

DRAFT TANZANIA STANDARD

Food dryer — Specification

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Foreword

This Draft Tanzania Standard has been prepared under Clean Cooking Stoves and Clean Cooking Solutions (MEDC 12) Technical Committee, under supervision of Mechanical Engineering Standards Divisional committee.

Access to drying oven has been identified as an important area of intervention to fisheries and food products drying. Majority of actors in fisheries and livestock in our country are relying on local drying mechanisms. The resultant vicious cycle of poverty and inefficiency drying mechanism can be broken by promoting Food dryer.

Food dryer is a recently identified drying option, which promises significant environmental, productivity and health benefits.

This standard, therefore will facilitate the uptake of Food dryers in several applications.

During the development of this standard, reference was made to the following document:

- PNS/PAES 248, Agricultural machinery Fruit Dryer Specifications.
- PNS/PAES 249, Agricultural machinery Fruit Dryer Methods of Test.

Scope

1

This Standard specifies the fabrication and performance requirements of food dryer for agricultural and fisheries products.

2 Normative References

No normative references cited.

3 Terms and Definitions

For the purpose of this Standard, the following definitions shall apply:

3.1 blower

air moving device that is used to force heated air through the mass of commodity to be dried at the desired air flow rate and pressure

3.2 convection

heat transfer from fluid to a surface or vice versa

3.3 drve

dryer

device used to remove moisture from commodities by utilizing heated air (naturally or forced) until desired moisture content is attained

3.4

drying capacity

amount of commodity that the dryer can dry per unit time, expressed in kilograms per hour

3.5

heating system

component of the dryer that adds heat to drying air

3.5.1

heat collector

device that intercepts, absorbs, and transforms solar radiation to heat and transfers that heat to a medium

3.5.2

heating element

device that transforms passing electric current to heat

3.5.3

heat exchanger

device that facilitates heat transfer between two fluids of different temperatures

3.6

heating system efficiency

ratio of the amount of heat added to the drying air to the heat available in heat source, expressed in percent.

3.7 load capacity

amount of commodity required to fill the dryer at the initial moisture content, expressed in kg; also commonly referred to as holding capacity.

3.8

moisture content, wet basis

amount of moisture in the commodity expressed as percent (%) of the total weight of the sample.

3.9

plenum

chamber wherein air pressure is developed for uniform distribution of the heated air through the commodity to be dried.

3.10 water activity

the ratio of vapor pressure of water in the product to the water vapor pressure of pure water at the same temperature.

NOTE Measure of water available for the growth of microorganisms

4 Classification

The classification of dryer shall be based on but not limited to the following:

4.1 System of operation

4.1.1 Batch type

A type of mechanical dryer wherein the commodity to be dried in a fixed amount is held in the drying chamber until it reaches the desired moisture content.

4.1.1.1 Flat bed/ Horizontal drying chamber

A shallow bed batch type dryer wherein a fixed amount of commodity is held stationary in a horizontal holding bin. An example is shown in Figure 1.



Figure 1. Parts of batch type flatbed dryer/horizontal drying chamber

4.1.1.2 Vertical bin/Vertical drying chamber

A batch type dryer wherein a fixed amount of commodity is held stationary in a vertical holding bin as shown in Figure 2.



Figure 2. Parts of a batch type vertical dryer.

4.1.1.3 Tray/Cabinet type

A batch type dryer wherein a fixed amount of commodity is placed on perforated tray(s) in the drying chamber. An example of tray/cabinet type is shown in Figure 3.



Figure 3. Parts of tray/cabinet type dryer

4.1.2 Enclosed/Greenhouse-type drying chamber

An enclosed chamber with fitted drying racks wherein a fixed volume of commodity is held stationary in the drying racks commonly used for fishery products. Examples are shown in Figure 4.



Figure 4 (a): Oblique view of Greenhouse dryer

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Figure 4 (b): Rear view of a greenhouse dryer.

4.2 Heating system

4.2.1 Method of heat introduction

4.2.1.1 Direct combustion

A type of dryer in which products of combustion come into contact with the commodity being dried.

4.2.1.2 Indirect combustion

A type of dryer in which products of combustion do not come in contact with the commodity being dried. This type of dryer uses a heat exchanger.

4.2.1.3 Indirect resistance heating

A type of dryer in which heat is added to the drying chamber by a heating element that transforms passing electric current to heat.

4.2.1.4 Heat pump

A type of dryer in which heat is transferred from an environment of lower temperature to the dryer system of higher temperature with the use of mechanical energy.

4.2.1.5 Solar radiative heating

a) Direct solar heating

A type of dryer in which solar energy is transmitted through the roof and heat is collected inside the drying chamber.

b) Indirect solar heating

A type of dryer in which solar energy is collected in heat collectors that add heat to the drying air before entering the drying chamber.

c) Mixed-mode

A type of dryer that utilizes a combination of direct and indirect solar heating.

4.2.1.6 Hybrid Hear Induction

A combination of any two or more of the previously defined methods of heat introduction.

4.2.2 Heat source

a) Petroleum-based

A source of energy that includes petroleum-based fuels such as kerosene, gasoline, diesel oil, bunker fuel, oil and gas.

b) Electrical energy

A source of energy generated from the conversion of chemical energy, potential energy, kinetic energy, nuclear energy, or electrolytic and fuel cells.

c) Biomass energy

A source of energy that can be generated by direct and indirect combustions from various forms of biomass, including wood, agricultural, and livestock residues.

d) Solar energy

A source of energy harnessed from the sun through the use of an air-type solar collector which heats up the drying air. Air circulation may be by natural or forced convection.

4.2.3 Hybrid Heat Sources

A combination of any two or more of the previously defined heat sources.

5 Fabrication Requirements

5.1 Dryer may be generally composed of drying chamber, blower and/or exhaust fan, heating system, controls, and/or ducting, drying rack(s)/tray(s)/bin(s), and safety features.

- **5.2** Stainless steel bars, metal sheet or plate, heavy-duty mild steel, polycarbonate sheets, greenhouse plastics and locally available materials (i.e., bamboo, wood, etc.) shall be generally used for the manufacture of the different components of the dryer.
- **5.2.1** Drying racks/trays/bins shall be rigid to be able to support its maximum load capacity and shall be perforated. There shall be a provision for ease of handling of the drying trays in and out on the walls of the dryer and/or on the tray cart.
- **5.2.2** Wall and floorings of the drying chamber, if present, shall be rigid to be able to support the maximum load capacity of the dryer. Floorings shall be perforated or meshed.
- **5.3** Parts of the dryer that are in direct contact to the commodity should be made of corrosion resistant and food grade materials (TZS 2891). They shall be made of non-toxic materials and designed to withstand the environment of their intended use and the action of food, and, if applicable, cleaning compounds and sanitizing agents.
- **5.3.1** For dryers that are intended to process commodities for human consumption, parts in direct contact to the commodity shall be made of food grade materials such as but not limited to accepted stainless steel grade.

NOTE 1 Type 304 stainless steel is satisfactory for the long term storage and transportation of cold and hot water with chloride contents less than about 200 ppm.

NOTE 2 Type 316 stainless steel would be preferred for critical application where the salt content exceeded 200 ppm and other adverse factors such as low sulphate content, tight crevices, and high temperature were involved.

- **5.3.1.1** For drying racks/trays/bins that are not made of food grade materials, there shall be a provision for perforated food containers that will be in contact with the commodity.
- **5.4** The dryer shall be provided with a control panel with an on/off switch, temperature sensors and display to measure the actual drying air temperature entering and inside the drying chamber, and a manometer to measure the working static pressure in the plenum if a blower/aspirator is present. This provision shall not apply to solar dryers.
- **5.4.1** Instruments and controls used for measuring, regulating, or recording temperatures, relative humidity, or other conditions that affect the final quality of the commodity shall be accurate and adequate in number for their designated use.
- **5.5** Solar dryers shall be provided with a monitoring panel that consists of temperature sensors and display to measure the actual drying air temperature, and a manometer to measure the working static pressure in the plenum if a blower/aspirator is present.
- **5.6** There shall be a provision for the exhaust of the drying air after passing through the commodities to be dried.
- 5.7 Bolts and screws to be used shall be in accordance to TZS ### and TZS ### respectively.
- **5.8** If necessary for tray/cabinet type dryers, tray carts shall be rigid to be able to support the drying racks/trays. Wheels suited for drying operation shall be installed for ease of transporting the drying racks inside and outside the drying chamber. Cabinet type dryers that use forced-air circulation should be air-tight.
- **5.9** There should be provision to ensure uniform distribution of drying air across the drying chamber.

- **5.10** Solar dryer should be composed of air type solar energy collector/panel (Teflon-coated), ducting, inlet of drying air, heat collector, burner (for supplemental heating on rainy days) and roof or top plastic cover.
- **5.10.1** The heat collector and drying chamber bed shall be made of Galvanized Iron (GI) sheet or locally available materials (i.e., bamboo, wood).
- **5.10.2** Roof of greenhouse-type dryer shall be made of clear, solid polycarbonate sheet or other similar material used for roofing.
- **5.10.3** Top plastic cover for flatbed type dryer shall be a 0.15-0.20 mm thick plastic sheet. This shall be used to cover the heat collector and the drying chamber. There shall be a provision to properly secure the plastic cover.

6 Performance and Other Requirements

- **6.1** The maximum drying capacity of the dryer shall be based on the specifications of the manufacturer.
- **6.2** The dryer during operation shall have uniform and equally distributed drying air temperature in the drying chamber.
- 6.3 The minimum heating system efficiency shall comply with the values indicated in Table 1.

| Heat source | Heat introduction | HSE, % min |
|----------------------|-------------------|------------|
| Electric | Direct | 90 |
| Petroleum-based fuel | Indirect | 75 |
| Biomass | Indirect | 50 |

 Table 1. Minimum Heating System Efficiency (HSE)

6.4 The dried commodity shall attain the quality specification in accordance with particular product standards as illustrated in Annex A.

7 Safety, Workmanship and Finish

- **7.1** The dryer shall have adequate provision for fire and dust control. The dryer shall have provision for prevention of pressure build up, and proper/emergency release of combustion gases directed away from the operator.
- **7.2** Guards or insulation shall be provided for exposed parts with surface temperature exceeding 40°C.
- **7.3** The dryer shall be free from defects that may be detrimental to its use and shall be free from sharp edges and surfaces that may hurt the operator. All metal parts should be machine bend, pressed, and cut and all rough surfaces should be machine finished and smoothed.
- **7.4** Surfaces and coatings of the dryer shall be free from pits and crevices, resistant to cracking, chipping, flaking and abrasion, and shall prevent penetration of unwanted matter under intended use.
- **7.5** The materials shall not transfer undesirable odors, colors or taint to the commodity nor contribute either to the contamination of commodity or have any adverse influence on the commodity.

- **7.6** Warning notices shall be provided for safety where applicable.
- **7.7** The dryer shall have adequate protection from or for all moving parts. All rotating parts shall be dynamically balanced.
- **7.8** When the noise level in the working environment exceeds 95 dB(A), operators are required to use earmuffs or other ear protection devices.
- **7.9** The dryer shall be compliant with Good Manufacturing Practices (GMP).
- **7.9.1** The design, construction, and use of equipment shall prevent the contamination of commodity with lubricants, fuel, metal fragments, contaminated water, or any other contaminants.
- **7.9.2** Seams that come in contact with the commodity shall be smoothed or maintained so as to minimize accumulation of commodity particles, dirt, and organic matter and thus minimize the opportunity for growth of microorganisms.
- **7.9.3** Corners shall be sealed and covered to minimize accumulation of commodity particles, dirt, and organic matter and thus minimize the opportunity for growth of microorganisms.
- **7.9.3.1** All internal angles of 135° or less shall have a minimum radius of 3 mm. Sharp corners (≤90°) shall be avoided.
- **7.10** There should be provision so the dryer can withstand extreme weather conditions to which it may be exposed, if applicable.

8 Maintenance and Operation

- **8.1** The dryer shall be provided with features for access to parts during repair, maintenance and operation.
- **8.2** Each unit of dryer shall be provided with a set of manufacturer's standard tools required for maintenance.
- **8.3** The dryer should be so installed and maintained as to facilitate the cleaning of the equipment and of all adjacent spaces. Surfaces that come in contact with the commodity shall be maintained to protect the commodity from being contaminated by any source, including unlawful indirect food additives.
- **8.4** Instruments and controls used for measuring, regulating, or recording temperatures, relative humidity, or other conditions that control or prevent the growth of undesirable microorganisms in food shall be regularly calibrated and adequately maintained.
- **8.5** Operator's manual based on maintenance schedule and list of operative parts of the dryer shall be provided.
- **8.6** The dryer shall be easy to clean and operate.

9. Sampling

The dryer shall be sampled for testing in accordance with part two of this standard (Food dryer – test methods) or any acceptable method of sampling.

10. Testing

Dryer shall be tested in accordance with part two of this standard (Food dryer — Methods of test).

11. Marking and Labeling

- **11.1** Each unit of dryer shall be marked at a prominent place with the following information:
- **11.1.1** Name of the manufacturer/brand/trademark;
- 11.1.2 Model;
- **11.1.3** Year of manufacture;
- **11.1.4** Serial number;
- **11.1.5** Contact details of the manufacturer;
- **11.1.6** Country of manufacture/origin;
- **11.1.7** Drying capacity, kg/h;
- **11.1.8** Range of drying temperature, °C;
- **11.1.9** Air flow rate (if applicable) m^3/s ; and
- **11.1.10** Power rate, kW.
- **11.2** Safety/precautionary markings shall be provided and stated in English and Swahili printed in red color with a white background.
- **11.3** The markings shall be durably bonded to the base surface material.
- **11.4** The markings shall remain legible and resistant to weather changes under normal cleaning procedures.

Annex A

Normative

Quality specifications for dried products

Dried products must meet specific standards. The following table provides illustrations of products and their corresponding standards.

| Standard No. | Title | Quality specification |
|----------------|--|--|
| TZS 1807: 2016 | Dried and salted dried fish - Specification | Water activity, maximum = 0.78 at 25°C |
| TZS 2961: 2022 | Dried tomatoes specification | % Moisture content dry basis, maximum = 15 Water activity, maximum = 0.70 at 25°C |
| TZS 3021 | Dried insect product | Water activity, maximum = 0.75 at 25°C |
| TZS 2750: 2022 | Dried seaweed - Specification | % Moisture content wet basis for <i>Kappaphycus spp.</i> , maximum = 40 % Moisture content wet basis for <i>Eucheuma spp.</i> , maximum= 35 |
| TZS 2783: 2022 | Dried sweet cherries - Specification | % Moisture content dry basis, maximum = 15 |
| TZS 2782: 2022 | Dried peaches - Specification and test methods | Water activity, maximum = 0.70 at 25°C |

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