KENYA STANDARD

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ICS 67.060

Silos for storage of unbagged cereals and pulses- Requirements

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Government Chemist's Department
Kenya Institute of Food Science and Technology
Agriculture and Food Authority
Warehousing Receipt Council
Capwell Industries
Kenya Association of Manufacturers
Kenya Livestock and Agricultural Research Organization
Kenya Institute if Research and Development
National Cereals and Produce Board
Unga Ltd.
East African Grain Council
Kenya Bureau of Standards — Secretariat

REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

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Silos for storage of unbagged cereals and pulses- Requirements

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Foreword

This Kenya Standard was prepared and revised by the Cereals and Pulses Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

Silos are intended for the storage and physical protection of grains from the weather, prevention of the entry of pests and security. They also include materials and equipment required for inspection, drying, screening, sorting, grading, packaging and handling of grain and storage pest control.

The structure should be properly built to provide good storage conditions, easy access and safe working conditions, and should not provide harbourage for pests.

In general, the condition of grain changes slowly while in storage; the extent of any change depends on ambient conditions at harvest. Changes in moisture content and temperature are limited to the periphery of a bulk, unless the storage period is prolonged or the grain is ventilated.

Heavy infestations of insects, however, may cause a rise in temperature and in the grain mass, possibly due to the development of fungi. Ideally, the silos should permit some control of temperature and humidity, to keep the grain cool, dry and at a uniform temperature as much as possible.

The objective of this standard is to provide guidance to industry regarding appropriate storage of cereals and pulses in order to reduce on the level of post-harvest losses incurred in these commodities.

This standard as well will be invaluable in promoting the Structured Trading Systems (STS) in the region to promote both regional and International trade in cereals and pulses.

During the preparation of this standard, reference was made to the following documents

ISO 6322-1:1981, Storage of cereals and pulse — General consideration in keeping cereals.

ISO 6322-2:2000, Storage of cereals and pulse — Practical recommendations.

KS 2657:2022 Warehouse and warehousing of bagged cereals and pulses- Requirements

Acknowledgement is hereby made for the assistance derived from these sources.

Silos for storage of unbagged cereals and pulses- Requirements

1 Scope

This draft Kenya Standard covers the location, structural, facility, safety and management requirements for silos for storing bulk unbagged cereals and pulses.

This standard applies to public silos, private commercial silos, bonded storage and cooperative silos.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6322-3, *Storage of cereals and pulses — Control of attack by vertebrate and invertebrate animals*

3 Terms and definitions

For the purpose of this standard, the following terms and definitions shall apply.

3.1
Silos
a large, round tower for storing grains

3.2
competent authority
any person or organization that has the legally delegated or invested authority, capacity, or power to perform a designated function

3.3
defective grains
grains which are mouldy, pest damaged, discolored, stained, rotten and diseased, immature and shriveled grains and broken grain

3.4
foreign matter
all organic and inorganic material

3.5 organic matter

any animal or plant matter (seed coats, straws, weeds) other than grains, damaged grains, inorganic extraneous matter and harmful/toxic seeds

3.6.
inorganic matter
stones, glass, pieces of soil and other mineral matter

3.7
dusting
Application of dry, finely powdered pesticides which may be mixed with an inert carrier and applied with some type of blower

4. Requirements

4.1 Location

Consideration shall be given to potential sources of contamination from the local environment and the surrounding areas

4.1.1 The location of a silos shall be authorized by the competent authority (ies).

4.1.2 The topography of the location shall be in such a way that it is well drained to avoid water logging and natural flooding calamities

4.1.3 The silo shall be located in a manner that radiant heat from the sun is minimal

4.1.3 The silos shall be accessible by road and /or rail

4.1.4 The silos shall have access to clean water, communication facilities and power supply.

4.1.5 The silos shall not be near any facility where the danger of fire is constantly present

4.1.6 the silo should be located away from busy public facilities such as schools and hospitals.

4.1.7 There should be ample space to facilitate movement and parking of transport.

4.2 Structural requirements

4.2.1 General

4.2.1.1 The construction and building materials shall conform to the National Building Regulations and relevant standards.

4.2.1.1. 2 The materials used for construction shall be durable, nontoxic water and wind tight

4.2.3 Foundation

The foundations shall be of adequate strength to take the weight of the building and of the grain filling, and should be termite proofed.

4.2.4 Floor

4.2.4.1 The floor shall be adequately strong and capable of withstanding heavy loads and vibrations.

4.2.4.2 The floor shall be elevated or constructed higher than the existing ground.

4.2.4.4 The floor shall be smooth, firm and easy to clean

4.2.4.6 The floor shall be free from cracks and crevices where moisture from the ground may affect the stored grains or can harbor pests.

4.2.5 Walls

4.2.5.1 The internal surfaces of the walls shall be smooth, free from projections to eliminate dust-laden surfaces, and facilitate cleaning of the store and avoid interference with other operations

4.2.5.2 The junction between walls and roof shall be well sealed in order avoid birds and rodents to access the stored grains

4.2.5.3 A water/damp-proof barrier shall be incorporated into the base of the walls. Water proofing compound may be incorporated during the plastering and finishing of the walls.

4.2.6 Roofs

4.2.6.1 Roof design shall be in a way that facilitates pest control and other stock management procedures.

4.2.6.2 The roof design shall be in such a way that it does not provide hobourage for insects and pests

4.2.6.*3* Internal pillars within the silos supporting roof frames should be avoided as much as practicable as it affects silos operations

4.2.6.4 Roof shall be provided with the necessary lateral and vertical wind brace to resist forces due to strong winds and earthquakes.

4.2.6.5 The roof covering materials shall be reflective and keep the silos dry.

4.2.6.6 The inclination of the roofs shall be sufficient to drain rainwater quickly, taking into account that the water may be forced up by the wind.

4.2.6.7 Roofs shall be watertight and gulleys kept clear of debris and leaves.

4.2.6.8 The roof shall be a good thermal insulator, not affected by condensation, and give protection against attack by pests and moulds.

4.2.6.9 Roofs with cyclones and ventilation fans shall ensure that the condensed water is drained properly

4.2.6.10 The roofing materials shall be designed to ensure proper temperature controls in the silos

.

4.2.6.11 Rainwater drainpipes shall not lesser than 90 mm in diameter.

4.2.6.12 All drain pipes from roof gutters shall be external, well fitted, firmly fixed and protected from damage and shall have mesh baffles fitted inside their open ends .

4.2.7 Doors

4.2.7.1
A minimum of 2 doors shall be provided in a silo.

4.2.7.2 The door shall fit tightly to facilitate effective pest control.

4.2.7.3 The door shall be made of steel or any other material with similar properties.

4.2.7.4 The door shall be provided with a secure locking system.

4.2.7.5 The size of the door shall allow for various silo operations to be carried out.

4.2.8 Ventilation

4.2.8 .1 Vents shall be provided on the roof or any other method of aeration that is suitable .

4.2.8.2 The design of the ventilation shall be such that it prevents birds and pests from accessing the silo.

4.2.8.3 In addition to natural ventilation exhaust, fans may be introduced for forced ventilation.

4.2.9 Illuminations

4.2.9.1 Illuminations inside the silos should be sufficient with lights not being too bright or too dim

4.2.9.2 Artificial lighting is preferable for the interior of the silos,

4.2.10 Fence

4.2.10.1 The site of the silos shall be secured against unauthorized entry of persons and animals.

4.2.10.2 Gates shall be adequate for their purpose and wide enough to allow easy vehicle access.

4.3 Facility requirements

There shall be annex rooms, separate from the silo and shall include the facilities for reception, offices, laboratory, equipment and chemical store, washrooms, changing room and showers.

4.3.1 Office space and related facilities

The office space shall be:

a) easily accessible for staff and other visitors;

b) clearly signposted;

c) well aerated;

d) safe and unobstructed; and

e) clean, naturally well-lit and suitably furnished.

4.3.2 Toilets and urinals

4.3.2.3 Washrooms for male and female shall be separately provided in the premises of the silos.

4.3.2.4 The floor of the washrooms shall be non-absorbent, washable and non-slip.

4.3.2.5 The wall shall be constructed from non-absorbent, washable materials and shall be light coloured, up to a minimum height of 2 m and they shall be smooth and without crevices and shall be easy to clean and disinfect.

4.3.2.6 The washrooms shall be furnished with hand washing facilities.

4.3.2.7 The number of washrooms shall be adequate for the number of employees. The number of washrooms may be determined using Table 1.

Table 1 — Number of washrooms in Silos

SL No	Number of employees	Number of washrooms
i)	1 – 15	1
ii)	16 – 35	2
iii)	36 – 55	3
iv)	56 – 80	4
v)	81 – 110	5
vi)	111 – 150	6
NOTE Over 150 employees, one additional fixture for each additional 40 employees.		

4.3.3 Changing rooms and showers

4.3.3.1 The silos shall provide suitable changing room and showers for workers.

4.3.3.2 Changing rooms shall be furnished with labelled lockers.

4.3.3.3 All cleaning materials shall be provided.

4.3.4 Equipment store

4.3.4.1 Equipment such as for fumigation, sampling, cleaning may be provided in the silos. Such equipment shall be appropriately stored and separate from the grain storage and chemical storage areas.

4.3.4.2 The floor shall be non-absorbent and washable.

4.3.5 Chemical store

4.3.5.1 Chemicals such as pesticide, rodenticides, fumigants may be stored at the silos. Such chemicals shall be stored in a separate room under lock and key.

4.3.5.2 The chemical store shall be well ventilated and the fumes released should not be harmful to the environment

4.3.5.3 Chemicals shall be clearly labeled for easy identification.

4.3.5.4 The floor and the wall shall be easy to clean.

4.3.5.5 Chemical store shall be clearly identified as such.

4.3.6 Laboratory

4.3.6.1 The silos shall be provided with laboratory for internal control.

4.3.6. 2 The laboratory should have an adjacent office for the lab workers

4.3.6.3; The laboratory shall have facilities to undertake basic tests such as moisture content, organoleptic test, physical tests, aflatoxin screening and grading.

4.3.6.4 The laboratory shall have adequate sample retention shelves and sample bags with labels

4.3.6.5 The laboratory shall have sufficient area for test to be conducted and the relevant equipment. These equipment may include moisture meters, sieves, aflatoxin screening kits, weighing balance.

4.3.6.6 The laboratory equipment shall be calibrated, serviced and maintained at scheduled intervals as per the equipment,

4.3.6.7 The laboratory shall be well aerated

4.3.6.8 The floor and the wall shall be easy to clean.

4.3.6.9 The testing area shall be sufficiently lit.

4.4 Safety requirements

4.4.1 The Silos and the silos site shall have Warning signs or boards displayed in hazardous/dangerous places

4.4.2 Firefighting equipment in working condition (fire extinguishers, fire hydrants) shall be provided and be installed in a conspicuous and accessible location.

4.4.3 There shall be provisions for well-equipped first aid facilities.

4.4.4 Safety signs, fire exits, eyewash stations, shall be indicated

4.4 .5 Smoking zones (where smoking is allowed) shall be clearly indicated

4.5 Management requirements

4.5.1 Cleaning and maintenance

4.5.1.1 The buildings, equipment, utensils and all other physical facilities of the establishment, including drains, shall be maintained in good and orderly condition.

4.5.1.2 The silos shall be cleaned and treated prior to any storage operation.

4.5.1.3 The silos and environment of the silos shall be kept clean and shall be disinfected /disinfested regularly to prevent rodents, insect and mites infestation.

4.5.1.4 Changing facilities and washrooms shall be kept clean.

4.5.2 Waste disposal

4.5.2.1. Waste from sorting and screening shall be disposed in such a way that does not harbour rodents and other pests.

4.5.2.2. Waste from the silos shall be collected and disposed in environmentally friendly manner.

4.5.3 Inspection, drying, screening, sorting and grading unfit materials

Such operations shall be carried out in a clean and sanitary manner. Only clean, sound product shall be stored.

4.5.3.1 Inspection

4.5.3.1.1 The general appearance of the products shall be observed during the process of unloading; if the grains are moist, insect infested, insect damaged, or contain an unusual amount of dirt, debris or other foreign material.

4.5.3.1.2 If the observations from sensory analysis do not allow taking the decision, a sample from the suspected lots shall be taken and accurate tests conducted before any acceptance of the lot.

Routine inspection shall be done depending on storage duration and at specified intervals.

4.5.3.2 Drying

4.5.3.2.1 If grains brought to the silos do not comply with maximum moisture content stated in relevant East African Standards, the grains shall be dried and moisture content reduced to the specified level.

4.5.3.2.2 If heated air is used for moisture reduction, temperature and drying time shall be synchronized so that they do not result in adverse effect on the nutritional composition and quality of the grain in its intended use.

4.5.3.2.3 If drying is done under the sun, drying should be held on a clean environment on clean drying sheets, preferably blue. The grain should be spread in a thin layer and raked at intervals, to remove the moisture.

4.5.3.2.4 Whatever the drying system, care shall be taken to avoid attack by pests.

4.5.3.3 Screening, sorting and grading

Ungraded grains shall be screened and sorted before being graded according to relevant East African Standards as soon as they reach the silos.

4.5.3.3.1 Grains shall be screened and/or aspirated to remove all defective grains and foreign matter

4.5.3.3.2 Screening shall be done in such a way that the operation does not pollute the environment

4.5.3.3.3 Sorting shall be done before any grain treatment to ensure the removal of all defective grains.

4.5.3.3.4 Defective grains, shall be bagged separately and tagged as unsuitable for human consumption.

4.5.3.3.5 Containers of defective grains shall be removed as soon as practicable from the silo area.

4.5.3.3.6 materials which carry the danger of contamination by mycotoxins shall be diverted to non-food uses.

4.5.4 Loading and unloading

4.5.4.1 Loading and unloading may be done mechanically or manually.

4.5. 4.2 Side ascending ladders for manual loading should be provided for efficiency and safety

4.5.4.3 Loading and unloading shall not take place in open area when it is raining. A canopy should be constructed to allow continuous loading and unloading even when it rains.

4.5.7 Pests prevention and control

4.5.7.1 Pests can be prevented and controlled by

a) keeping grains in a modified atmosphere

b) spraying the floors and walls with pesticides;

c) dusting of grains by pesticides; and

d) fumigation.

e) Maintain the walls and the floors free from cracks and crevices

f) The silos shall be kept clean and tidy both inside and outside for easy management and to keep away pests

g) rodent traps

4.5.7.2 Where control is by fumigation, the following provisions shall apply:

a) fumigants shall only be used by properly trained and authorized persons, who know the dangers and the necessary safeguards.

b) fumigated silos shall be kept closed and post warning signs displayed until the gas concentration is at the safe level for human beings

c) the silos shall be properly closed during fumigation and where direct fumigation is done there shall be no silo imperfections, e.g. cracks in the floor, unfilled floor joints, roof leaks etc., which might jeopardize the success of the fumigation.

d) at the end of the fumigation, silos shall be aerated carefully according to the standard procedure to minimize dangers.

4.5.7.3 The control of attacks by vertebrate and invertebrate animals shall be done in accordance with ISO 6322-3.

4.5.8 Structural management and maintenance

4.5.8.1. Floor cracks and crevices should be repaired as soon as possible to prevent pests and moisture in the silos

4.5.8 .2 Storage conditions

4.5.8.2.1Temperature

The storage temperature shall be maintained depending on the type of cereal, use and period of storage. Refer to standards for individual cereals.

4.5.8.2.2 Humidity

A hygrometer shall be maintained in the silo to measure the humidity levels depending on the type of cereal and pulse under storage.

4.5.8.2.3 Moisture content

This shall be a continuous management process in the laboratory as referred to in section **4.3.6.3**

4.6 Record keeping

Silos shall keep records of:

a) origin, history of and volume of each lot of cereals and/or pulses kept;

b) laboratory tests carried out;

c) names of chemicals used for pests control;

d) fumigation detailing the fumigant used, the date and method of fumigation, person or company carrying out the fumigation;

e) names of employees and training undertaken;

f) authorization by Environmental agency;

g) Inspection, servicing, maintenance and calibration of all equipment;

h) cleaning; and

i) pest control detailing the pesticide used, the date and method of spray/dusting, person or company carrying out the pest control.

j) Dispatch records

ANNEX 1

(Informative Annex)

CATEGORIES OF SILOS

1. Private Silos:

These are owned and managed by the channel suppliers (manufacturers/traders) and resellers and are used exclusively for their own distribution activities.

Examples:

(a) Silos constructed by farmers/producers near their fields/places of work.

(b) Silos owned and managed by wholesalers and retailers close to their selling centers.

(c) Silos constructed by manufacturers near their production units.

(d) Silos taken on rent by retail stores.

(e) Retailers may have several regional silos to cater the needs of their stores.

(f) Silos owned/leased by a wholesaler where it stores and distributes. Maintaining private silos involves fixed as well as variable costs. Examples of fixed costs are basically the investments made in terms of insurance, capital, interests and taxes. The variable costs on the other hand, include maintenance costs and operating costs.

Note: when these private silos are used for commercial purposes, this standard shall apply

2. Public Silos:

These silos are owned by government and semi government bodies and are made available to private firms to store goods on payment of rent. The public silos are usually set up to help small traders who are not in position to have their own silos due to financial constraints.

Therefore, in order to promote trade and industry, central or state governments come forward to cater such storage needs of traders/retailers. Anyone can avail these facilities to solve its short-term distribution needs. Retailers sometimes due to increased sales even find their private silos insufficient if their facilities have reached capacity or if they are making a special, huge purchase of products for some reasons.

3. Bonded Storage:

These silos are owned, managed and controlled by government as well as private agencies. Bonded silos are storage facility used to store imported goods for which import duty is still to be paid. The bonded silos run by private agencies have to obtain license from the government.

In actual, this enables the government bodies to hold control on private firms to pay their taxes on time. Without paying duties, importers cannot take over or open the goods. Globally, it has been seen that these silos are found near the ports and are usually owned by dock authorities. Bonded silos are subject to two types of taxes: (a) Excise duty and (b) Custom duty.

4. Co-operative Silos:

These silos are owned, managed and controlled by co-operative societies. These societies provide storage facilities on the most economical rates to their members only. The basic purpose to run such silos is not to earn profit but to help their members.

Annex II
(Informative annex)
competent Authorities for approving building of silos

1. Building permit
It is issued by the City planning department of the county. Can also be issued by National Construction Authority

2. Environmental permit
Given by National Environmental Management Authority

3. Occupancy Certificate
Given by the municipal Authority upon completion of inspection of the building