DRAFT GUYANA STANDARD

Specification for
Rotationally moulded polyethylene water storage tanks

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Foreword

This Guyana Standard was developed by the Technical Committee (TC) 19 – Plastics and plastic products established by the Guyana National Bureau of Standards (GNBS) and approved by the National Standards Council in 2022.

This GNBS National Standard is modified adoption of the Trinidadian Standard TTS 551: 1998- Specification for Rotationally Moulded Polyethylene Storage Tanks.

This standard is intended to guide water tank manufacturers and consumers on the requirements for water tanks made for potable water storage.

In preparing this standard, the following standards were reviewed:

(a) Indian Standard IS 12701: 1998 (Reaffirmed 2006) – Rotational moulded polyethylene water storage tanks- Specifications;

(b) ASTM D1998 – 21– Standard specification for polyethylene upright storage tanks.
Members of the Technical Committee – Plastics and plastic products

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Specification for Rotationally moulded polyethylene water storage tanks

1 Scope
This standard covers flat-bottomed water storage tanks of circular cross-section manufactured from unreinforced polyethylene by the process of rotational moulding. Included are requirements for physical characteristics, dimensions, materials performance, testing marking and labelling.

These specifications apply to tanks intended for:

(a) the storage of potable water at normal atmospheric pressure;
(b) installation and use at environmental or service temperatures such that the material of tank remains between 15 °C and 80°C; and
(c) vertical, above-ground installation on fixed, flat, fully-supporting bases.

2 Normative references

These following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of declaration of this standard, the editions indicated were valid. These editions shall remain valid until this standard has been revised or amended to incorporate the more recent editions:

(a) ASTM D2837:22- Standard test method for obtaining hydrostatic design basis for thermoplastic pipe materials or pressure design basis for thermoplastic pipe products;
(b) ASTM D1693:21- Standard test method for environmental stress-cracking of ethylene plastics;
(c) Code of Federal Regulations (CFR) Title 21; Section 177.1520: 2022- Indirect food additives-Olefin polymers;
(d) BS 2782: Method 452 B: 1993- Determination of carbon black content of polyolefin compound; and

3 Definitions

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

3.1 closed top tank
Means a tank of circular cross-section with either (See Figure 1):

(a) an integrally moulded top head; or
(b) a separate top head mechanically fastened to the shell wall.

(The latter is sometimes known as a CKD- completely knocked down- tank.)
3.2 drain pipe
Means a pipe connected near to the base of the tank for draining the stored water.

3.3 effective height
Means the height of the finished empty tank from its base to the base of the inlet pipe.

3.4 gross capacity
Means the total enclosed volume of the tank including any space which may not be capable of being filled with water.

3.5 handhole
Means an opening provided at the top of the tank for the purposes of installation, repair or maintenance.

3.6 inlet pipe
Means a pipe connected near to the top of the tank for the purpose of filling.

3.7 manhole
Means an opening of suitable internal diameter to afford entry, provided at the top of the tank for the purposes of installation, repair or maintenance.

3.8 nominal capacity
Means the internal volume of the tank measured up to the base of the inlet pipe.

3.9 open top tank
Means a tank of circular cross-section with an open top i.e. without an integral top head. (See Figure 2).

3.10 outlet pipe
Means a pipe connected near to the base of the tank for the purpose of drawing down the stored water.

3.11 overflow pipe
Means a pipe connected near to the top of the tank for the discharge of excess water.

3.12 overall height
Means the height of the finished empty tank from the base to its highest point including the top rim of the handhole/manhole and cover.

3.13 recycled materials
Means material obtained from manufactured tanks which have been returned after leaving the manufacturer's works or being put into service.

3.14 rework material
Means uncontaminated material obtained from defectively manufactured tanks which have neither left the manufacturer's works nor been put into service.

3.15 rotational moulding
Means a three stage process consisting of:

(a) charging a hollow mould with powdered and/or liquid polyethylene resin;
(b) fusng and moulding the resin by heating and rotating the mould; and
(c) cooling and removing the moulded article.

3.16 shell wall
Means that vertical section of the tank above the base.

3.17 shoulder
Means a special stiffener incorporated into the top head designed with horizontal surfaces to facilitate access to the top of, or entry into the tank.

3.18 top head
Means that part of a closed top tank above the shell wall usually designed to accommodate a cover with a handhole or manhole.

4 Physical characteristics

4.1 Type
Tanks may be of two types:
Closed Top (CT) – (See Fig. 1)
or Open Top (OT) – (See Fig. 2)

4.2 Configuration
Any tank conforming to this standard shall consist of a shell wall of circular cross-section moulded integrally with a flat base. A closed top tank shall, in addition, include a top head (of any space) which may be moulded integrally with, or mechanically fastened to the shell wall.

NOTE 1 Tank diameter may be constant or increase uniformly with height.

4.3 Construction
The final moulding may be achieved by utilizing compounded polyethylene resins of different compositions to form two (or more) layers, at least one of which shall be opaque. The formulation and construction shall be such that the interior of the tank is completely shielded from light. All materials used shall meet the requirements of 6.0 for the preservation of water quality.

4.4 Finish
The internal and external surfaces of the finished tank shall be smooth, clean and free from foreign inclusions and other defects such as air bubbles, perforations, pimples, crazing, cracking or delaminations that will impair its serviceability.

4.5 Stiffeners
Tank design may incorporate stiffening features including ribs and shoulders to achieve greater rigidity. Such features shall not however result in any reduction of the required wall thickness as determined by 5.2.
4.6 Provision for fittings

4.6.1 Circular holes shall be provided at the top and bottom for accommodating inlet and outlet pipe fittings, as shown in Fig 1.

4.6.2 Tanks may be equipped with an indentation or capped hole which could be opened to create an overflow outlet if needed.

NOTE 2 Drain and overflow pipes are optional features; where these are included in the design, similar accommodation shall be provided for these fittings.

NOTE 3 Tank diameter may be constant or increase uniformly with height.

FIG.1. Typical closed top tank
FIG. 2. Typical open top tank

NOTE 4: Tank diameter may be constant or increase uniformly with height.

4.7 Venting

All tanks shall have adequate provisions for venting to allow the escape of displaced air during filling (thereby preventing rupture). The design of this feature shall be such that it does not facilitate the ingress of insects, dust particles, or other wind-borne contaminants.

NOTE 5 It is recommended that the total area of venting shall be at least equal to the cross-sectional area of the inlet pipe.
4.8 Lugs

Lifting and/or holding down lugs may be provided to facilitate safe transfer and installation of the tank.

5 Dimensions and capacities

5.1 Overall dimensions

The ratio of overall height to base (outer) diameter shall be not greater than 2:1.

5.1.1 Base diameter shall be determined by finding the mean of two measurements of diameter taken at right angles to each other. Overall height shall be determined by finding the mean of height measurements taken at four points spaced evenly around the entire circumference of the tank.

NOTE 6 Dimensional measurements shall be conducted (at least 48 hours after moulding) on finished empty tanks placed on a flat, level surface.

5.1.2 Diameters and heights shall be measured with a steel rule, steel tape or other appropriate means; dimensions shall be stated to the nearest millimetre.

5.2 Shell wall thickness

The actual wall thickness shall not be less than the design wall thickness, subject to the tolerance given in 5.2.3. The design thickness at any level shall be calculated in accordance with the following formula.

\[ t = \frac{h \rho g D}{2\sigma_H} \]

where:
- \( t \) = design wall thickness (m);
- \( h \) = height of water above the level (m);
- \( \rho \) = density of water (kg/m\(^3\));
- \( g \) = acceleration due to gravity (N/kg);
- \( D \) = outer diameter at the level (m); and
- \( \sigma_H \) = design hoop stress of the tank material (Pa).

NOTE 7 Owing to the limitations of the rotational moulding process, the wall thicknesses of the top head, the base and the edges of the shell wall (where the shape of the tank changes) are usually found to be much greater than the thicknesses at other locations.

5.2.1 The design hoop stress shall be determined by multiplying the Hydrostatic Design Basis (obtained in accordance with ASTM Test Method D 2837:1992 – Standard test method for obtaining hydrostatic design basis for thermoplastic pipe materials), by a service factor as follows:

- 0.5 - for wall thicknesses less than or equal to 9.4 mm
- 0.475 – for wall thicknesses greater than 9.5 mm.

5.2.2 Measurements of wall thickness shall be taken at a minimum of eighteen points, six points at each of three different levels. These levels shall be spaced evenly along the entire shell wall height and the individual points spaced evenly along the entire circumference of the tank. Where
readings fall below the design thickness, further measurements shall be taken in the immediate vicinity to determine the extent of the deficient area.

5.2.3 Tolerances

Tolerances for thickness shall be minus 5% of the design thickness on the low side and shall be unlimited on the high side. The sum of individual areas falling below the design thickness but within this minus 5% limit shall not exceed 10% of the total surface area of shell wall of the tank; individual areas shall not exceed 0.1m².

5.2.4 Wall thicknesses shall be measured by an appropriate method, using calibrated instruments capable of measuring to the desired accuracy. Thicknesses shall be stated correct to the nearest 0.1 mm.

5.3 Manholes and handholes

All closed top tanks of nominal capacity less than 400 litres shall have handholes of appropriate size but not less than 280 mm internal diameter. Tanks of nominal capacity greater than 400 liters shall have manholes with minimum internal diameter of 400 mm.

5.4 Capacities

Tanks shall be adequately sized to accommodate the stated nominal capacity. The actual nominal capacity shall not vary from the stated nominal capacity by more than ±3% when determined by the method described in Appendix A. Alternatively, the proving tank method may be used for determining actual nominal capacities.

6 Materials

6.1 Formulation

All polyethylene resin and other materials used in the manufacture of tanks and covers shall be so manufactured or compounded that they do not constitute a toxic, carcinogenic or other know health hazard. They shall be certified as conforming to the U.S Food and Drug Administration requirements for food contact plastics, namely 21 CFR 177:1520:1996: Indirect food additives – Olefin polymers.

NOTE 8 Attention is drawn to the other parts of these Regulations which by reference form part of Part 177:1520 and which give limitations and guidance on polymer additives and other auxiliary substances.

6.2 Effects on water quality

Materials used in the construction of those components of tanks, covers and fittings, which are likely to come into contact with potable water, shall be such that they do not adversely affect the potability of the stored water. In particular, they should not impart any discernible colour, odour or taste nor support microbial growth.

6.3 Resistance to degradation

All polyethylene materials used in the outermost layer shall be formulated to ensure adequate resistance to degradation from atmospheric or environmental conditions. In particular, they shall:

(a) contain an ultraviolet stabilizer at an adequate level to give protection for the intended service life of the tank; and
(b) have a minimum Environmental Stress Cracking Resistance (ESCR) of 1000 hours (100% Igepal CO-630) when tested in accordance with ASTM D1693:1995 – Standard test method for environmental stress-cracking of ethylene plastics.

6.4 Carbon black content

The content and dispersion of carbon black used for shielding shall satisfy the following conditions:

(a) the content shall be 2.5 ± 0.5 % (mass/mass) when tested in accordance with BS 2782: Method 452 B: 1993 – Determination of carbon black content of polyolefin compound; and

(b) when tested in accordance with BS 2782: Method 823A:1978 – Method for assessment of carbon black dispersion in polyethylene using a microscope, the dispersion shall show a numerical rating of 5 or less and the uniformity of appearance shall be equal to or better than photomicrograph A of Figure 1 of that standard.

6.5 Material reuse

For the outer layer(s), material reuse shall be limited to 25% (mass/mass) of the manufacturer’s own network material resulting from the manufacture of tanks whose material originally complied with the requirements of this section; no rework material shall be used for the innermost layer. No recycled material shall be allowed in any layer.

7 Performance requirements

7.1 Resistance to deformation

When the tank is tested in accordance with the method described in Appendix B, the difference between the circumferential measurements shall not be greater than 2 percent of the original circumferential measurement.

7.2 Resistance to impact

When the tank is tested in accordance with the method described at Appendix C, no impact shall permanently deform, crack or puncture the tank.

7.3 Top load resistance (Applicable only to Closed Top Tanks with Shoulders)

When the tank is tested in accordance with the method described at Appendix D, there shall not be any crack or permanent deformation anywhere in the tank.

NOTE 9 This test shall be applied to tanks with net capacity of 500 litres and over.

8. Covers

8.1 Materials

The material used in the manufacture of tank covers shall conform to the requirements of 6.0, except that up to 100% of rework material may be used.

8.2 Design

Tank covers shall be such shape and of sufficiently rigid construction so as to prevent contact with the water surface under normal working conditions.
8.3 Fixing
Covers shall be close fitting, easily installed, and readily secured by mechanical traction so as to prevent dislodgement under windy conditions.

8.4 Ingress of foreign matter
The method of fixing shall be such as to prevent the entrance of foreign matter including insects or particulate contaminants through the top of the tank.

8.5 Impact resistance
When tested in accordance with the method described in Appendix E, no impact shall permanently deform, crack or puncture the cover.

9 Fittings

9.1 Fittings
Fittings shall be provided for connections to outlet pipes and for drain and overflow pipes, where these are incorporated in the tank design.

9.2 Materials
Threaded nipples, lock nuts, washers and other fittings used in providing connections for fixtures shall be of galvanized iron, brass, PVC, polypropylene, or other suitable engineering materials and shall conform to the relevant clauses of 6.0.

9.3 Sizes of fittings
The recommended minimum sizes of threaded fittings to be fixed for different capacities of water storage tanks shall be as follows:

(a) capacities up to 750 litres: 12.5 mm;
(b) capacities 751 to 2650 litres: 19mm;
(c) capacities 2651 to 4500 litres: 25mm; and
(d) capacities over 4500 litres: 37.5 mm.

9.4 Openings
Holes cut in tanks for the installation of fittings shall be free from sharp angles or corners and should have minimum practical clearance to ensure best performance of fittings.

10 Marking

Marking – The following information shall be clearly and prominently imprinted on all tanks:

(a) the manufacturer’s name and/or trademark;
(b) the nominal capacity in litres;
(c) the lot or batch number; and
(d) date of manufacture (year and month)

(e) country of origin.

(f) certification marks

NOTE 10 The manufacturer may provide any other pertinent marks or information considered necessary, such as the address and telephone numbers of his place of business; these may be printed on adhesive labels.

11 Labelling

11.1 General

Information pertinent to installation and use, and health and safety considerations shall be printed on a waterproof, adhesive label and prominently displayed on the tank.

11.2 Installation

The following installation guidelines (a) to (d) shall be included in the manufacturer's instructions:

(a) The base of the tank shall be fully supported over its entire area by a durable, rigid, flat and level platform designed to withstand the weight of the tank when filled with water, in addition to any imposed wind or seismic forces.

(b) When required, and particularly when installed for outdoor service, the tank shall be suitably anchored.

(c) The locknuts of threaded connections should not be overtightened. Plastic or rubber sealing washers or tape may be used, but under no circumstances shall putty or jointing compounds be used.

(d) The tank should not be installed close to heaters, open flames, electric light bulbs or other similar sources of heat.

11.3 Health and safety

The following health and safety guidelines (a) to (d) shall be included in manufacturer's instructions:

(a) This tank is intended for the storage of drinkable water.

(b) The tank should be inspected, cleared of extraneous matter and washed out with a weak solution of liquid chlorine bleach in clean tap water, before being put into service.

(c) Water for drinking purposes should not be allowed to remain stagnant in the tank for longer than one month. If this is unavoidable, liquid chlorine bleach, conforming to GYS 213: 2002 Specification for Liquid household chlorine bleaches, should be added to the water every month in the following proportion - 125 ml to every 1500 litres of water.

Further guidelines for safe water storage are available from the authority responsible for the supply and distribution of potable water.
Appendix A

(Refer to 5.4)

Method of test for determination of capacity

A.1 Place the empty tank on a calibrated scale of suitable weight capacity. Take the reading \(W_1\) of the weight of the empty tank.

A.2 Fill the tank up to its effective height with water at 27 ± 2 °C. Take the reading \(W_2\) of the weight of the tank and water.

A.3 Calculate the (volume) capacity of the tank as follows:

\[
\text{Volume in litres} = \frac{(W_2 - W_1) \times 1000}{p}
\]

where: \(W_1, W_2 = \text{weight in kg};\) and

\[p = \text{density of water in kg/m}^3\]

(assume \(p = 1000 \text{ kg/m}^3\) at 27 ± ° C)

A.4 Compare the calculated volume to the stated volume; express the difference as a percentage of the stated value.
Appendix B

(Refer to 7.1)

Method of test for resistance to deformation

B.1 Place the tank on a flat level surface. Make a circumferential measurement parallel to the tank base and at a distance of one-third the effective height, measured from the level surface.

B.2 Fill the tank up to its effective height with water at 27 ± °C; the minimum rate of filling shall be 23 litres/minute.

B.3 In order to minimize evaporation, after filling, introduce a membrane barrier to separate the water surface from the external atmosphere by placing a polyethylene membrane over the top of the tank, pulling taut and securing around the lid.

B.4 Maintain the temperature of the tank and water at 27 ± °C; after 10 days make a circumferential measurement at the previously determined level.

B.5 Express the difference between the two measurements as a percentage of the original circumferential measurement.

NOTE 11 The entire test shall be carried out in the shade.

NOTE 12 The tank shall be tested with its cover in place; for tanks with screw-type covers, the cover shall be loosely screwed in place.
Appendix C

(Refer to 7.2)

Method of test for resistance to impact

C.1 Invert the tank so that its base is horizontal and maintain it at a temperature of 27 ± °C (in the shade) for a period of not less than 1 hour prior to the commencement of the test.

C.2 Strike the tank base with a 25mm diameter hemispherically ended striker of mass 2.5 kg falling freely from a height of 3 m at each of the following locations:

(a) at the centre of the base; and

(b) at three different points as close to the edge of the base as it practical.

C.3 Inspect the tank for deformation, cracks, puncture or other failure.

NOTE 13 The shape of the striker shall be such that only the surface of the specified hemisphere comes into contact with the tank under the initial impact for each blow.
Appendix D

(Refer to 7.3)

**Method of test for top load resistance**  
(Applicable only to closed top tanks with shoulders)

**D.1** Place the tank on a flat, level surface and fill with water up to 98% of its nominal capacity. Apply a vertical load of 100 kg seated on a rubber bearing pad on the shoulder of the tank. Leave in place for a minimum of 4 hours at a constant temperature of 27 ± °C.

**D.2** Remove the load and examine the tank for deformation or failure. Leave the tank standing for another 4 hours and examine again.
Appendix E

(Refer to 8.5)

**Method of test for determining impact resistance of covers**

**E.1** Support the cover on a tank of the appropriate dimension and maintain it at a temperature of 27 ± °C for a period of not less than 1 hour prior to the commencement of the test.

**E.2** Strike the cover with a 25mm diameter hemispherically ended striker of mass 2.5 kg falling freely from a height of 1.5 m. Arrange the striker so as to hit the cover at its midpoint. Make three other impacts a close to the edge or corners as it practical. The shape of the striker shall be such that only the surface of the specimen hemisphere comes into contact with the cover under the initial blow.

**E.3** Examine the cover for deformation, cracks, puncture or other failure.

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