

DRAFT TANZANIA STANDARD

Polyethylene Terephthalate (PET) Preform-Specification

TANZANIA BUREAU OF STANDARDS

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1st Edition

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The organizations marked with an asterisk (*) in the above list, together with the following were directly represented on the Technical Committee entrusted with the preparation of this Tanzania Standard:

Industrial Packaging Limited (IPL) Zanzibar Bureau of Standards (ZBS) Small Industries Development Organization (SIDO) Kioo Limited Nyanza Bottling Company Limited Silla Africa Company Limited

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0 National Foreword

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 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.

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

RS 499-1 Post-consumer polyethylene terephthalate (PET) containers — Specification — Part 1: Food grade PET recyclates, preforms and containers, published by Rwanda Standard Board

Acknowledgement is hereby made for the assistance derived from this source

0.2 Terminology and conventions

The text of the International standard is hereby being recommended for approval without deviation for publication as Tanzania standard.

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 is to use a full point on the baseline as decimal marker.

Whenever the words "International Standard" appear, referring to this Finalized Tanzania Standard, they should read as "Tanzania Standard".

1. Scope

This draft Tanzania standard describes the requirements, sampling and test methods for preforms made from Polyethylene terephthalate (PET) thermoplastic polyester resin.

2. Normative references

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

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

ISO 15512 Plastics — Determination of water content.

ISO 1628-5 Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 5: Thermoplastic polyester (TP) homopolymers and copolymers.

ASTM F2013-10 Standard test method for determination of residual acetaldehyde in polyethylene terephthalate bottle polymer using an automated static head-space sampling device and a capillary GC with a flame ionization detector.

ASTM D4754-18 Standard test method for two-sided liquid extraction of plastic materials using FDA migration cell.

EN1186-3:2022 Materials and articles in contact with foodstuffs. Plastics Test methods for overall migration in evaporable simulants.

EN 13130-1:2004 Materials and articles in contact with foodstuffs - Plastics substances subject to limitation - Part 1: Guide to test methods for the specific migration of substances from plastics to foods and food simulants and the determination of substances in plastics and the selection of conditions of exposure to food simulants

3. Terms and definitions

For the purpose of this document, the following terms and definitions shall apply:

3.1 bubble

spherical, internal void of air or other gas trapped within a plastic

3.2

crystallinity

state of molecular structure in some resins which denotes uniformity and compactness of the molecular chains forming the polymer, normally can be attributed to the formation of solid crystals having a definite geometric form

3.3

flash

extra plastic attached to a moulding along the parting line; under most conditions it would be objectionable and must be removed before the parts are acceptable

3.4

gate

In injection and transfer moulding, the orifice through which the melt enters the cavity

3.5

gate nub

small bits of plastic, left on the parts after cutting them from the runners

3.6

intrinsic viscosity

limiting value of the reduced viscosity or the inherent viscosity at infinite dilution of the polymer is a common descriptor of PET flow ability

3.7

perpendicularity

distance between two parallel straight lines (tangents) between which the cut surface profile is inscribed and within the set angle (e.g. 90° in the case of vertical cuts)

3.8

preform

coherent, test tube shaped mass of powdered, granular or fibrous polyethylene terephthalate thermoplastic polyester resin

4 Requirements

4.1 General requirements

- **4.1.1** The preform shall be manufactured in accordance with good manufacturing practice (GMP) so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could endanger human health; bring about an unacceptable change in the composition.
- **4.1.2** Foreign materials in the preform, inhomogeneous areas, vacuoles, non-molten material, burnt material, and moisture rings shall not be permitted.
- **4.1.3** All preform visual defects as shown in Annex C shall not be permitted.

4.1.4 Materials

- **4.1.4.1** The material used for manufacturing preform shall be thermoplastic polyester resin polyethylene terephthalate (PET) having density between 790 to 850 kg/m³. Any additive, to impart preform may be added to the resin in quantity that does not endanger human health and environment.
- **1.4.2** The Intrinsic Viscosity of polyethylene terephthalate (PET) resins shall be between 0.72 dl/g (low molecular weight resins) and 0.88 dl/g (high molecular weight resins) when tested in accordance with ISO 1628.
- **4.1.4.3** The thermoplastic polyester resin polyethylene terephthalate (PET) shall be supplied with a humidity content less than 0.2 % or 2000 ppm when tested in accordance with ISO 15512.
- **4.1.4.4** PET resin, as determined by laboratory method shall start melting at around 215-220 °C and complete melting at around 285 °C, presenting a peak temperature at 290 °C.

4.2 Specific requirements

4.2.1 Physical chemical requirements

Preforms shall comply with the requirements of Table 1 when tested in accordance with the test methods specified therein.

S/No.	Parameter		Requirement		Test method	
i.	Intrinsic viscosity, minimum (dl/g)		For NCSD	0.72	ISO 1628	
ii.		,	For CSD	0.82		
iii.	Acetaldehyde content, max	kimum (ppm)	For NCSD	4	ASTM F2013-10	
iv.			For CSD	10		
٧.	Weight tolerance, g	<30	± 0.3			
		30 to 50	± 0.4			
		>50	± 0.5			
vi.	Gate nub length, maximum, mm		3			
vii.	Perpendicularity, mm		± 0.75		Annex B	
viii.	Wall thickness variation, m	aximum, mm	0.25		Annex A	
NOTE: "NCSD"- Non-Carbonated Soft Drink "CSD"- Carbonated Soft Drink						

Table 1 — Physical chemical requirements of PET preforms

4.2.2 Specific migration of chemicals

4.2.2.1 Specific migration of compound

The specific migration limit of compound from the polyethylene terephthalate (PET) material shall not exceed the limit specified in Table 2 when determined in accordance with the test method specified therein.

S/No.	Compound	Specific migration limit, mg/kg of food, max.	Test method
i.	Mono- and diethylene glycol (including the ester of stearic acid with ethylene glycol)	30	
ii.	Terephthalic acid	7.5	ASTM
iii.	Isophthalic acid	5	D4754-18
iv.	Antimony trioxide (calculated as antimony)	0.04	
٧.	2-Aminobenzamide (anthranilamide)	0.05	

4.2.2.2 Restrictions on release of inorganic substances

The preform material shall not release contaminants in quantities exceeding their migration limits given in Table 3 when determined in accordance with EN 13130-1:2004.

Table 3 — Specific migration limit of inorganic substances

S/No.	Substance	Specific migration limit mg/kg of food, beverage or food stimulant, max.
i.	Aluminium	1
ii.	Barium	1

iii.	Cobalt	0.05
iv.	Copper	5
٧.	Iron	48
vi.	Lithium	0.6
vii.	Manganese	0.6
viii.	Zinc	10

4.2.2.3 Restrictions on release of hazardous substances

The preform material shall not release contaminants in quantities exceeding their migration limits given in Table 4 when determined in accordance with the test method specified therein.

Table 4 — Specific migration limit of hazardous substances

Hazardous substances	mg/kg of food, beverage or food stimulant, max	Test method
Lead	0.1%	
Hexavalent chromium	0.1%	EN1186-
Mercury	0.1%	3:2022
Cadmium	0.01%	
Polybrominated biphenyls (PBB)	0.1%	
Polybrominated diphenyl ethers (PBDE)	0.1%	

5 Packaging and marking

5.1 Packaging

The preforms shall be packaged in suitable packaging materials that maintain their integrity, prevent the ingress of dust, moisture and other foreign matters during transportation and storage.

5.2 Marking

5.2.1 The preform shall be legibly and indelibly marked with mould number.

5.2.2 The following information shall be legibly and indelibly marked on the packaging, or in accompanying documents:

- a) name, trade mark or other means of identification of the manufacturer;
- b) batch number;
- c) date of manufacture;
- d) words "for food contact" or symbol for food contact material;
- e) words "PET" or symbol indicating that it is made from PET material;
- f) expiry date;
- g) product type, i.e., weight of the preform.

6 Sampling

The sampling criteria shall be in accordance with ISO 2859-1.

Annex A

(normative)

Measurement of wall thickness

A.1 Apparatus

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

A.2 Procedure

Cut the preform body horizontally into upper, middle, and lower equal sections. 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 upper, middle, and lower.

A.2.1 Micrometer method

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

A.2.2 Dial calliper gauge method

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

A.2.3 Non-contact instrument method

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

A.3 Results

The wall thickness is recorded as the mean of the four readings each for upper, middle, and lower sections

Annex B

(normative)

Measurement of perpendicularity

B.1 General

The perpendicularity test verifies that the body of a preform is perpendicular to the finish surface. The perpendicularity test is designed to ensure that preform stand upright in an orientation that is completely perpendicular to the bearing surface on which they stand.

B.2 Test equipment

Perpendicularity gauge assembly or Digital perpendicularity tester or equivalent.

B.3 Sample quantities

To be determined by end users' specifications and risk analysis.

B.4 Procedure

B.4.1 Using randomly selected sample preforms as a source, select a sub-group of perpendicularity samples.

B.4.2 Place the sample in the measuring apparatus. Be sure that the base of each preform is held securely in the support fixture.

B.4.3 Adjust the dial indicator contact so that it rests on the locking ring of the preform finish. Set the dial indicator on "0."

B.4.4 Rotate the preform through at least 360° and note the maximum and minimum deviation on the gauge on either side of vertical. Set the zero mark of the gauge at that position.

B.4.5 Repeat steps 3 and 4 for remaining samples.

B.4.6 Record all measurements

Annex C

(normative)

Common preform visual defects with their possible solutions

Defects can reduce the speed and cost-efficiency of the entire product development process, and can potentially shorten product life spans if left unchecked. Preform visual defects can be caused by a host of reasons, including poor design, production process mistakes, quality control failures, and more. As such, it is important to take a proactive approach to risk mitigation throughout the product development process so as to reduce the chances of preform defects. There are many visual defects that are encountered by the producers at very initial stage of production of preforms. Some of the common defects and their possible solutions are as shown in Table 5.

Table 5 — Common types of preform visual defects with their possible solutions

S/N	Type of visual defect	Description	Possible solutions
1.	Plack apacks (Contamination)	Black particles that	1. Check the thermocouples
1.	Black specks (Contamination)	occur randomly in the	on the hot runner, extruder and
		preform	dryer.
			2. Check the dryer condition.
			3. Check the resin quality.
			4. Reduce the extruder
		\sim	temperature.
			Reduce the hot runner manifold temperature.
			6. Reduce the hot runner
			manifold temperature.
			7. Reduce the screw speed
	• • • • • • • • • • • • • • • • • • •		and the back pressure.
	\sim		8. Check the injection time,
			and adjust the speed if
			necessary. 9. Reduce the temperature
			during the extruder standby.
2.	Bubbles	Bubble(s) in any part of	1. Increase the extruder
		the preform	temperature.
			2. Increase the screw speed
			and the back pressure.
			3. Check the residence time and the temperature of the
			dryer.
	5		4. Decrease the
			decompression by decreasing
			the pullback stroke and the
			pullback
			dwell time. 5. Make sure that the resin flow
*			of the feeding zone is constant
3.	Burn marks	Black marks and	1. Check all the temperature
		streaks in the gate area	readings.
		-	2. Check the thermocouples
			on the extruder and the hot
			runner.
			3. Decrease the extruder
			temperature.

		[
				4. Decrease the hot runner
				manifold temperature.
				5. Decrease the hot runner
				nozzle temperature.
				6. Check the water cooling
				temperature and the flow.
				7. Decrease the screw speed
				and the back pressure.
				8. Decrease the injection
				speed.
				9. Decrease the temperature
				during extruder standby.
	4.	Colour streaks	Colour streaks in the	1. Make sure that the colour
			preform body	feeder is dosing colour
				correctly.
				2. Make sure that no clogging
				has occurred.
				3. Increase the transfer
				cushion by increasing the
				extruder position.
				4. Increase the screw speed
				and the back pressure.
				5. Increase the extruder
				temperature.
				6. Make sure that the colour
				mixer rotates continuously
	5.	Degradation (Yellow	An abnormal yellow tint	Check the resin dryer for
		preforms)	or discoloration	proper operation: airflow,
			throughout the entire	hopper residence time, and
			preform	temperature (resin
				dependent).
				2. Reduce the temperature of
				the hot runner.
		\sim		3. Reduce the machine
				temperature settings.
				4. Reduce the shear heat by
				reducing the screw speed,
				back pressure, and/or transfer/
				injection rate.
				5. Minimize heat up times
				during start-ups.
				6. Purge the barrel and
				shooting pot prior to start-up.
				Make sure that all discoloured
				resin
				is flushed out.
				7. During system shutdowns,
				purge the extruder barrel and
	X			shooting pot completely, and
				immediately reduce machine
				heats.
				8. During system shutdowns,
				immediately turn off the hot
$\mathbf{\nabla}$				runner nozzle heats. Then turn
*				off the manifold heats, and
				keep the chilled water flowing
				through the mould until the hot
				runner manifold temperature
				dropped below 100°C.

				9. Check the resin supply for	
				degradation such as	
				discoloration and reduced IV.	
				10. Make sure that the regrind	
				supply is not overdried,	
				discoloured. or sticking to	
				virgin resin	C
				pellets.	
	6.	Flash	A thin plastic protrusion	 Reduce the shot size. 	\sim
			(flash) at the parting	Increase the injection time.	
			lines	3. Increase the transition point.	
				4. Make sure that there is no	
				debris in the mould.	
				5. Reduce the hold pressure.	r
				6. Reduce the injection speed	
				to reduce the injection	
				pressure.	
				7. Check the stack / mould	
				alignment.	
				8. Check for part interference	
				during closing (e.g., tonnage	
				block, leader pin, taper lock,	
				and bolt.).	
				9. Check for any part damage	
				(e.g., taper wear).	
				10. Increase the clamp force.	
				(Do not exceed the maximum	
				•	
				allowable clamp tonnage.)	
				11. Modify the extruder	
				temperature according to the	
				PET characteristics.	
				12. Check for parting line	
				damage (if the mould has been	
				flashed).	
	7.	Gate crystallinity	White crystalline	1. Increase the temperatures	
			formations appearing	of the hot runner nozzles.	
			in the preform gate	2. Optimize the dry cycle time	
			area. Commonly found	of the machine.	
			throughout the entire	3. Decrease the temperatures	
			wall cross section, in	of the hot runner nozzles.	
			the interior wall section,	4. Make sure that the	
			close to the core cap		
			•	•	
			surface, and as a	pressure of the mould chilled-	
			streak extending from	water supply are proper.	
			the gate area into the	5. Make sure that the water	
			preform body.	channels of the mould gate	
)		insert are free of	
				contamination and blockages.	
	V İ			6. Make sure that the hot	
				runner nozzle heater does not	
				touch the gate insert.	
				7. Reduce the injection fill rate	
				in order to reduce the melt	
				shear heat in the gate seal /	
\mathbf{V}				-	
				gate passage.	
				8. Make sure that the preform	
				in the robot take-out tube	
				contacts the spherical base	
				insert.	

				9. Increase the preform	
				cooling time.	
				10. Open the valve gates	
				earlier prior to injection.	
				11. Increase the valve-gate	
				open time after hold (preform	
				gate quality permitting).	
				12. Reduce the hold pressure.	
				13. Increase the	
				decompression by increasing	
				the pullback stroke.	
				14. Increase the	
				decompression by increasing	
				the pullback dwell time.	
				15. Make sure that the hot	
				runner nozzles and gate area	
				are free of contamination and	
				blockages.	
				16. Make sure that the valve	
				pin is opening correctly	
	8.	Gate depressions	The outer surface of	1. Check the flow rate and the	
	0.		the preform gate /	temperature of the cooling	
			dome has indentations	water.	
			that are usually in a	2. Increase the preform	
			circular pattern. They	cooling time.	
			may be smooth or	3. Decrease the hold time.	
			wrinkled in	4. Increase the transition point.	
			appearance.	4. merease the transition point.	
	9.	Gate flaking	A portion of the gate	1. Examine the hot runner	
	5.	Cate haking	vestige that remains	valve pin and the gate insert	
			trapped between the	for wear, and replace if	
			gate insert land and the	necessary.	
			valve pin is injected	2. Examine the gate seal	
			into the cavity in the	insulator and the gate seal for	
			next cycle. It appears	deformation and wear, and	
		\sim	as a torn crystalline	replace if necessary.	
			vestige	3. Increase the temperatures	
			or a flake moulded into	of the hot runner nozzles to	
			the dome wall section	melt the preform gate vestige	
			of the preform.	to enable easier separation	
			••••••••••••••••••••••••••••••••••••••	and correct valve gate shut off.	
				4. Decrease the hold pressure	
				in order to decrease the	
				cooling rate and melt pressure	
				in the gate well area.	
				5. Increase the decompression	
				by increasing the pullback	
				stroke and/or the pullback	
				dwell time to decrease the	
0				cooling rate and the melt	
				pressure in the gate well area.	
~~				6. Adjust the valve-pin close-	
\frown				delay timer.	
	10.	Gate void (Pin hole)	A small hole on the	1. Check the flow and	
×			gate nub or just below	temperature of the cooling	
			the gate nub	water.	
			U	2. Examine the valve pin, gate	
				insert, nozzle, and gate seal	
				insulator for wear and	
				damage.	
I				U U	

			3. Reduce the mould break.	
			4. Increase the last hold	
			pressure/time to favour	
			cooling.	
			5. Decrease or increase the	
			temperature of the hot runner	
			nozzles.	
			6. Increase the cooling time.	
			7. Decrease the pullback	
			stroke and pullback dwell time	
			to prevent melt draw away.	
			8. Reduce the valve-pin close	
			delay.	
				r
			9. Increase the hot runner	
			manifold temperature to favour	
			the valve pin closing.	
			10. Check all the temperature	
			readings and correct if	
			necessary.	
			· · · · · · · · · · · · · · · · · · ·	
			11. Check the compressed air	
			of the valve gate.	
11.	Haze	A cloudy white	1. Make sure that the dryer is	
		appearance in the	operating correctly.	
		preform body. It can be	2. Make sure that the moisture	
		circumferential white	level at the machine extruder	
		streaks or localized	throat is less than 50 ppm.	
		cloudiness in thick wall	3. Make sure that the	
		sections of the preform.	temperature (resin	
			dependent), airflow, dewpoint,	
			and hopper	
			residence time of the resin	
			dryer are correct.	
			4. Make sure that the dryer is	
			operating correctly.	
		•		
			5. Make sure that the	
			temperature (resin	
			dependent), airflow, and	
			hopper residence time of the	
			resin dryer are correct.	
			6. Check for preferential resin-	
			•	
			flow channelling in the hopper.	
			7. Increase the screw back	
			pressure.	
			•	
			8. Check for resin bridging in	
			the extruder feed zone. If	
			necessary, clear the bridging	
			and reduce the temperature of	
			the extruder feed zone.	
			9. Increase extruder	
			temperatures.	
-			10. Increase the back pressure	
			to increase the shear heating.	
			11. Increase the screw speed	
			to increase the shear heating	
			12. Increase the screw back	
			position in order to increase	
			•	
			the screw cushion. (Generally	
			the screw cushion is 10-20	
			mm.)	
			·	

	12.	Knit line (Weld line)	A microscopic groove that forms when two flow fronts converge	 13. Make sure that the pressure, flow, and temperature of the water cooling system are correct. 14. Make sure that the mould cooling channels are free from contamination and blockages. 15. Increase the cooling time. 1. Increase the injection speed. 2. Increase the injection 	
8		SANDARD	but do not bond together, which creates a minute indentation along the interface at this boundary. Usually is observed where the melt paths join around a thread vent blade up to the top sealing surface of a neck finish.	 pressure. 3. Increase the hold speed. 4. Increase the hold pressure. 5. Increase the temperature of the mould chilled water. (Note: This may affect the preform quality and moulding cycle time.) 6. Clean the mould neck ring and the locking ring vents. 7. Make sure that the mould vent size agrees with the drawing dimensions. 8. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. 9. Increase the temperature of the mould chilled water. 9. Increase the temperature of the mould chilled water to more than the ambient dew point in the moulding area to prevent condensation. (Note: This may affect the preform quality and moulding cycle time.) 10. Examine the mould cavity plate at the cavity and gate inserts for water leaks, and repair if necessary. 11. Examine the locking rings, nick rings, and neck ring slides of the mould core side for water leaks, and repair if necessary. 12. Examine the hose and fitting connections on the supply and return manifold and the neck ring slides for water leaks, and repair if necessary. 13. Make sure that the moulding surfaces are free of contamination: mould spray residue, flash particles, and others. 	
	13.	Long gate vestige	An elongated gate on a preform that appears	1. Check for foreign matter in the nozzle.	
			as a melt protrusion	2. Check the valve pin for damage.	

				3. Check the piston seals of	
				the valve pin for damage.	
				4. Make sure that the air	
				pressure of the valve gate is	
				correct, and clean the filter.	
				5. Check the gate seal	
				insulator for damage. 6. Decrease the hold pressure	
				/ time to decrease the cooling	
				rate and the melt pressure in	$\langle \ \rangle$
				the gate well area.	
				7. Increase the pullback stroke	
				and the pullback dwell time to	
				reduce the pressure in the	
				preform.	
				8. Increase the hot runner	
				manifold temperature to favour	
				the valve pin closing.	
				9. Increase or decrease the	
				temperature of the hot runner	
				nozzles.	
	14.	Malformed top-sealing surface	The top sealing surface	1. Make sure that the mould	
			of the preform is not	neck ring and the locking ring	
			fully formed. This is usually seen as a	vents are clean. 2. Make sure that the sizes of	
			usually seen as a glossy sink on or		
			adjacent to the top	drawing dimensions.	
			sealing surface.	3. Set the clamp tonnage to the	
			5 5 m · · · · ·	minimum permitted by the	
				minimum permitted by the	
				process.	
	15.	Moisture marks	Circumferential rings		
	15.	Moisture marks	appear on the inner	process. 1. Make sure that the ambient dew point in the moulding area	
	15.	Moisture marks	appear on the inner and/or outer surfaces	process. 1. Make sure that the ambient dew point in the moulding area is less than the temperature of	
	15.	Moisture marks	appear on the inner and/or outer surfaces of the preform. The	process. 1. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water.	
	15.	Moisture marks	appear on the inner and/or outer surfaces of the preform. The rings	 process. 1. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. 2. Increase the temperature of 	
	15.	Moisture marks	appear on the inner and/or outer surfaces of the preform. The rings are usually seen as	 process. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. Increase the temperature of the mould chilled water to 	
	15.	Moisture marks	appear on the inner and/or outer surfaces of the preform. The rings are usually seen as clear ridges having an	 process. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. Increase the temperature of the mould chilled water to more than the ambient dew 	
	15.	Moisture marks	appear on the inner and/or outer surfaces of the preform. The rings are usually seen as	 process. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. Increase the temperature of the mould chilled water to more than the ambient dew point in the moulding area to 	
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R		SAMPAR	appear on the inner and/or outer surfaces of the preform. The rings are usually seen as clear ridges having an elliptical shape.	 process. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. Increase the temperature of the mould chilled water to more than the ambient dew point in the moulding area to prevent condensation. (Note: This may affect the preform quality and moulding cycle time.) Examine the mould cavity plate at the cavity and gate inserts for water leaks, and repair Examine the locking rings, nick rings, and neck ring slides of the mould core side for water leaks, and repair if necessary. Examine the hose and fitting connections on the supply and return manifold and the neck ring slides for water leaks, and repair if necessary. 	
R	15.	Moisture marks	A circumferential	 process. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. Increase the temperature of the mould chilled water to more than the ambient dew point in the moulding area to prevent condensation. (Note: This may affect the preform quality and moulding cycle time.) Examine the mould cavity plate at the cavity and gate inserts for water leaks, and repair Examine the locking rings, nick rings, and neck ring slides of the mould core side for water leaks, and repair if necessary. Examine the hose and fitting connections on the supply and return manifold and the neck ring slides for water leaks, and repair if necessary. Decrease the hold pressure. 	
98		SAMPAR	appear on the inner and/or outer surfaces of the preform. The rings are usually seen as clear ridges having an elliptical shape.	 process. Make sure that the ambient dew point in the moulding area is less than the temperature of the mould chilled water. Increase the temperature of the mould chilled water to more than the ambient dew point in the moulding area to prevent condensation. (Note: This may affect the preform quality and moulding cycle time.) Examine the mould cavity plate at the cavity and gate inserts for water leaks, and repair Examine the locking rings, nick rings, and neck ring slides of the mould core side for water leaks, and repair if necessary. Examine the hose and fitting connections on the supply and return manifold and the neck ring slides for water leaks, and repair if necessary. 	

			at the neck ring / cavity parting line because of deformation when opening the mould.	 Decrease the shot size. Increase the pullback stroke to increase the decompression. Increase the pullback dwell 	
				time to increase the decompression. 6. Extend the valve-gate open timer after hold. 7. Increase the preform	15
				cooling time. 8. Make sure that the flow, pressure, and temperature of the water-cooling system are correct.	
	17.	Peeling	A torn section on the	 9. Make sure that the mould cooling channels are free of contamination and blockages. 1. Check the gate insert, gate 	
			external surface of the preform, starting from the gate nub extending outward toward the hemispherical area.	 seal insulator, valve pin, and gate seals for any wear or damage and replace if necessary. 2. Check the clearance 	
			The torn section sticks on the moulding surface of the gate insert and can remain	between the valve pin and the gate insert. 3. Check for an oval gate hole. 4. Make sure that the water	
			for several cycles.	cooling and the flow are correct.5. Check the water channel for contamination.	
				 6. Decrease the cooling rate at the preform tip. 7. Decrease the hold pressure/time to decrease the 	
		JOAN		cooling rate and the melt pressure in the gate well area. 8. Increase the hot runner nozzle temperature to increase the melt in the gate	
		THIS		well area. 9. Increase the decompression to decrease the cooling rate in the gate well area.	
1				10. Increase the cooling time to increase the dome solidification and break the gate vestige during mould opening.	
8×				11. Make sure that the pressure of the compressed air of the valve gate is not below 7.6 bar (110 psi).	
*	18.	Pulled gate vestige	An elongated gate on a preform that appears as a stretched crystalline vestige	 Check the flow and temperature of the cooling water. Decrease the mould break to zero. 	
				·	

				3. Increase the mould opening	
				speed.	
				4. Increase the last hold	
				pressure to favour cooling.	
				5. Decrease the hot-runner	
				nozzle temperature.	
				6. Increase the cooling time.	
				7. Decrease the pullback	
				stroke and pullback dwell time	
				to prevent melt draw away.	
	19.	Preform buckling	The preform body	1. Make sure that the flow,	
			collapses during	pressure, and temperature of	
			ejection, usually at the	the water-cooling system are	
			thickest and hottest	correct.	
			part of the	2. Make sure that the mould	
			wall section.	cooling channels are free of	
				contamination and blockages.	
				3. Increase the cooling time.	
				4. Increase the hold pressure.	
				5. Increase the hold time.	
				6. Decrease the machine	
				temperatures.	
				7. Decrease the hot runner	
				temperatures.	
				8. Decrease the hold pressure.	
				9. Make sure that the ambient	
			\sim	dew point in the moulding area	
				is less than the temperature of	
				the mould chilled water.	
				10. Increase the temperature	
				of the mould chilled water to	
				more than the ambient dew	
				point in the moulding area to	
				prevent condensation. (Note:	
				This may affect the preform	
				quality and the moulding cycle	
				time.)	
	20.	Short shot	A not fully filled preform	1. Increase the shot size.	
			from a completed	2. Decrease the transition	
			injection cycle. It is	position.	
			usually seen as an	Increase the hold time.	
			underdeveloped thread	Increase the hold pressure.	
			section in the preform	5. Increase the injection	
			neck area and a	speed.	
			decreased preform	6. Increase the injection	
			weight.	pressure.	
			0	7. Increase the melt	
				temperature to reduce the melt	
				viscosity.	
				8. Make sure that the resin and	
				preform have a correct IV.	
				9. Increase the hot runner	
				manifold temperatures.	
$\mathbf{\nabla}$				10. Increase the hot-runner	
Ŧ				nozzle temperatures.	
				11. Increase the machine	
				temperatures.	
				12. Examine the hot runner	
				gate seal for contamination,	
				and clean if necessary.	
					-

	21.	Splay marks	Sink marks are depressions on the internal and/or external preform surfaces.	 13. Examine the valve pin for damage, and replace if necessary. 14. Examine the valve-pin piston seals for damage, and replace if necessary. 15. Increase the hot runner manifold temperature to allow increased valve pin movement. 16. Make sure that the air pressure of the valve pin is correct. 17. Examine the air mufflers of the valve gate for blockages, and clean or replace if necessary. 18. Clean the mould vents. 19. Make sure that the sizes of the mould vents agree with the drawing dimensions. 1. Check the mould cooling temperature and the flow. 2. Check the valve pin motion. 3. Make sure that the sizes of the residence time of the resin. 5. Check the temperature and the residence time of the resin. 5. Check the robot and the iChill alignment. 6. Increase the hold time / pressure. 7. Increase the cooling time. 8. Reduce the injection speed. 9. Maintain a cushion of 5-8 mm on the plunger. 10. Decrease the transition point. 11. Reduce the extruder temperature. 1. Make sure that the dryer is operating correctly. 2. Decrease the hot-runner manifold temperatures. 3. Decrease the screw speed, back pressure, and/or transfer/injection rate to decrease the shear heating in the out-out-st the strueture. 	
988				back pressure, and/or transfer/injection rate to	

				_
			before start-up.	
			8. Examine the hot-runner	
			gate seal for damage that	
			could create hang-up spots for	
			the melt.	
			9. Examine the gate seal	
			insulator and gate insert area	
			for damage that could create	
			hang-up spots for the melt.	
			10. Increase the screw back	$\langle \ \rangle$
			pressure.	
			11. Examine the resin supply	
			for degradation, and replace if	
			necessary.	
			12. Examine the extruder feed	
			zone for plastic bridging. If	
			necessary, clear the bridging,	
			and reduce the temperature of	
			the extruder feed zone.	
			13. Decrease the pullback	
			stroke and/or pullback dwell	
			time to decrease the	
			decompression	
23.	Stringing	Hair-like strands that	1. Check the flow and	
20.	Stillightg	protrude from the gate	temperature of the cooling	
		nub	water.	
			2. Increase the preform	
			cooling time.	
			3. Decrease the hold time.	
			4. Make sure that the hot	
			runner heat settings are	
			correct.	
24	Surface blemishes	Random marks that		
24.			1. Keep to a minimum the	
	(Scratches)	appear as elliptical	handling and transferring of	
		blemishes, scratches,	preforms after robot ejection.	
		and irregular	2. Keep to a minimum the	
		impressions, or	distance the preforms fall from	
		recurring marks that	the robot to the conveyor.	
		appear as longitudinal	3. Decrease the robot ejection	
		scratches or	force.	
		irregularities on the	4. Increase the preform	
		surface of the preform	cooling time to reduce the	
			preform surface temperature	
			and	
			sensitivity to damage.	
			5. Make sure that the flow,	
			pressure, and temperature of	
			the water cooling system are	
			correct.	
			6. Make sure that the mould	
			cooling channels are free of	
			contamination and blockages.	
			7. Make sure that the cooling	
			channels of the takeout plate	
			tube of the robot are free of	
			contamination and blockages.	
			8. Increase the cooling time.	
			9. Increase the cooling dwell	
			time in the robot takeout plate.	I

25. Unmelts Resin pallets in the full part of the dynamic and the information and clean if necessary. 11. Examine the roulding surfaces for contamination, and clean if necessary. 12. Examine the moulding surfaces for contamination, and clean if necessary. 13. Make sure that the mould core half and the cavity half are aligned. 14. Examine the level of the mould core and cavity half are aligned. 15. Examine the robot takeout tubes for surface damage, and repair if necessary. 15. Examine the robot takeout tubes for interference when the preform sare ejected, and taign if necessary. 16. Examine the hopper in free for particular resin dependent) of the dynamic core and cavity half are fully or particular resin dependent) of the dynamic core data. 15. Examine the hopper in free for particular resin dependent) of the dynamic core data. 16. Examine the hopper in free for particular resin dependent) of the dynamic core data. 17. Index such the mould core and cavity half are fully or particular resin dependent). 18. Examine the core time. 19. Index such the target for particular resin dependent) of the dynamic core and cavity half are fully or core particular resin dependent of the dynamic core. 19. Examine the hopper in freed hose for irregularities. 10. Do a DSC analysis of the unmetede						-
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25 Unmetts Resin pellots in, high processing in the casing hardware in the interpret of the casing hardware interpret of the period takeout tubes for surface structure (resin dependent) of the dependent of the casing hardware interpret of the period takeout tubes for interference when the performs are ejected, and align if recessary in the performs are ejected, and align if recessary in the perform sare ejected, and the performs are ejected, and align if recessary in the performs are ejected, and align if recessary in the perform sare ejected, and align if recessary in the perform sare ejected, and align if recessary in the performs are ejected, and align if recessary in the performs are ejected, and align if recessary is in the perform sare ejected, and align if recessary is in the perform sare ejected, and align if recessary is interference when the performs are ejected, and align if recessary is interference when the performs are ejected, and align if recessary is interference when the performs are ejected, and align if recessary is interference when the performs are ejected, and align if recessary is interference when the performs are ejected, and align if recessary is interference interviewed in the perform perform body that are interviewed in the perform perform body that are ejected. 25 Unmetts Resin pellots in the pellots in the perform body that are ejected. 3 Examine the end takeout tubes is a set of the advector intergulation in the pellots with the pellots in the preform body that are interviewed the casing the pellots with the manufacturer's appendix the pellots indiging, and remove any bridging that you find. 9 Reduce the temperature of the					repair or replace if necessary.	
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	6		A anishelling rest (b. (generally, 10–20 mm.)	
20	6.	White spot in tamper-	A crystalline spot that	1. Increase the injection rate.	
		proof band	appears in the tamper-	2. Decrease the injection	
			proof band	transition position. 3. Increase the first hold-	
				pressure zone.	
				4. Increase the machine	
	White			temperature.	
	spot			5. Increase the hot runner	
	in the			temperatures.	
	neck			6. Increase the hot-runner	
	finish			nozzle temperatures.	
				7. Increase the back pressure	
				and/or the screw speed to	
				increase the extruder shear	
				heating.	
				8. Clean the mould vents.	
				9. Make sure that the sizes of	
				the mould vents agree with the	
		M/bita anat in the	A onyotalling and that	drawing dimensions.	
		White spot in the support ring	A crystalline spot that appears in the support	1. Decrease the injection fill rate.	
1		support mig	ring	2. Clean the mould vents.	
				3. Make sure that the sizes of	
				the mould vents agree with the	
			\sim	drawing dimensions.	
				4. Decrease the melt	
				temperature to keep the vent	
				clogging to a minimum.	
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		ANDARY			

Bibliography

[1] ISO 472:2013 Plastics - Vocabulary

[2] MS 250:2021 Plastics - Post-consumer polyethylene terephthalate (PET) bottle -Specifications for food grade PET recyclates and preforms

rei in in the communication of the second se [3] ISO 13106, Plastics — Blow-moulded polypropylene containers for packaging of liquid foodstuffs