;

"**sprouted maize kernels**" mean -

maize kernels which have sprouted so far that developing roots and/or sprouts are clearly visible, or the shoot (plumule) in the germ is visibly discoloured;

"**discoloured maize kernels**" mean -

maize kernels that are as a result of environmental conditions more than 25% discoloured on both sides of the kernel, excluding coffee stained maize kernels, oxidation stained maize kernels and pinked maize kernels;

"**shriveled or obviously immature maize kernels**" mean -

maize kernels with a thin and shrunken appearance;

"**water damaged maize kernels**" mean -

maize kernels with a light yellow shine from the tip carp in a band around the maize kernel.

4. DESCRIPTION OF GRADING FACTORS

This is maize kernels and/or pieces of maize kernels irrespective of colour of the kernel that appear above or below the sieve.

Wizened — The germ and endosperm (soft and hard starch) of these kernels **do not develop to maturity**. These kernels have a shrivelled appearance and appear to be shrunken.

Immature — The endosperm of these kernels do not develop. These kernels are easily identified by their flat appearance. Immature kernels should not be confused with small kernels. A practical way to distinguish between immature and small kernels is to decide whether the kernel will germinate when planted, or not. If you decide that it would not grow to a mature plant, only then is the kernel immature.

Frost damage — The characteristics of kernels damaged by frost and water are very similar in appearance.
The discolouration starts at the connecting tip and then spreads to the rest of the endosperm. This typical dull brown discolouration is also found when water damaged occurs. This discolouration will extend around the kernel, but will be more noticeable in the germ portion of the kernel. The kernel has a dull chalky appearance, due to the fact that the hard endosperm has not developed. A very low hectolitre mass is typical of frost damaged kernels.

Mouldy — This damage appears in sound kernels that have been exposed to mould development. These kernels do not have the typical mouldy odour, but the green/blue mould spores are clearly visible on the kernel.

Discoloured — The discolouration is normally caused by external factors such as water, sun, heat and other chemicals (paint). Because most of the discolouration is caused by water, only water discolouration is described.
Discolouration of the connecting tip:

the yellow- to brown discolouration that appears on the connecting tip, is as a result of a wet cob and therefore as previously mentioned, the similarity of water damaged kernels.
This discolouration must exceed 25 % of the surface on both sides of the kernel before it could be considered as defective.

Water discolouration is normally caused when the kernel is fully developed and three types of damages are found:

water damage that occurs when the cob is still attached to the maize plant and the drying process is in progress;

water (rain) enters the cob and is absorbed by the dry cob. This is all nature needs to start the breakdown process and subsequently the rotting process/discolouration starts at the connecting tip and spreads to the rest of the kernel. The damage is clearly indicated by a dull brown stain that is clearly visible around the kernel.

	Grain harvested with a high moisture content, has a shining swollen appearance and a dull sound is heard if the kernel is dropped onto a hard surface, because the hard endosperm is not fully developed. These kernels mostly consist of a soft endosperm; Water damage that occurs in storage: the kernels show the yellow brown discolouration that is typical when internal heat damage occurs. The discolouration is more noticeable in the germ of the kernel, but would eventually spread to the rest of the kernel.
Oxidation	The kernels have a shiny brown discolouration, that only appears on the surface of the kernels. The discolouration is only found on the sides and back of the kernel. Discolouration never occurs in the germ of the kernel.
Pinked maize	This is a genetic characteristic that occasionally appears on the kernels. This discolouration is limited to the surface area of the kernel and does not discolour the endosperm at all.
Sprouted	The growing tip in the germ is visibly altered and is indicated by a discolouration of the growing tip. Even plant forming is sometimes visible.
Insect damage	Any holes or other indications of damage to the germ or endosperm caused by insects and/or rodents (webbing or indications of feeding). Surface damage to the pericarp, is not considered to be damage.
Contamination	Visible contamination could be caused by external commodities such as smut spores, soil, smoke, coal or dust. The contamination must be clearly visible before it would be considered to be defective.
Screenings	This includes all pieces and whole kernels found below the 6.35 mm round hole sieve, during the grading proses. Any other commodity other than maize, is not considered to be part of the screenings and must be removed before the mass of the screenings is determined.
Fungi contamination	Cob rot is the general term used to describe fungi damage to grain. The following types of fungi damage occur: *Diplodia-cob Rot* (*Diplodia Stenocarpella Maydis*) The fungi are systematically absorbed by the roots of the plant from the soil and first indications of contamination is noticeable in the germ of the kernel. This contamination is characterised by a slight grey discolouration of the germ. The fungi will continue to grow, if the moisture content of the maize is above 12.5 %. During this growth period, the fungi will contaminate both the germ and endosperm of the kernel. The kernel is characterized by light brown- to greyish fungi growth, that would eventually develop to a dull black discolouration. *Fusarium-cob Rot* (*Fusarium Moniliforme*)

This type of contamination usually occurs with bird and/or insect damage, but the fungi is also capable of damaging the kernels on its own. Contamination of this fungi is characterized by a dull pinked- to red discolouration.

Fusarium-cob Rot (*Fusarium Graminearum*)
These fungi cause the well-known Gibberella-cob rot.
Contamination of this fungi is characterized by a dull pinked- to dark red discolouration.

Fusarium-cob Rot (*Fusarium Oxysporrum*)
Contamination of this fungi, is characterized by a light brown- to a dark brown stain. In some cases, the kernels can develop a black colour.

2. MAIZE KERNELS OF ANOTHER COLOUR

2.1 white maize means maize kernels or pieces of maize kernels of which the endosperm as a result of genetic (characteristics) composition have another colour than white, excluding pinked maize kernels;

2.2 yellow maize means maize kernels or pieces of maize kernels of which the endosperm as a result of genetic (characteristics) composition have another colour than yellow.

3. FOREIGN MATTER

It means any matter other than maize.
Stones above the sieve, glass, dung, coal and/or metal are not a foreign matter, due to the fact that these materials are not allowed in the sample.

4. PINKED MAIZE KERNELS

Pinked maize kernels indicate white maize kernels of which the endosperm is white and which the pericarp or part thereof, is of a red- or pinked colour.

5. CLASSIFICATION AND GRADING OF MAIZE

There are three classes of maize, namely:

white maize; yellow maize; and class other maize.

6. GRADES

The grades for the different classes of maize (excluding class other maize) must be as follow:

Class e.g. of maize		Grades
6.1	White maize	WM1, WM2 and WM3
6.2	Yellow maize	YMI, YM2 and YM3

7. DEVIATIONS

The maximum deviations allowable in respect of the mentioned grades, are as follows:

Deviation		Maximum permissible deviation %					
		White maize			Yellow maize		
		WM1	WM2	WM3	YM1	YM2	YM3
7.1	Defective maize	7	13	30	-	-	-
7.1.1	Defective maize above the 6.35mm sieve				9	20	30
7.1.2	Defective maize below the 6,35mm sieve				4	10	30
7.2	Other colour maize	3	6	10	2	5	5
7.3	Foreign matter	0,3	0,5	0,75	0,3	0,5	0,75
7.4	Total deviations collectively allowed for 7.1, 7.2 and 7.3	8	16	30	9	20	30
7.5	Pinked maize kernels	12	12	12			

8. CLASS OTHER MAIZE

Class other maize is the harvested seed of the plant Zeal mays indentation or Zeal mays indurate, that does not conform to the requirements of any of the classes of maize.

Maize is classified as class other maize, when the following defects appear:

8.1 maize that does not conform to the requirements of any of the other classes of maize as set out in the Regulations, e.g.:

when defective kernels for white maize exceeds	30%;
when defective kernels for yellow maize below the sieve exceeds	30%;
when defective kernels for yellow maize above the sieve exceeds	30%;
when maize kernels of another colour for white maize exceeds	10%;
when maize kernels of another colour for yellow maize exceeds	5%;
when foreign matter in yellow- and white maize exceeds	75%;
when total deviations for yellow- and white maize exceeds	30%; and
when pinked maize kernels for white maize exceeds	12%

8.2 maize that has a musty-, sour- or other objectionable odour;

8.3 maize which for some reason or another, is not suitable for the manufacturing of maize products for human consumption;

8.4 maize containing more poisonous seeds than the legal norm, such as:

Argemone Mexicana L. (Mexican Poppy), *Convolvulus-Species* (Field Bindweed), *Crotolaria-Species* (Wild Lucerne), *Datura-Species* (Thorn Apple), *Ipomoea Purpurea Roth.* (Morning Glory), *Lolium Temulentum* (Darnel) R*icinus Communis* (Caster oil), *Xanthium Strumarium* (Cockle Bur) and Xanthium *Spinosum* (Bur weed) in a 1 kg representative sample than allowed;

8.5 maize containing glass, coal, dung or metal;

8.6 maize containing live grain insects;

8.7 maize containing stones which cannot pass through the 6.35 mm round hole sieve;

8.8 maize containing more than 1 gram of stones, sand or pebbles in a representative sample of 10 kg, which pass through the 6.35 mm round hole sieve; and

8.9 maize with a moisture content more than 14 %.

9. MAIZE TREATED WITH A CHEMICAL SUBSTANCE

Maize treated with a chemical substance, renders it unfit for human- or animal consumption and may not be sold, unless such maize is intended for seed and containers in which it is packed, are clearly marked to indicate that the maize is intended for seed and has been treated with a poisonous substance. Further tests are not required in respect of such maize.

10. CALCULATION AND TESTING METHODS

Samples of maize to be graded must be taken in such manner as to be representative of such maize.

10.1 Determination of percentage (m/m) of defective maize kernels

The percentage (m/m) of defective maize kernels, must be determined by screening a working sample of at least 150 g from the sample of the consignment. Place the working sample on the 6,35 mm round-hole sieve and screen the sample by moving the sieve 20 stroke to and from, alternately away from and towards the operator of the sieve. Move the sieve, which rests on a table or other suitable smooth surface, 250 mm to 460 mm away from and towards the operator with each stroke. The prescribed 20 strokes must be completed within 20 to 30 seconds.

10.1.1 in the case of white maize, the mass of the defective maize kernels selected by hand as well as the broken- and maize kernels that went through the sieve, is calculated as a percentage of the total mass of the sample; and

10.1.2 in the case of yellow maize, the mass of the defective maize kernels selected by hand as well as the broken- and maize kernels that went through the sieve, is separately calculated as a percentage of the total mass of the sample. Defective maize will be shown above and below the sieve.

10.2 Determination of percentage (mass by mass) maize kernels of another colour

The percentage (mass by mass) maize kernels of another colour can be determined by separating by hand from a working sample of at least 150 g, the maize kernels of another colour and by calculating the mass of such maize kernels of another colour, as a percentage of the total mass of the sample.

10.3 **Determination of percentage (mass by mass) of foreign matter**

The percentage (mass by mass) of foreign matter can be determined by separating by hand from a working sample of at least 150 the foreign matter and by calculating the mass of such foreign matter, as a percentage of the total mass of the sample.

10.4 **Determination of percentage (mass by mass) of pinked maize kernels**

The percentage (mass by mass) of pinked maize kernels, can be determined by separating by hand from a working sample of at least 150 g, the pinked maize kernels and by calculating the mass of such pinked maize kernels as a percentage of the total mass of the sample.

11. HANDLING OF AN ELECTRONIC MASS METER

Before measuring the mass of a sample, the mass meter must be tested to ensure that the meter is in a good working order. Before use, ensure that the mass meter indicates zero. The mass meter should be assize with standard mass pieces, from time to time.

12. SURFACE ON WHICH GRADING IS DONE

The colour of the surface on which grading is carried out is important, since it can facilitate the separation of defective kernels. It is important that the colour of the grading surface should be in clear contrast, with that of the maize. Care must also be taken to ensure that the grading surface is smooth.

13. LIGHTING

Table or surface on which grading is done, must be in such a position that it is properly illuminated. Direct sunlight, electric lights and other artificial light are either too bright, or have the tendency to impart and seemingly yellowish colour to white maize, making the detection of defects very difficult.

METHOD OF SETTING OUT OF GRADING PARTICULARS

Class .....

No	Foreign matter	Defective kernels		Another colour	Total	Pinked maize
		Below 6,35 mm sieve	Above 6,35 mm sieve			
1.						
2.						
3.						
4.						
5.						
Total						
Grade						

FINAL CLASS AND GRADE _____