



2025-2026 Global PFAS-Free Tableware Performance White Paper

120°C Hot Oil Barrier Benchmarking Across 100 Formulations

Performance Benchmark • Technical Analysis • Buyer Selection Framework

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Scope PFAS-Free Molded Fiber / Sugarcane Bagasse Tableware

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Document Control & Evidence Classification

Field	Value
Document Title	2025-2026 Global PFAS-Free Tableware Performance White Paper
Document Number	BL-WP-PFAS-2026-001
Version	v2.0 (2025-2026 Edition)
Method Reference	Bioleader® 120°C Hot Oil Penetration Test Method, BL-BG-HTO-001 v1.0
Primary Dataset	100 formulations / SKUs; minimum n=3 replicates per formulation
Primary Metric	Shadowing Onset (SO) and Strike-Through (ST) time at 120°C
Issuer	Bioleader®
Intended Users	Procurement, QA/QC, compliance, sustainability, distributors, foodservice brands

Evidence levels used in this publication

Evidence Level	Meaning	Typical Use
Controlled manufacturer benchmark	Bioleader-controlled test using defined conditions and replicate rules	Hot-oil performance comparison, failure-mode analysis
Third-party report / certificate	Evidence issued by an external lab or certification body for its stated scope	Food-contact, PFAS screening, compostability, certification
Manufacturer technical specification	TDS or controlled production specification	Dimensions, weights, storage, typical use conditions
Regulatory / standards source	Government, regulator or formal standard reference	Market-access context and procurement requirements

Important evidence boundary

The 120°C hot-oil dataset is a Bioleader-controlled performance benchmark. It is not an ASTM/ISO test standard, not a third-party certification, and not a substitute for SKU-specific regulatory documentation. The dedicated method document BL-BG-HTO-001 defines the controlled test procedure.

Revision History

Version	Date	Change
1.0	2025	Initial benchmark framework and dataset publication
2.0	2026	Regulatory update, 100-formulation benchmark, buyer scorecard and verification framework
PDF Ed. 1.0	Oct 2026	Formal publication layout; method reference BL-BG-HTO-001 added; evidence boundaries clarified

How to use this white paper

- Leadership: Executive Summary, Top 20 and Buyer Actions
- Procurement: Full Dataset, Use-Case Matrix and Supplier Scorecard
- QA / Engineers: Test Method, Failure Modes and Data Integrity
- Compliance Teams: Regulatory Context and Verification Pack

0. Executive Summary

PFAS-free is increasingly a market-access baseline, but the procurement problem is no longer limited to chemical compliance. The practical question is whether a PFAS-free molded-fiber system can maintain grease resistance and structural stability under hot, oily and moisture-rich foodservice conditions.

This publication benchmarks 100 sugarcane-bagasse formulations using 120°C hot-oil exposure. It separates early internal wetting (Shadowing Onset, SO) from functional breakthrough (Strike-Through, ST), and links performance to barrier system, product geometry, basis weight and failure mode.

Key findings

- 120°C hot-oil ST time is used as the primary high-heat grease-resistance benchmark; SO is recorded separately as an early-warning indicator.
- The dataset covers 100 formulations across clamshells, bowls, plates, trays, lids and cups, with minimum n=3 replicates per formulation.
- PFAS-Free System 3.0 models show the strongest overall high-heat performance in this dataset; System 1.0 is intended for lower-risk/basic resistance applications.
- Higher weight can support performance, but weight alone is not a reliable predictor. Barrier stability, fiber densification, geometry and edge integrity remain decisive.
- Buyer qualification should combine performance evidence, PFAS verification, food-contact documents, compostability scope and batch-consistency controls.

Dataset snapshot

Barrier System	Models	Average ST (min)	Observed ST Range
PFAS-Free 1.0	39	24.9	13.4-41.1
PFAS-Free 2.0	15	36.2	28.9-47.3
PFAS-Free 3.0	46	50.2	36.7-64.1

Procurement principle

Do not specify “PFAS-free” as a yes/no label only. Define the intended food, contact temperature, holding time, delivery condition and acceptable performance threshold, then verify the selected SKU against that use case.

1. Regulatory & Market Context

Regulatory and retailer expectations continue to move away from intentionally added PFAS in food packaging. For buyers, the practical consequence is a need to separate chemical-compliance evidence from physical-performance evidence: a product may satisfy a PFAS requirement yet still fail in hot-oil service.

Market	Current reference point	Buyer implication
United States	FDA announced in 2024 that PFAS-containing grease-proofing agents were no longer being sold for paper food-contact use; in January 2025 FDA determined 35 related FCNs were no longer effective. State restrictions also apply.	Use no-intentionally-added-PFAS procurement controls and maintain supporting documentation by SKU/material system.
European Union	Regulation (EU) 2025/40 (PPWR) applies from 12 Aug 2026. Article 5(5) sets PFAS concentration limits for food-contact packaging.	EU-facing buyers should validate current product-level evidence and distinguish targeted PFAS analysis from broader screening methods.
Multi-market programs	Retailer and brand requirements can exceed the minimum legal baseline.	Standardize documentation, scope statements and batch traceability across markets.

EU PPWR Article 5(5)

From 12 August 2026, food-contact packaging is subject to PFAS concentration limits under Regulation (EU) 2025/40. The regulation distinguishes targeted PFAS thresholds from the broader 50 ppm limit; analytical methods and enforcement guidance should be interpreted using the current EU text and Commission guidance.

2. Technical Framework: Why PFAS-Free Performance Varies

2.1 Fiber network and moisture/heat stress

Molded sugarcane bagasse depends on a cellulose fiber network consolidated during forming. Heat, moisture and steam can weaken stiffness and open liquid-transport pathways. The practical challenge is therefore not only oil repellency; it is maintaining the integrity of the fiber structure and barrier interface under combined thermal and moisture stress.

2.2 Surface wetting and barrier stability

At elevated temperature, oil viscosity falls and wetting becomes more aggressive. High-performing systems delay wetting, reduce capillary pathways and maintain a stable barrier network after thermal forming. Tacky or softened surfaces after heating can indicate an unstable barrier interface.

2.3 Why thickness is not enough

- Fiber density and porosity control
- Barrier system thermal stability
- Surface-energy control and wetting delay
- Edge/rim geometry and closure stress
- Production repeatability across batches

3. Test Method & Data Integrity

Method reference

The formal controlled procedure is documented separately as Bioleader® 120°C Hot Oil Penetration Test Method, BL-BG-HTO-001 v1.0. This white paper summarizes the decision-relevant conditions and reports the benchmark results.

Parameter	Controlled Condition
Sample conditioning	23°C ±2°C; 50% ±10% RH; minimum 24 h
Oil	Refined vegetable oil / soybean-oil reference
Target temperature	120°C; monitored to ±1°C
Temperature stabilization	At least 10 minutes before application
Contact zone	25-30 mm diameter
Oil volume	2-5 mL; enough to fully cover the defined zone
Primary observations	Shadowing Onset (SO) and Strike-Through (ST)
Replicates	Minimum n=3 per formulation
Retest trigger	Replicate deviation >20%
Maximum observation	Typically 45-60 min, unless ST occurs earlier

Failure definitions

Term	Operational meaning	Procurement relevance
Shadowing Onset (SO)	Visible internal/underside darkening indicating early wetting	Warning threshold; staining margin is decreasing
Strike-Through (ST)	Confirmed oil breakthrough to the underside	Functional failure for high-risk takeaway use
Edge Softening	Loss of stiffness at rim/corner/closure zones	Can cause handling or lid-seal failure
Thermal Deformation	Warping, sagging or base collapse	Structural failure even if oil barrier remains acceptable

4. 100-Model 120°C Hot-Oil Benchmark Dataset

Table 2 reports the current 100-model dataset used by this white paper. “System” refers to Bioleader benchmark performance categories: 1.0 = basic water/oil resistance; 2.0 = enhanced bio-based grease barrier; 3.0 = heat-stable cross-linked bio-based barrier. These are internal performance categories, not regulatory or third-party certification grades.

Code	Product	g	Format	System	SO	ST	Result	Use Tag
B001	7 x 5 Clamshell Box (600-650ml)	20	Clamshell/Box	3.0	29.8	45.8	Pass	Fried Foods / Delivery
B004	6 x 4 Clamshell Box (450-500ml)	18	Clamshell/Box	3.0	27.5	42.0	Pass	Fried Foods / Delivery
B003	6 x 6 Burger Box	21	Clamshell/Box	3.0	31.4	49.6	Pass	Fried Foods / Delivery
B024A	5.5 x 5.5 Burger Box	19	Clamshell/Box	3.0	28.1	41.4	Pass	Fried Foods / Delivery
B002	9 x 6 2-C Clamshell Box (850-1000ml)	30	Clamshell/Box	3.0	38.5	53.4	Pass	Fried Foods / Delivery
B030	9 x 6 Clamshell Box (850-1000ml)	30	Clamshell/Box	3.0	37.0	47.1	Pass	Fried Foods / Delivery
B034	9 x 6 Clamshell Box (850-1000ml)	30	Clamshell/Box	3.0	38.4	53.2	Pass	Fried Foods / Delivery
B026	8 x 8 Clamshell Box (900-1000ml)	38	Clamshell/Box	3.0	45.4	61.6	Pass	Fried Foods / Delivery
B031	8 x 8 3-C Clamshell Box (900-1000ml)	38	Clamshell/Box	3.0	45.9	64.1	Pass	Fried Foods / Delivery
B025	9 x 9 Clamshell Box (1100-1200ml)	45	Clamshell/Box	3.0	43.7	54.2	Pass	Fried Foods / Delivery
B032	9 x 9 3-C Clamshell Box (1100-1200ml)	45	Clamshell/Box	3.0	43.6	53.8	Pass	Fried Foods / Delivery
B036	8 x 8 Clamshell Box (900-1000ml)	38	Clamshell/Box	3.0	45.6	62.4	Pass	Fried Foods / Delivery
B036 3-C	8 x 8 3-C Clamshell Box (900-1000ml)	38	Clamshell/Box	3.0	45.3	61.4	Pass	Fried Foods / Delivery
B037	9 x 9 Clamshell Box (1100-1200ml)	42	Clamshell/Box	3.0	44.6	58.3	Pass	Fried Foods / Delivery
B037 3-C	9 x 9 3-C Clamshell Box (1100-1200ml)	42	Clamshell/Box	3.0	43.6	53.9	Pass	Fried Foods / Delivery
B2320 2-C	8 x 8 2-C Clamshell	33	Clamshell/Box	3.0	40.2	52.0	Pass	Fried Foods / Delivery
B046	800-850ml Box	22	Clamshell/Box	3.0	30.6	43.4	Pass	Fried Foods / Delivery

Code	Product	g	Format	System	SO	ST	Result	Use Tag
B047	800-850ml Box (2-compartment)	22	Clamshell/Box	3.0	29.8	39.9	Pass	Fried Foods / Delivery
B045	Lid for B046/B047	15	Lid	1.0	15.3	31.3	Early	Lid / Sealing
B063	800ml Tray	22	Tray	3.0	31.0	45.0	Pass	Retail Meal Prep / Saucy Foods
B064	1000ml Tray	26	Tray	3.0	33.7	44.9	Pass	Retail Meal Prep / Saucy Foods
B062	800/1000ml Tray Lid	12	Lid	1.0	12.1	26.5	Early	Lid / Sealing
B022	5-Compartment Tray Lid	26	Lid	1.0	25.2	41.1	Early	Lid / Sealing
B023	5-Compartment Tray	32	Tray	3.0	41.4	60.2	Pass	Retail Meal Prep / Saucy Foods
CIB-02	Taco Box - 2-C	27	Clamshell/Box	3.0	36.0	51.5	Pass	Fried Foods / Delivery
B101	Taco Box - 3-C	42	Clamshell/Box	3.0	45.2	60.9	Pass	Fried Foods / Delivery
B049	13.9 Pizza Box	100	Clamshell/Box	3.0	44.8	59.1	Pass	Fried Foods / Delivery
L001B	18oz (500ml) Bowl	13	Bowl	1.0	11.8	22.3	Early	Hot Soup / Noodles
L003	12oz (340ml) Bowl	9	Bowl	1.0	10.2	27.0	Early	Hot Soup / Noodles
L006	24oz (680ml) Bowl	13	Bowl	1.0	14.3	32.8	Early	Hot Soup / Noodles
L010	16oz (460ml) Bowl	10	Bowl	1.0	10.2	24.1	Early	Hot Soup / Noodles
L014A	32oz (950ml) Lid	12	Lid	1.0	13.3	31.8	Early	Lid / Sealing
L014B	32oz (950ml) Bowl	24	Bowl	3.0	32.6	46.0	Pass	Hot Soup / Noodles
L026B	12oz (350ml) Bowl	9	Bowl	1.0	9.7	24.9	Early	Hot Soup / Noodles
L038	29oz (850ml) Bowl	16	Bowl	2.0	20.0	31.9	Minor	Hot Soup / Noodles
L044	14oz (400ml) Bowl	11	Bowl	1.0	10.9	24.1	Early	Hot Soup / Noodles
L058	11oz (300ml) Bowl	8	Bowl	1.0	8.2	21.4	Early	Hot Soup / Noodles
L061	12oz (350ml) Bowl	10	Bowl	1.0	11.4	29.5	Early	Hot Soup / Noodles
L064	24oz (710ml) Bowl	18	Bowl	3.0	26.3	36.7	Pass	Hot Soup / Noodles
L063	32oz (950ml) Bowl	23	Bowl	3.0	32.9	50.1	Pass	Hot Soup / Noodles

Code	Product	g	Format	System	SO	ST	Result	Use Tag
L011	24oz Square Bowl	22	Bowl	3.0	32.2	50.3	Pass	Hot Soup / Noodles
L012	32oz Square Bowl	28	Bowl	3.0	37.5	55.2	Pass	Hot Soup / Noodles
L013	40oz Square Bowl	30	Bowl	3.0	39.6	58.3	Pass	Hot Soup / Noodles
L067	1100ml Rectangle Bowl	22	Bowl	3.0	31.1	45.3	Pass	Hot Soup / Noodles
L068	1800ml Rectangle Bowl	33	Bowl	3.0	40.3	52.2	Pass	Hot Soup / Noodles
L083	700ml Bowl	19	Bowl	3.0	27.5	39.0	Pass	Hot Soup / Noodles
L084	900ml Bowl	22	Bowl	3.0	32.5	51.3	Pass	Hot Soup / Noodles
L085	1200ml Bowl	24	Bowl	3.0	33.7	50.6	Pass	Hot Soup / Noodles
L086	Bagasse Lid for L083/L084/L085	18	Lid	1.0	17.2	30.5	Early	Lid / Sealing
L087	24oz Bowl (720-750ml)	22	Bowl	3.0	32.3	50.4	Pass	Hot Soup / Noodles
L088	32oz Bowl (950-1000ml)	25	Bowl	3.0	34.5	51.2	Pass	Hot Soup / Noodles
L750	24oz Round Bowl (750ml)	18	Bowl	3.0	28.0	44.0	Pass	Hot Soup / Noodles
L1000	32oz Round Bowl (1000ml)	23	Bowl	3.0	33.1	50.9	Pass	Hot Soup / Noodles
L1250	42oz Round Bowl (1250ml)	30	Bowl	3.0	39.4	57.4	Pass	Hot Soup / Noodles
L015	9oz (250ml) Bowl	6	Bowl	1.0	5.9	17.5	Early	Hot Soup / Noodles
L027	16oz (425ml) Bowl	12	Bowl	1.0	13.3	31.8	Early	Hot Soup / Noodles
L028	16oz (425ml) Lid	6	Lid	1.0	7.1	22.7	Early	Lid / Sealing
L051	8oz (260ml) Cup	9	Cup	1.0	9.8	25.7	Early	General Foodservice
L056	12oz (360ml) Cup	12	Cup	1.0	11.6	24.1	Early	General Foodservice
L060	2oz (60ml) Sauce Cup	3	Cup	1.0	3.0	13.4	Early	General Foodservice
L048	5oz (140ml) Cup	5	Cup	1.0	4.9	16.2	Early	General Foodservice
L205	70/100/130ml Square Tray Lid	5	Lid	1.0	5.4	18.2	Early	Lid / Sealing
L206	Square Sauce Cup (2oz, 70ml)	5	Cup	1.0	6.6	23.7	Early	General Foodservice

Code	Product	g	Format	System	SO	ST	Result	Use Tag
L207	Square Sauce Cup (3oz, 100ml)	5	Cup	1.0	6.8	24.3	Early	General Foodservice
L208	Square Sauce Cup (4oz, 130ml)	6	Cup	1.0	5.6	16.1	Early	General Foodservice
L070	80mm Pulp Lid	5	Lid	1.0	4.6	14.8	Early	Lid / Sealing
L071	90mm Pulp Lid	5	Lid	1.0	6.9	24.9	Early	Lid / Sealing
L075	90mm Pulp Dome Lid	5	Lid	1.0	5.9	20.4	Early	Lid / Sealing
P004	6 Plate	6	Plate	1.0	7.5	24.7	Early	BBQ / Catering
P010	6.75 Plate	8	Plate	1.0	9.9	28.8	Early	BBQ / Catering
P011	7 Plate	10	Plate	1.0	10.9	27.3	Early	BBQ / Catering
P006	8.75 Plate	14	Plate	2.0	18.1	29.6	Minor	BBQ / Catering
P013	9 Plate	15	Plate	2.0	19.7	33.6	Minor	BBQ / Catering
P005	10 Plate	20	Plate	2.0	24.6	39.9	Minor	BBQ / Catering
P012	9 3-Compartment Plate	15	Plate	2.0	19.7	33.5	Minor	BBQ / Catering
P007	10 3-Compartment Plate	20	Plate	2.0	24.5	39.6	Minor	BBQ / Catering
P036	6 Square Plate	10	Plate	1.0	11.2	28.4	Early	BBQ / Catering
P035	8 Square Plate	16	Plate	2.0	19.7	30.7	Minor	BBQ / Catering
P031	10 Square Plate	28	Plate	2.0	31.8	47.3	Minor	BBQ / Catering
P038	8.75 2-Compartment Plate	14	Plate	2.0	20.1	38.4	Minor	BBQ / Catering
P020	10 x 8 Oval Plate	17	Plate	2.0	21.5	35.7	Minor	BBQ / Catering
P030	12.5 x 10 Oval Plate	30	Plate	2.0	32.5	44.2	Minor	BBQ / Catering
T001	7 x 5 x 1.5 Tray	10	Tray	1.0	11.2	28.7	Early	Retail Meal Prep / Saucy Foods
T005	8 x 6 x 0.6 Tray	12	Tray	1.0	12.6	28.5	Early	Retail Meal Prep / Saucy Foods
T009	5-Compartment Tray	25	Tray	3.0	33.4	46.4	Pass	Retail Meal Prep / Saucy Foods
T011	7 x 4 Tray Lid	7	Lid	1.0	6.5	17.3	Early	Lid / Sealing

Code	Product	g	Format	System	SO	ST	Result	Use Tag
T012	7 x 4 Tray	12	Tray	1.0	12.8	29.4	Early	Retail Meal Prep / Saucy Foods
T023	8 x 6 x 1 Tray	14	Tray	2.0	17.9	28.9	Minor	Retail Meal Prep / Saucy Foods
T034	7 x 5 Tray	13	Tray	1.0	12.7	25.9	Early	Retail Meal Prep / Saucy Foods
T039	9 x 6 Tray	19	Tray	3.0	28.4	42.6	Pass	Retail Meal Prep / Saucy Foods
T040	10 x 7 Tray	24	Tray	3.0	32.5	45.3	Pass	Retail Meal Prep / Saucy Foods
T500	Rectangular Tray 500ml	15	Tray	2.0	20.3	36.1	Minor	Retail Meal Prep / Saucy Foods
T650	Rectangular Tray 650ml	17	Tray	2.0	21.6	36.1	Minor	Retail Meal Prep / Saucy Foods
T750	Rectangular Tray 750ml	18	Tray	3.0	27.0	39.9	Pass	Retail Meal Prep / Saucy Foods
T1000	Rectangular Tray 1000ml	20	Tray	3.0	28.6	40.4	Pass	Retail Meal Prep / Saucy Foods
BT-Lid	Pulp Lid for 550/650/750/1000ml Tray	12	Lid	1.0	11.4	23.3	Early	Lid / Sealing
T053	12oz Tray	10	Tray	1.0	9.2	19.7	Early	Retail Meal Prep / Saucy Foods
T054	16oz Tray	13	Tray	1.0	13.5	29.5	Early	Retail Meal Prep / Saucy Foods
T055	24oz Tray	17	Tray	2.0	22.0	37.8	Minor	Retail Meal Prep / Saucy Foods
T056	32oz Tray	20	Tray	3.0	29.9	46.2	Pass	Retail Meal Prep / Saucy Foods

5. Top 20 Heat-Stable Models

Rank	Code	Product	g	Format	SO	ST	Use
1	B031	8 x 8 3-C Clamshell Box (900-1000ml)	38	Clamshell/Box	45.9	64.1	Fried Foods / Delivery
2	B036	8 x 8 Clamshell Box (900-1000ml)	38	Clamshell/Box	45.6	62.4	Fried Foods / Delivery
3	B026	8 x 8 Clamshell Box (900-1000ml)	38	Clamshell/Box	45.4	61.6	Fried Foods / Delivery
4	B036 3-C	8 x 8 3-C Clamshell Box (900-1000ml)	38	Clamshell/Box	45.3	61.4	Fried Foods / Delivery
5	B101	Taco Box - 3-C	42	Clamshell/Box	45.2	60.9	Fried Foods / Delivery
6	B023	5-Compartment Tray	32	Tray	41.4	60.2	Retail Meal Prep / Saucy Foods
7	B049	13.9 Pizza Box	100	Clamshell/Box	44.8	59.1	Fried Foods / Delivery
8	B037	9 x 9 Clamshell Box (1100-1200ml)	42	Clamshell/Box	44.6	58.3	Fried Foods / Delivery
9	L013	40oz Square Bowl	30	Bowl	39.6	58.3	Hot Soup / Noodles
10	L1250	42oz Round Bowl (1250ml)	30	Bowl	39.4	57.4	Hot Soup / Noodles
11	L012	32oz Square Bowl	28	Bowl	37.5	55.2	Hot Soup / Noodles
12	B025	9 x 9 Clamshell Box (1100-1200ml)	45	Clamshell/Box	43.7	54.2	Fried Foods / Delivery
13	B037 3-C	9 x 9 3-C Clamshell Box (1100-1200ml)	42	Clamshell/Box	43.6	53.9	Fried Foods / Delivery
14	B032	9 x 9 3-C Clamshell Box (1100-1200ml)	45	Clamshell/Box	43.6	53.8	Fried Foods / Delivery
15	B002	9 x 6 2-C Clamshell Box (850-1000ml)	30	Clamshell/Box	38.5	53.4	Fried Foods / Delivery
16	B034	9 x 6 Clamshell Box (850-1000ml)	30	Clamshell/Box	38.4	53.2	Fried Foods / Delivery
17	L068	1800ml Rectangle Bowl	33	Bowl	40.3	52.2	Hot Soup / Noodles
18	B2320 2-C	8 x 8 2-C Clamshell	33	Clamshell/Box	40.2	52.0	Fried Foods / Delivery
19	CIB-02	Taco Box - 2-C	27	Clamshell/Box	36.0	51.5	Fried Foods / Delivery
20	L084	900ml Bowl	22	Bowl	32.5	51.3	Hot Soup / Noodles

How to use this leaderboard

Use the ranking as a performance-screening tool, not a universal product recommendation. Final selection should account for format, lid system, target food, holding time, geometry, cost and the compliance evidence attached to the exact SKU.

6. Weight × Barrier System × Performance Insights

The 100-model dataset supports three practical selection rules. First, barrier-system stability is a stronger predictor of high-heat performance than weight alone. Second, additional weight helps only when the fiber structure is sufficiently dense and the barrier interface remains stable. Third, comparisons are most meaningful within the same product format.

Format	Models	Average ST	Range
Bowl	27	39.9	17.5-58.3
Clamshell/Box	21	52.8	39.9-64.1
Cup	7	20.5	13.4-25.7
Lid	12	25.2	14.8-41.1
Plate	14	34.4	24.7-47.3
Tray	19	37.4	19.7-60.2

Selection laws for procurement

- Treat basis weight as a supporting variable, not the primary purchasing specification.
- Compare bowls to bowls, clamshells to clamshells, plates to plates, etc.; geometry changes stress paths.
- For high-risk fried-food programs, prioritize long ST time plus stable edges/closures.
- For soup and mixed oil-water foods, combine barrier data with wall stiffness, lid seal and moisture-holding validation.
- Use lower-risk applications to avoid over-specification and protect portfolio margin.

7. Use-Case Selection Matrix

Use Case	Typical Foods	Dominant Risk	Recommended Performance Direction
Fried foods	Fried chicken, fries, tempura	Hot-oil penetration + steam + holding	Highest ST margin; stable rim/base; System 3.0 preferred for demanding programs
BBQ / grilled	Grilled meat, kebab, steak	Heat holding + load + oil residue	Medium-high barrier; deformation resistance and edge stiffness
Hot soup / noodles	Broth, ramen, mixed oil-water meals	Moisture attack + steam + lid stress	Wall stiffness, lid integrity, anti-softening plus adequate ST
Saucy / acidic meals	Curry, gravy, tomato/vinegar sauces	Long contact + moisture/fat + possible acidity	Stable surface, low staining, longer holding validation
Cold / dry foods	Salad, bakery, snacks	Low oil/heat stress	Lower barrier level may be sufficient; avoid unnecessary over-specification

8. Buyer Qualification Scorecard

A strong qualification process evaluates both performance and evidence. Passing one side only creates procurement risk.

Category	Priority	What to verify
120°C ST performance	High	SO/ST data, n≥3, method reference, failure mode
Structural heat stability	High	No unacceptable softening, sagging or

Category	Priority	What to verify
		handling collapse
Seal & stacking performance	Medium	Closure stability, warpage, stacking and logistics strength
PFAS verification	High	No-intentionally-added-PFAS declaration + applicable analytical evidence
Food-contact documents	High	Market-relevant composition, food-contact and migration evidence
Compostability scope	Medium	Industrial vs home pathway and exact certification scope
Batch consistency	High	Lot mapping, production controls, retest and traceability logic
Supply/logistics readiness	Medium	Lead time, packing, container loading, export documentation

9. Compliance & Verification Pack

9.1 PFAS evidence

- No-intentionally-added-PFAS supplier declaration
- Analytical screening / targeted PFAS evidence where applicable
- Clear detection limits and ND definitions
- Tested SKU/material-system identification
- Batch/lot traceability where required by buyer policy

9.2 Food-contact evidence

- Material composition declaration
- Target-market food-contact compliance report or declaration
- Migration evidence where required
- Printing/ink declarations for customized printed applications
- Manufacturing and hygiene controls where required by customer

9.3 Compostability evidence

Industrial and home compostability are different pathways. Certificates and test reports should be interpreted according to the exact product/material scope stated by the issuing body. Common procurement references include EN 13432 and ASTM D6400/D6868 frameworks, with certification programs such as BPI, TÜV Austria or DIN CERTCO depending on product and market.

Scope rule

Never generalize one test report or certificate to every Bioleader product. Claims should be limited to the tested/certified products, formulations, materials and production scope stated in the underlying document.

10. Professional FAQ

Why can PFAS-free tableware feel sticky after heating?

Tackiness can indicate an unstable barrier interface that softens under heat. It is a warning sign for hot-oil performance and consumer perception, so it should be evaluated alongside SO/ST results.

Why can a product look fine at room temperature but fail with fried food?

Hot oil has lower viscosity and wets porous fiber more aggressively. Room-temperature appearance therefore does not predict 120°C performance.

Does higher basis weight always mean better grease resistance?

No. Weight can help, but porosity, densification, surface wetting, barrier stability and geometry can dominate the result.

What is the difference between SO and ST?

SO is early internal wetting/darkening; ST is confirmed breakthrough. SO is a warning threshold, while ST is treated as functional barrier failure for high-risk use.

Is 120°C too extreme?

It is intentionally a stress benchmark for hot-oil and fried-food scenarios. It should not be confused with the normal continuous-use temperature of every foodservice application.

How should buyers prevent quality drift after samples pass?

Use replicate-based evidence, batch controls, stable process parameters, lot traceability and periodic validation of critical SKUs.

Appendix A. Glossary & Data Integrity

Term	Definition
Hydrogen bonding	Intermolecular bonding between cellulose fibers that contributes to molded-fiber stiffness and can weaken under heat/moisture.
Surface energy	A surface property that affects how readily oil wets and spreads; lower effective wetting generally delays penetration.
Cross-linking	Formation of a more stable network within a barrier system during processing, intended to improve heat stability.
Shadowing Onset (SO)	Early internal wetting visible as darkening; a warning indicator rather than confirmed leakage.
Strike-Through (ST)	Confirmed oil breakthrough to the underside; functional failure in the benchmark.
Heat softening	Loss of stiffness under combined thermal and moisture stress.

Data integrity rules

- Minimum n=3 replicates per formulation.
- Record SO and ST separately for every replicate.
- Report the mean; note meaningful variance.
- Retest where a replicate deviates by more than 20%.
- Compare primarily within the same product format.
- Confirm critical SKUs against the intended food, temperature, holding time and delivery condition before bulk adoption.

Limitations

- This dataset is generated under controlled benchmark conditions and does not guarantee identical field performance.
- Food acidity, oil composition, food load, contact time, storage humidity, stacking pressure and closure geometry can change outcomes.
- PFAS-Free Systems 1.0/2.0/3.0 are Bioleader benchmark categories, not universal industry grades.
- This white paper does not replace applicable laws, third-party certifications, food-contact reports or buyer-specific validation.

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