
**Plastic- Polyethylene terephthalate
(PET) bottle – Specification: For the
use of Fruit juices**

ICS: 55.020

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Forward

This Ethiopian Standard has been prepared under the direction of Technical Committee -----
----- and published by the Ethiopian Standards Agency (ESA).

In preparation of this Ethiopian standard, reference has been made to the following:

- ES 965 ,Specification for plastic potable water bottles"
- ASTM D2911, " Standard Specification for Dimensions and Tolerances for Plastic Bottles"
- GSO /FDS 121/2012 "Food packages – Part 2: Plastic package –General requirements "
- BS EN 16594 ," Packaging , Rigid plastic containers ,PET finish 26/22 (12.0)
- IS 14 537, Polyethylene terephthalate (pet) bottles for packaging of alcoholic liquors – specification
- ES 6015, Polyethylene Flexible Pouches for the Packing of Natural Mineral Water and Packaged Drinking Water-Specification
- **MINISTRY OF HEALTH AND FAMILY WELFARE (Food Safety and Standards Authority of India)**Notification New Delhi, dated the 1st August, 2011

Acknowledgement is made for the use of the information from the above publications.

Polyethylene terephthalate (PET) bottle – Specification:

For the use of Fruit Juices

1. Scope

This Ethiopian standard specifies requirements for the PET plastic bottle for fruit juices.

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.

ES 923-6, Plastic material for food contact use: part 6- colorants

ES 9 23-8, Plastic material for food contact use: part 8- miscellaneous additives

ES ISO 15270, Plastics — Guidelines for the recovery and recycling of plastics waste

ES 6033, Printing ink for food packaging—Code of practice

ES ISO 177, Determination of overall migration of constituents of plastic materials and articles intended to come in contact with food stuffs- method of analysis.

ES ISO 472, Plastics – Vocabulary.

ES 6195, Methods of test for plastics containers

ES 6196, Methods for random sampling

ES 6197, Specification for roll seal pilfer proof closures

ES 6198, Specification for polyalkylene terephthalates (pet and pbt) for their safe use in contact with food stuffs pharmaceuticals and drinking water

3. Terms and definitions

For the purposes of this document, the terms and definitions given in ES ISO 472 and the following shall apply.

3.1.

Plastic materials

Materials manufactured from simple petrochemical products of low molecular weights by polymerization to produce high molecular weight compounds such as polyethylene, polypropylene, polyvinyl chloride, polystyrene, and polyethylene terephthalate.

3.2.

Bottle thickness

The smaller dimension in a plane parallel to the bottle base.

3.3.

Bottle width

The larger dimension in a plane parallel to the bottle base.

3.4.

Antioxidants

Materials added to the plastic material to avoid its oxidation during processing, storage, and final use.

3.5.

Permeability of gases and water vapors

a measure of the rate of permeable of the gas or vapor through a specific thickness of the plastic material at a specific conditions of temperature, pressure and relative humidity.

3.6.

Creep

A measure of deformation that takes place with time when the plastic material is exposed to a constant load.

3.7.

Degradation of the plastic package

Occurrence of a sensible change in its chemical composition, physical properties and appearance.

3.8.

Dimensional stability

Ability of the package to retain its initial dimensions and shape.

3.9.

The overall migration limit

The amount of non-volatile substances released from a material or article into food simulants;

3.10.

Bottle finish

The configuration of the neck or opening of the bottle which serves to engage specific parts of the closure in order to securely attach it to the bottle.

3.11.

Container height to Neck face

The height of the height point of the neck face of the finished empty container

3.12.**Closure**

Closures are devices and techniques used to close or seal container such as a bottle, jug, jar, tube, can, etc.

3.13**Neck face**

The upper most surface of the container neck.

3.14**Container Overall height**

The height of the finished empty container as its highest point with closure and fitment.

3.15**Container Diameter**

The external diameter of the finished empty container at a specified height, expressed as the mean of the two perpendicular diameters.

3.16**Neck height**

The perpendicular distance from the highest point of the plane including the neck face to the nearest point of the finished container's shoulder along a line passing through (in the case of screw threaded necks, the outer most edge of the thread; a feature below the thread of greater diameter than the thread is considered as a part of the container's shoulder)

3.17**Thread diameter**

The external diameter of the neck thread measured as the mean of the two perpendicular diameters avoiding part line.

3.18**Neck bore**

The diameter of the inner periphery of the neck at a specified depth.

3.19**Neck ovality**

The difference between the maximum and the minimum neck diameter

3.20

Nominal capacity

A recommended range of nominal capacities for stock containers for liquid products, together with the corresponding minimum brimful capacities.

3.21

Brimful Capacity

Filled to maximum capacity.

3.22

Food simulant

The food simulant is a chemical with characteristics similar to the different food categories (watery, acidic, alcoholic, milk, oil and fat and dry foods)

4. Requirements

4.1. General requirement

The following general requirements for plastic packages used in packaging food materials shall be met:

- 4.1.1. All plastic raw materials used in manufacturing food packages shall be of food grade and known origin and composition to avoid use of scrap or pre used raw materials.
- 4.1.2. They shall be clean and homogeneous, free from any foreign materials, swelling or air pockets.
- 4.1.3. They shall not cause any hazards to consumer health.
- 4.1.4. They shall not lead to degradation of sensory properties of the packaged food material, or occurrence of undesirable changes in the nature and quality of food material.
- 4.1.5. Pigments, coloring materials, and other components used in their formulation and manufacture shall be nonpoisonous and with no tendency for migration which may cause migration of components to react or mix with the food material.
- 4.1.6 The bottle shall be resistant to impact effects caused by shocks and mechanical vibrations
- 4.1.7. The bottle shall not be affected by heat during filling, closing, storing, transportation, or handling, in a way that deform them or change their composition, chemical or physical properties; or increase probabilities of reactions and migrations of monomers or additive materials within the permissible levels.
- 4.1.8. Their creep value shall be low in order to avoid problems arising as a result of stacking and handling and they shall be characterized with good dimensional stability in order to avoid printing difficulties.
- 4.1.9. The bottle shall be stable to the pH of the packaged food as specified in the relevant Ethiopian standard.
- 4.1.10. Their permeability to gases, water vapor and alcohol shall be suitable to the packaged food material.
- 4.1.11. The plastic bottles shall not be affected by light when exposed.
- 4.1.12. The bottle design shall be such that it is stable when kept in a vertical position.
- 4.1.13. The bottles and closures shall be manufactured in accordance with good manufacturing practices and they shall be free from undesirable odor, bottles shall be transparent (even if Colored), free from any flash and scratches.

4.1.14 The material used for product packaging shall be recyclable or biodegradable

5. Specific requirements

5.1 Material

5.1.1 The bottles shall be made of virgin polyethylene terephthalate material. The material shall be food grade according to the requirements laid down in ES6198.

5.2 Cap

5.2.1 The bottles shall be provided with a cap, and, if required, with an insert plug. The material for cap and plug shall be food grade. HDPE injection molding grade 45 MA or 55 MA or any other suitable material as agreed to between the purchaser and the supplier.

5.3 Wad

5.3.1 The wad, if required, shall be of cork board or pulp board or any other suitable material compatible with the contents and suitable for food contact application.

5.4 Migration

The overall migration shall be less than 10 mg/dm² or 60 mg/kg as tested with ES ISO 177.

5.5 Capacity

The bottle shall be manufactured in normal capacity of 500, 1000, 3000 and 5000 ml or any other capacities agreed between the purchaser and the supplier. The overfilled capacity shall exceed the nominal capacity by a minimum of 10% as tested with ES 6195.

5.6 Shape and Design

The shape and design shall be as agreed to between the purchaser and supplier.

5.7 Tolerance

The tolerance on the specified diameter and over all height of bottle shall be as under

Up to and including 100 mm	± 1.5 mm
Over 100 mm and up to and including 200 mm	± 2 mm
Over 200 mm	± 2.5 mm

5.8 Wall Thickness

The minimum wall thickness of the bottle measured at any point by dial caliper gauge fitted with spherical anvil, vernier calipers or micrometer shall be 0.25 mm. Mean of three readings at any location shall be taken as the wall thickness at that point.

5.9 Verticality

The variation in verticality when tested according, to the method given in 7 of ES 6195 shall not be more than ±1.5 mm

5.10 Variations in Body Dimensions

The recommended variations in the body dimensions of plastic bottles covered by this specification shall be in accordance with Table2.of ASTM D 2911.

5.11 Ink Adhesion Test for Printed PET

The printed matter on the filled PET when tested in accordance with the method given in Annex B shall be still legible.

5.12 The pH of a water solution within the range of 6-8 shall not be changed when placed in the package for one hour.

5.13 Permeability of gases and vapors

The overall permeability of gases and vapors shall be within the range of specified values as is given in table 1.

Table 1. The overall permeability of gases and vapors for PET

Polymer	Oxygen Permeability cc.mm/m2 .day.atm	Carbon Dioxide Permeability cc.mm/m2 .day.atm	Water Vapor Transmission g.mm/m2 .day
Polyethylene terephthlate	1.2-2.4	5.9-9.8	0.39-0.51

All permeability values are at 23° C, 0% RH unless otherwise specified
1cc.mm/m2 .day.atm = 65.62 Barrer and 1 Barrer = 1x10-10 ccSTP.cm/cm2 .s.cmHg

5.14 Storage and transport

Based on ES ISO 5667-3, the end- product should be stored and transported under such conditions as will preclude contamination with and/or proliferation of micro-organisms and protect against deterioration of the product or damage to the container.

5.15 Sampling

The method of drawing representative sample from a lot and the determination of criteria of conformity of a lot to requirements of this specification shall be as prescribed in Annex A.

6 Tests

6.1 Closure Leakage Test

The bottle filled with water at ambient temperature and closed tightly with the cap when subjected to vibrations on a vibration table as detailed in **Annex A**, shall not show any leakage trough the closure after one hour of testing.

6.2 Drop Impact Test

The bottle and the cap when subjected to the dropt test as given in **Annex B** shall not show any sign of cracking. Slight deshaping of the body shall not render the bottle unacceptable in the test.

6.3 Stacking Test

The bottles shall not show any leakage, cracks, or p permanent buck ling when subjected to test. A arrange four bottles, filled with water at ambient temperature to their normal capacity and closed with their caps to the normal torque on a flat level surface in a block of 2 x 2 without any other support. Apply a top load evenly distributed on a flat surface placed on the unsupported bottles and examine after 24 hours. The total superimposed load on the flat surface shall be as under:

s.no	Bottle Capacity (Litre,L)	Top Load for bottles(Newton, N)
1	0.5	320
2	1	400
3	2	600

6.4 Storage Test

This shall be a type test. The storage test shall be carried out both at 38 ±(1 °C)and 90 ± 2 per cent RH (accelerated condition) and 27 ± 1 °C and 65 ± 2 percent RH (standard conditions). The change in free fatty acids (as percentage of oleic acid), moisture content, peroxide value as milliequivalent of oxygen per kilo fat (wherever applicable) and rancidity, of the content shall be noted at the end of 60 and 180 days when tested under accelerated and standard conditions respectively. Bottles shall be accepted if the edible oil does not show rancidity or increase in the values of the moisture content, free fatty acid and per oxide value above the per missiblelim its specified i n t he corresponding Ethiopian Standards on edible oils at the end of 60 and 180 days under accelerated and standard condition respectively.

Note: – If agreed to between the purchaser and the supplier testing of oils at frequent intervals may be carried out during storage.

7 Marking

Each bottle shall be marked with:

- a) name of material (PET);
- b) recycling symbol, ;
- c) nominal capacity in ml; and
- d) Manufacturer's name and/or his recognized trademark if any.



PET polyethylene terephthalate

Annex A

(Clause 5.1 and 9.1)

Closure Leakage Test

A – 0 General

A 0.1 The method helps to determine the ability of a closure (on a container) to prevent leakage due to transformational vibration.

A – 1 Apparatus

A – 1.1 A vibrating table conforming to ES ISO 4180.

A – 2 Procedure

A – 2.1 Fill the bottle to its nominal capacity with the product/water and close it with the usual closure in a manner in which it is intended to be used.

A – 2.2 Mount the bottle upside down rigidly on the vibrating table and subject to vibrations for 1 hour at a peak acceleration of 1 g.

A – 2.3 At the end of the test period, the closure shall show no indication of leakage, loss of tightness, backing-off or popping.

A – 3 Precautions

A – 3.1 Before the test is carried out it should be ensured that the inner plug, if provided and cap are fully tightened.

Annex B

(Clause 9.2)

Drop Impact Test

B – 1 Apparatus

B – 1.1 The apparatus shall consist of a vertical scale marked in 150 mm increments from 1 m to 4 m fixed above a rigid flat base of steel or smooth concrete as a dropping surface.

B – 2 Procedure

B – 2.1 The bottles shall be filled to their nominal capacity with water at ambient conditions and closed tightly with the cap. Each bottle shall be dropped from a height of 12 m in the following sequence:

- a) Vertical position, so that the bottom strikes the impact surface flat; and
- b) Horizontal position, so that the bottom strikes the impact surface horizontally with its side flat.

B – 2.2 Bottles shall not show any leakage of water through cracks or closures. Slight denting shall not be taken as failure of the bottle in the test.

Annex C

(Clause 11.1)

Sampling

C – 1 Scale of Sampling

C – 1.1 Lot

In any consignment all the bottles of the same material, nominal capacity and drawn from a single batch of manufacture shall be grouped together to constitute a lot.

C – 1.2 scale of Sampling

For ascertaining the conformity of the lot to the requirements of this standard, tests shall be carried out for each lot separately. The number of bottles to be sampled from a lot shall be in accordance with Table 1.

Table 1 Scale of Sampling and acceptance Number
(Clauses C1.2, C-2.1, C-2.3 and C-2.5)

Lot Size Examination	For Visual Examination		For Closure Leakage Test		For Dimensional
	Sample Size	Acceptance Number	Sample Size	Acceptance Number	
(1)	(2)	(3)	(4)	(5)	(6)
Up to 500	13	1	5	0	2
501 – 1000	20	2	8	0	2
1001 – 3000	32	3	13	0	2
3001 – 5000	50	5	20	1	3
5001 and above	80	7	32	2	5

C – 1.3 The bottles selected at random from the lot.

C – 2 Criteria for Conformity

C – 2.1 Visual Examination

The sample bottles selected as per col 2 of Table 1 shall be examined for workmanship and finish . Any bottle failing in one or more of the requirements shall be termed as defective. The lot shall be accepted under this head if the number of defective bottles in sample does not exceed the acceptance number given in col 3 of Table 1.

C – 2.2 Brimful Capacity and Bottle Mass

For the purpose of above tests, five bottles for lot size up to 5000 and 10 bottles for lot size above 5000 shall be selected at random from three samples already drawn according to **C-1.3**. Each of the sample bottles shall be subjected to tests for brimful capacity (**5.1**) and container mass (**6.1**). There shall be no failure if the lot is to be accepted under this clause.

C – 2.3 Test for Closure Leakage and Stacking

The number of sample bottles to be drawn shall be in accordance with col 4 of Table 1. Each of the sample bottles shall be subjected closure leakage and stacking test. Any bottle showing leakage, crack or permanent buckling when subjected to tests will be taken as defective. The number of defectives shall not exceed the acceptance number given in col 5 of Table 1 for the lot to be accepted as conforming to specification.

C – 2.4 Drop Test

Take a sample of size of ten bottles at random from a lot. Divide these into two sets of five bottles each, designated as set 1 and set 2.

C – 2.4.1 Each bottle of set 1 shall be subjected to the above mentioned test. Leakage of water through cracks or closures after the test shall be considered as a defect. However, slight denting shall not be taken as failure of the bottle in the test.

C – 2.4.2 If none of the bottles fail in the test the lot shall be accepted. If only one bottle is found defective, the test shall be repeated on the second set that is set 2 of bottles (**see C-2.4**), otherwise the lot shall be rejected.

C – 2.4.3 If in the second test (set 2) none of the bottles are found defective, the test shall be accepted as conforming to specification.

C – 2.5 The sub-sample of size given in col 6 of Table 1 shall be subjected to dimensional examination. No failures shall occur for acceptance of the lot under this clause.

Annex D
(Normative)
Test for ink adhesion of printed PET

D-1 Apply two strips of 25 mm wide transparent pressure sensitive taps or cello-tape to the printed area of the pouch, one piece down the length of the pouch and the other along the width.

D-2 Press the tape firmly on to the pouch and leave for 15 s.

D-3 Remove the tape by pulling slowly at about 10 mm/s from one end at about 90° to the pouch surface.

D-4 There shall be no significant removal of the print from the surface of the pouch and the printed material shall be still legible.

Organization and Objectives

The Ethiopian Standards Agency (ESA) is the national standards body of Ethiopia established in 2010 based on regulation No. 193/2010. ESA is established due to the restructuring of Quality and Standards Authority of Ethiopia (QSAE) which was established in 1998.

ESA's objectives are:-

- ❖ Develop Ethiopian standards and establish a system that enable to check whether goods and services are in compliance with the required standards,
- ❖ Facilitate the country's technology transfer through the use of standards,
- ❖ Develop national standards for local products and services so as to make them competitive in the international market.

Ethiopian Standards

The Ethiopian Standards are developed by national technical committees which are composed of different stakeholders consisting of educational institutions, research institutes, government organizations, certification, inspection, and testing organizations, regulatory bodies, consumer association etc. The requirements and/or recommendations contained in Ethiopian Standards are consensus based that reflects the interest of the TC representatives and also of comments received from the public and other sources. Ethiopian Standards are approved by the National Standardization Council and are kept under continuous review after publication and updated regularly to take account of latest scientific and technological changes. Orders for all Ethiopian Standards, International Standard and ASTM standards, including electronic versions, should be addressed to the Documentation and Publication Team at the Head office and Branch (Liaisons) offices. A catalogue of Ethiopian Standards is also available freely and can be accessed in from our website.

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ESA, representing Ethiopia, is a member of the International Organization for Standardization (ISO), and Codex Alimentarius Commission (CODEX). It also maintains close working relations with the international Electro-technical Commission (IEC) and American Society for Testing and Materials (ASTM). It is a founding member of the African Regional Organization for standardization (ARSO).

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