DRAFT TANZANIA STANDARD

GDC 4 (1076) DTZS Polyethylene terephthalate (PET) bottles for packaging liquids products -Specification

TANZANIA BUREAU OF STANDARDS

1st Edition

EXECUTIVE SUMMARY OF GDC 4 (1076) DTZS POLYETHYLENE TEREPHTHALATE (PET) BOTTLES FOR PACKAGING LIQUIDS PRODUCTS - SPECIFICATION

This draft Tanzania standard specifies requirements, method of sampling and test for bottles made from Polyethylene Terephthalate (PET) intended for the packaging of liquids.

This standard does not cover PET bottles for packing pharmaceutical products.

It is anticipated that this draft Tanzania Standard will be made **COMPULSORY i**n its application.

NATIONAL FOREWORDS

0.1 The Tanzania Bureau of Standards is the statutory national standards body for Tanzania, established under the Act.No.3 of 1975, amended by Act.No.2 of 2009.

This draft Tanzania Standard has been adopted by Packaging Technical committee, under the supervision of the General Techniques Standards Divisional Committee (GTDC) and it is in accordance with the procedures of the Bureau.

Polyethylene Terephthalate popularly known as PET bottles are popular for packaging of different liquids including foodstuffs. Their glass like clarity, lightness and better barrier properties for moisture and air permeation and excellent organoleptic property make them popular for food packing industry. PET can be used in pure form without any additive. Due to this, there is no organoleptic quality of food packed in PET bottles. However, to ensure the compatibility and suitability of PET bottles for their shelf life a compatibility test has been included for this standard. Hence due these reasons and increasing use of PET containers for packaging of liquid foodstuff and other products in our country has led to the formulation of this standards.

In formulating this standard, considerable information was derived from the following documents:

IS 2798 Methods of test for plastic containers

IS 13123 Polyethylene Terephthalate (PET) Bottles for Packing of Liquid Pesticides

IS 12887 Polyethylene Terephthalate (PET) Bottles for Packaging of Edible Oils

Acknowledgement is hereby made for the assistance derived from this source.

0.2 Terminology and conventions

Some terminology and certain conventions are not identical with those used as Tanzania Standard; attention is drawn to the following:

The comma has been used as decimal marker for metric dimensions. In Tanzania, its current practice to use a full point on the baseline as decimal marker.

Whenever the words “International Standard” appear, referring to this draft Tanzania Standard, they should read as “Tanzania Standard”.

1. Scope

This draft Tanzania standard specifies requirements, method of sampling and test for bottles made from Polyethylene Terephthalate (PET) intended for the packaging of liquids.

This standard does not cover PET bottles for packing pharmaceutical products.

2. Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ASTM D 2463, Standard Test Method for Drop Impact Resistance of Blow-Molded Thermoplastic Containers

ISO 2859-1 Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

EN 1186-3 Materials and articles in contact with foodstuffs - Plastics - Part 3: Test methods for overall migration into aqueous food simulants by total immersion

3. Terms and definitions

For the purpose of this document, the following terms and definitions shall apply.
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1 brimful capacity
volume of liquid held by the container when filled to the point of overflowing while standing on a level with all closures removed

3.2 closure
device used to seal off the opening of the container for product containment and providing a barrier to external contaminants

3.3 bottle
flat-bottomed container, made from Polyethylene Terephthalate (PET)

3.4 blow moulding
method of forming hollow objects by inflating a parison into a mould with compressed gas

3.5 thermal stability
ability to withstand long time exposure to elevated temperature

3.6 polyethylene terephthalate
PET
polymer made by the polycondensation of ethylene glycol and terephthalic acid or dimethyl terephthalate

3.7 stack load
maximum weight applied to the top of a bottle when stacked

4. Requirements

4.1. General Requirements

4.1.1 The packaging covered by the provisions of this specification must be packed in appropriate packaging, which safeguard the hygienic, nutritional, technological, and organoleptic qualities of the product.

4.1.2 The bottles, including packaging material, shall be made of substances that are safe and suitable for their intended use. They should not impart any toxic substance or undesirable odor or flavor to the product.

4.2 Raw material

4.2.1 The bottles shall be made by blow moulding process from polyethylene terephthalate (PET) material.

4.2.2 The materials must be free of Phthalates (such as Butyl Benzyl Phthalate, Dibutyl Phthalate, Diethyl Hexyl Phthalate, Diisodecyl phthalate, di-n-octyl phthalate), Polyvinyl chloride (PVC), Polyvinylidene chloride (PVdC), and be manufactured with materials which do not contain bisphenol A (BPA) as an intended component of the plastic formulation.

4.3 Closure and sealing system

4.3.1 The product must be properly sealed with no leakages.

4.3.2 The closure system must have a visible tamper evident system showing that the product has not been opened.

4.3.3 The closure must resist with no cracking or permanent buckling and when applied to the same top load as the container.

4.3.4 The product must be re-closable whilst remaining leakage proof.

4.2. Specific Requirements

4.2.1 The product shall meet the requirements given in Table 1, when tested in accordance with the test methods specified therein.

Table 1 — Specific requirements for PET bottles

S/No	Parameter	Purpose					Test method
		For packing drinking water	For packing edible oil	For packing Carbonated soft drinks	For packing alcoholic or liquors	For packing liquid pesticides	
1.	Stack load	shall not show any cracks or permanent buckling					Annex A
2.	Drop impact	Not showing any sign of cracking					ASTM D 2463
3.	Closure leakage test	Shall not show any leakage, loss of tightness, backing off or popping					Annex B
4.	Wall thickness minimum, mm	0.25	0.2 (middle of side panels) and	0.2	0.2	0.25	Annex C

			0.1mm on the corners				
5.	Leakage test	Shall not show any sign of rupture or leakage from the bottle					Annex D
6.	Thermal stability	NA	NA	Shall not creep		NA	Annex E

4.2.2 Ink adhesion test

The printed bottles, when tested by the method described in Annex F, shall show no sign of printed ink or paint removal.

4.2.3 Handling system

The product must have a system to ease its handling - If required (see table 2 below), the handle should be fit for an adult man hand size with no sharp edges.

Table 2 — Handling system

Volume	Handling system
1L TO 2L	No specific handling system required
2.5 TO 4L	At least a grabbing feature
> 5L	Handle required

4.2.3 Compatibility test

The suitability of PET bottles for packing of liquid articles shall be ascertained by subjecting them to compatibility test by the method prescribed in Annex G.

4.2.4 Capacity

4.2.4.1 Nominal capacity

The bottle shall be of the following capacities:1500,1000,500,750,375,250,180 and 60 ml or any other capacity as agreed to between the purchaser and the supplier

4.2.4.2 Brimful Capacity

The brimful capacities shall be as agreed to between the purchaser and the supplier. The tolerance on agreed capacities shall be as follows:

Table 3-Bottle brimful capacity tolerance

Nominal capacity, ml	Tolerance, ml
1500	±51
1000	±10
750	±7
500	±5
375	±4

250	±4
180	±3
60	±3

4.2.5 Overall migration

The overall migration of constituents of PET bottle shall be 10 mg/dm² when tested with accordance with the EN 1186-3.

Note: This requirement is applicable to PET bottles intended for food packing only.

4.2.6 Storage stability test

IS 14537

5. Marking and Labeling

5.1 Marking and Labeling

Each PET bottle shall be marked, embossed, or labelled with the following information:

a) Manufacturer's name, identification mark, initials or trade-mark.
b) Nominal capacity of the container in ml or litres.
c) Batch No. and year of manufacture.
d) Recycling symbol
e) Plastic identification code or name.
f) For PET containers for packing pesticides the following sign shall be embossed on the side of the container to safeguard the reuse of these empty containers for storing foodstuffs, pharmaceutical and drinking water.

The sign shall be suitably supplemented with a line “DANGEROUS FOR HUMAN”

6 Sampling

6.1 Sample of bottles shall be drawn and the criteria for conformity determined as described in Annex H.

ANNEX A

(Clause 4.2.1)

STACK LOAD TEST

A.1 Principle

A force is applied to the top face of the package equivalent in magnitude to the total weight of identical packages stacked on top to a minimum stack height of 3 m. The duration is 24 h.

A.2 Sample Size

Four bottles shall be used for each single test.

A.3 Procedure

Fill the bottle with water at ambient temperature up to nominal capacity and close with the usual closure to the nominal torque (if the liquid to be packed is of high density, it should be used as the test medium).

Arrange the bottle in a block at 2 x 2 on a rigid, level, flat surface. Apply a top load evenly distributed on a flat plate placed on the unsupported containers.

The total superimposed load along with the load of the flat surface for different sizes of containers shall be as specified below according to the usage of bottle.

Table 3 details of stack load for bottle for packing alcoholic liquors

Nominal capacity, ml	Top load for 4 bottles, N
60	80
180	160
250	240
375	240
500	320
750	400
1000	400

Table 4 details of stack load for bottle for packing edible oil

Bottle capacity	Top load for 4 bottles ,N
1kg	400
2kg	600

Table 5 details of stack load for bottle for packing drinking water and Carbonated drinks

Nominal capacity, L	Top load for 4 bottles ,N
1	60
1.5	90
2	120

2.5	150
3	210
4	270
5	300

Table 6 details of stack load for bottle for packing liquid pesticides

Bottle capacity ,ml	Top load for 4 bottles ,N
100	400
250	400
500	350
1000	350
3000	480
5000	800

Examine the containers after 24 h of test period. The containers shall not show any cracks or permanent buckling likely to reduce their strength, cause leakage or reduction in effectiveness of the closure or cause instability in stacks.

ANNEX B

(normative)

(Clause 4.2.1)

CLOSURE LEAKAGE TEST

B.0 Principle

B.0.1 The method helps to determine the ability of a closure to prevent leakage.

B.1 Apparatus

A vibrating table

B.2 Procedure

B.2.1 Fill the bottle up to nominal capacity with coloured water or the material to be packed at ambient temperature, and close tight with the closure.

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

B.3 At the end of the test period, the closure shall show no indication of leakage, loss of tightness, backing off or popping.

Annex C

(normative)

(Clause 4.2.1)

MEASUREMENT OF CONTAINER WALL THICKNESS

C.1 Apparatus

A suitable instrument, e.g. micrometer, vernier caliper, non-contact instrument, etc. having a measurement accuracy of 0,02 mm.

C.2 Procedure

Cut the container body horizontally into three equal sections, top, middle, and bottom. Measure the wall thickness at four places, 90° apart and offset from the parting line, in each section. Take average of four readings and report as wall thickness at top, middle, and bottom.

C.2.1 Micrometer method

Measure the wall thickness with a micrometer or screw gauge fitted with ball point tip.

C.2.2 Dial caliper gauge method

Measure the wall thickness with the help of dial caliper fitted with spherical anvils. Care shall be taken to avoid movement of the container during measurement as this can affect the reading obtained.

C.2.3 Non-contact instrument method

Measure the wall thickness according to the manufacturer's instructions.

C.3 Results

The wall thickness is recorded as the mean of the four readings each for top, middle, and bottom sections.

Annex D

(normative)

(Clause 4.2.1)

LEAKAGE TEST

D.1 Apparatus

D.1.1 Compressed air supply

A source of compressed air and a pressure line with pressure regulator and indicator to provide uniform air pressure can be used for this test.

D.1.2 Reservoir

A reservoir suitable to hold enough water so that the test container can be fully or partly immersed in it as required. In case of large containers, the reservoir might not be necessary, and could be functionally substituted by the use of a soap solution.

D.2 Procedure

The leakage test shall be performed with the compressed air maintained at 35 KPa (0.35 bar). Connect the airline to the test container by tightly fitting the plunger with rubber plug in the mouth of the container. The test container shall be immersed in water while an internal air pressure is applied. The test container shall be kept under water in such a way as not to distort the test result.

Increase the air pressure until the predetermined pressure is obtained. Observe the container for any leakage by the bubbles of air escaping through the water. For large containers, detect the leakage by applying soap solution at various areas on the container. The formation of bubbles is an indication of leakage at those specific areas on the container.

Other acceptable techniques involve the use of pressure decay instrumentation. These can be single determination (manual) units or automated in-line units for detection of container leakage during production. With this technique, the container under test is injected with air to some specified overpressure, and the pressure is monitored for a specified period of time. If the pressure does not decay below a specified limit value at the end of the designated time period, the container under test is considered to be leak-free. Specific guidance should be obtained from the instrument supplier.

D.3 Results

Any sign of rupture or leakage from the container other than from the closure shall be deemed to indicate failure. Container shall be retested if the leakage is detected from the closure, after necessary corrections have been made to correct the leakage. Localized bulging shall not be considered as rupture or leakage.

Annex E

(normative)

(Clause 4.2.1)

THERMAL STABILITY

E.1 Purpose

CO_2 gas in carbonated beverages exerts a pressure on the container walls. As temperature increases, pressure increases, causing the bottle to expand and creep (permanently deform under the influence of an applied stress). Excessive creep will cause the beverage fill level to drop, which will negatively affect package appearance and affect how the bottle fits into a carrier shell, sits on a shelf, or fits into a vending machine. The purpose of this test is to measure a bottle's resistance to creep.

E.2 Application

For CSD and NCB Cold-fill Pressurized bottles.

E.3 Test equipment

F.3.1 Equipment or chemicals to carbonate bottle to 4.20 +/- 0.05 GV of CO_2

E.3.2 An oven or temperature controlled room set to 38°C +/-1°C (100°F +/- 2°F) at any % RH

E.3.3 Equipment to measure carbonation level.

E.3.4 Measurement tools: Pi tape, height gauge, calipers, etc.

E.4 Procedure

E.4.1 Verify calibration of equipment.

E.4.2 Mark and then measure the required bottle dimensions on empty bottles.

E.4.3 Mark the target fill level height on each bottle.

E.4.4 Fill samples with carbonated water or product to a level of:

CSD: 4.2 ± 0.1 volumes

NCB Cold Fill Pressurized: 2.72 bar (40 ± 5psi)

E.4.5. Wait approximately 1 hour after the bottles have been carbonated and check and record the carbonation level on 3 extra samples. Then place the remaining 12 bottles in the 38°C (100°F) condition.

E.4.6. Leave the bottles in the 38°C (100°F) condition for 24 hours.

E.4.7. Remove the bottles from the 38°C (100°F) condition and measure the required bottle dimensions.

a) Measure the bottles "hot" which is 2-4 hours after the bottles have been removed.

b) Measure the fill point drop from the original mark.

c) Check the bottles for final carbonation level

d) Note any visual abnormalities

Annex F

(normative)

(Clause 4.2.2)

INK ADHESION TEST FOR PRINTED CONTAINERS

F.1 Procedure

Apply two strips of 25 mm wide transparent pressure sensitive tape or cellophane tape to the printed area of container; one piece down the height and the other round the circumference of the container. Press the tape firmly on to the container and leave it for 15 s. Remove the tape by pulling slowly at about 1 cm/s pulling rate from one end at 90° to the container surface.

F.2 Results

There shall be no removal of the print from surface of the container and the print shall be legible to the naked eye after the test.

Annex G

(normative)

(Clause 4.2.3)

TEST FOR COMPATIBILITY

G.1 General

This method is for determination of compatibility of plastics containers for an intended purpose.

G.2 Principle

Piece of plastics material with which the container is made are treated at an elevated temperature with the liquid which the container is intended to transport. Any changes in organoleptic characteristics, weight, odour or flavour, size, shape and colour that occur in the test specimens are noted. For dry products, the tests may be carried out only on the containers filled with the product as in G.4.2.

G.3 Test Specimens

G.3.1 Material

Three test pieces of approximately 15cm x 15cm size shall be cut from any convenient part of the container. Each test piece shall be cleaned, wiped and dried. It shall be measured for length, width and thickness to the nearest 0.05 mm and weighed to the nearest milligram.

G.3.2 Container

Six samples of specific bottle intended for packing of particular product shall be tested in accordance with the test procedure given at G.4.2.

G.4 Procedure

G.4.1 Testing of Material

The liquid -which is intended to be filled in the bottle shall be introduced into a glass vessel and test pieces completely immersed, avoiding unnecessary contact with the other pieces or the walls of the glass vessel. Where the density of plastics material is less than that of the liquid, small weights, inert to the liquid, may be used to prevent the test pieces from either floating or curling. The test shall be carried out continuously over 28 days at a temperature of 50 ± 2°C. The liquid and the test pieces shall be thoroughly agitated every 24 h.

After the required test period has elapsed, the. Test pieces shall be removed from the liquid, suitably cleaned, dried, weighed and measured as in G.3.1

G.4.2 Testing of Container

In order to assess the compatibility of the container, the container shall be filled with the product to nominal capacity, sealed and capped in the manner intended and kept at a temperature of 50 ± 2°C for a period of 28 days. At the end of this period the containers shall be examined for the following:

a) Visible cracks, if any;

b) Change in colour;

c) Change in weight; and

d) Change in shape.

G.5 Test Result and Interpretation

Any change in weight, dimensions or alterations in other characteristics (such as colour, blooming, etc.) or any other deterioration in quality of the product shall be used by manufacturer and purchaser in reaching agreement as to the stability of the plastics material for its intended purpose.

Annex H

(normative)

(clause 6)

SAMPLING

H.1 Scale of sampling

H.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.

H.1.2 Scale of sampling

For ascertaining the conformity of the lot to the requirements of this standard, test shall be carried out for each lot separately. The sampling criteria shall be in accordance with ISO 2859-1 and as given in Table 7.

For drop impact resistance, Closure leakage, Leakage and stack load tests, one set of sample containers as given in the test methods shall be drawn from the lot and these shall be subjected to the respective tests.

The sample shall pass the tests for the lot in respect of drop impact resistance and stack load requirements.
Ink adhesion testing is applicable only to printed containers.

Compatibility testing to confirm conformance to the requirements of the application shall be conducted when changes are made in the raw materials used to produce containers (e.g. material composition, formulation, and functional additive master batch, etc.)

Table 7 -Scale of Sampling and Permissible Number of Defectives

S/No.	Lot size	Sample size	Permissible number of defects
1.	501-1200	32	1
2.	1201-3200	50	2
3.	3201- 10000	80	3
4.	10001-35000	125	5
5.	35001-150000	200	7
6.	Over 150000	300	10

H.1.3 The bottles shall be selected at random from a lot.