MPFREE — WHITE PAPER

The MPFREE Standard: Scientific Basis, Governance, and Certification Methodology

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ABSTRACT

This paper documents the analytical, governance, and legal basis for the MPFREE certification standard: what each required test method measures and why no single method is sufficient on its own, how numeric thresholds are set and revised by an independent body rather than by MPFREE itself, and how the resulting claims are scoped to survive scrutiny under current U.S. and EU advertising law. It is written for the audience that needs the underlying reasoning, not just the headline claim: technical reviewers at applicant organizations, journalists, policy staff, and other certification bodies.

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1. Introduction and Scope

The term "microplastics" is roughly two decades old, first used in its current sense in a 2004 paper documenting widespread microscopic plastic fragmentation in ocean sediment [1]. In that time, detection methods have matured considerably, but public and commercial claims about microplastic content have not kept pace — the phrase "microplastic-free" appears on packaging far more often than any accredited test substantiating it.

This paper documents what MPFREE certification actually requires: which analytical methods are used, what each one does and does not measure, how numeric pass/fail thresholds are set, and how the resulting public claims are worded to survive scrutiny under current advertising law in the United States and European Union. It is deliberately more technical than the site's consumer-facing pages — those pages exist to communicate a result; this paper exists to show the reasoning behind it.

2. What "Microplastic" Means Here

The current cross-matrix analytical framework defines a microplastic as a solid, water-insoluble plastic particle with at least one dimension between 1 micrometer (µm) and 1,000 µm [2]. Below 1 µm, particles are generally classified as nanoplastics — a distinction that determines which analytical method can resolve them at all, and is the central reason this Standard requires more than one method (Section 3).

This definition is a practical range bounded by instrumentation, not a claim about biological relevance. A single mass-based unit — a bare "parts per billion" figure — cannot meaningfully describe both a 900 µm fragment and a 2 µm fiber in the same measurement, which is why MPFREE does not publish a single collapsed number for "microplastic content" the way some marketing claims imply exists.

3. Analytical Methods and Their Structural Limits

Three methods are used across the Standard's two pillars, and each measures something distinct enough that none is a substitute for the others.

µFTIR (micro-Fourier-transform infrared spectroscopy) identifies polymer type by matching infrared absorption spectra against a reference library, and reports particle count. Its conventional practical size floor is approximately 20 µm [6]; specialized variants such as large-area ATR-FTIR have demonstrated detection down to roughly 1.3 µm in research settings [7], though this is not yet the routine floor at accredited-lab scale.

Raman microspectroscopy uses inelastic light scattering rather than absorption, and likewise reports particle count and polymer identity. Its finer laser spot size extends practical resolution to approximately 1 µm [8]. Historically, comprehensive reference spectral libraries were a cost barrier; open-access libraries have begun to close that gap [9].

Py-GC-MS (pyrolysis-gas chromatography–mass spectrometry) is structurally different from the two optical methods: it thermally decomposes the entire sample and identifies polymers from their pyrolysis products, reporting total mass rather than particle count. Reported detection sensitivity reaches nanogram levels across a dozen common polymers [10]. Because the sample is destroyed, Py-GC-MS produces no particle-size, shape, or count data [11] — but critically, it has no size floor at all, because it is not sizing particles. This is what makes it the only method in this Standard capable of capturing the sub-1-µm nanoplastic fraction neither optical method can resolve.

The practical consequence: a product tested only by µFTIR and Raman has been evaluated for particles above roughly 1 µm — not for nanoplastics, and a certification that implied otherwise would misstate its own test coverage. MPFREE's top certification tier requires all three methods specifically to close this gap, and every public result names which method or methods actually produced it.

4. Threshold Governance

A numeric detection-limit claim is only as credible as the process that set the number. MPFREE does not set its own pass/fail thresholds internally. That work is delegated to an independent Scientific Advisory Board: a majority-non-employee body with published conflict-of-interest disclosures, structured so that no member sets a threshold for a certification they also audit.

Thresholds are derived from published, peer-reviewed literature as it exists at the time of review, and every published threshold carries a dated rationale document. This mirrors established precedent rather than inventing a new governance model: the Non-GMO Project, one of this Standard's benchmark schemes, publishes a specific numeric action threshold (0.9% for products intended for human consumption) with public reasoning, rather than an unqualified absolute claim [17].

Thresholds are reviewed at minimum every 24 months, or immediately upon material new published evidence, whichever occurs first. A threshold revision is versioned; existing certifications are not silently reclassified but are instead given a defined re-test window against the new threshold.

5. Why No Absolute Claim Is Made

No analytical method — including the three used in this Standard — can demonstrate the complete absence of a substance. Every method has a detection limit below which a particle or mass concentration cannot be reliably distinguished from noise. "Non-detect" means "not observed above this validated limit," not "absent."

This is not a hedge unique to MPFREE; it is the basis of the applicable U.S. advertising standard. Under the FTC's Green Guides (16 CFR § 260.9), a "free-of" claim is substantiated only where any trace amount present does not exceed general background levels and does not cause the harm a reasonable consumer associates with the substance [12]. An unscoped "microplastic-free" claim, without a named method, matrix, and standard version, does not meet that bar — which is precisely why MPFREE requires every public claim to follow a fixed pattern: "Verified below the MPFREE Standard v[N] detection limit for [matrix], tested by [method(s)]." The certification mark identifies conformance to a published, tested Standard — not an absolute-purity assertion.

6. Regulatory Context

In the United States, the FTC Green Guides (Section 5) govern environmental marketing claims generally, with 16 CFR 260.9 specifically addressing "free-of" language [12].

In the European Union, the proposed Green Claims Directive — which would have imposed formal substantiation and independent-verification requirements on environmental claims — cleared Parliament (March 2024) and Council (June 2024), but by mid-2025 the European Commission indicated it was considering withdrawing the proposal after a scope dispute, and it remains unresolved as of this writing [13]. This Standard treats that proposal's substantiation mechanics as not yet settled law, while treating the separately-adopted and already-binding Empowering Consumers for the Green Transition Directive (effective September 27, 2026) as the operative floor regardless of the Green Claims Directive's outcome.

At the U.S. state level, California's SB 1422 is the first mandatory statewide microplastics testing law in the world, requiring an official definition, a standard testing method, and accredited laboratory capacity for drinking-water testing, with implementation phased from 2023 through 2025 [21]. MPFREE's own requirement that every partner laboratory hold ISO/IEC 17025 accreditation before joining the network mirrors this same structural choice — tying a testing mandate to independently verified analytical competence, not a self-reported result.

7. Accreditation Structure

Two distinct accreditation standards apply, and they are not interchangeable. ISO/IEC 17025 accredits a laboratory's technical competence for a defined scope of tests [15]; every MPFREE partner lab must hold this accreditation, covering the specific methods described in Section 3, before being admitted to the network. ISO/IEC 17065 accredits a certification body itself — MPFREE — as operating impartially and consistently [16]; this is a longer, separate process, and MPFREE's current status against it is stated plainly wherever the Standard is referenced, rather than implied by proximity to lab-accreditation language.

8. Pillar 2: Downstream Waste and Degradability Claims

Global plastic waste production has grown from roughly 180 million to nearly 400 million tonnes annually over two decades, with packaging the largest single waste category and only about 9% of all plastic waste ultimately recycled [18]. Pillar 2 of the Standard addresses this directly, auditing packaging, farm mulches, and processing effluent for persistent synthetic polymer content.

Inert materials (glass, aluminum) are verified through straightforward compositional audit. A "marine-degradable" or "compostable" claim on an alternative material is evaluated differently and requires independent third-party test data — for marine biodegradation specifically, ASTM D6691 requires at least 60% of the material's carbon content to convert to CO_2 within 180 days at 30°C under a defined marine microbial consortium; no equivalent ISO standard currently exists [14]. A manufacturer's own internal testing, or a claim based on the material's design intent, does not satisfy this requirement.

Agricultural sourcing is included in this pillar's scope for a specific reason: plastic mulch film is the largest single source of agricultural plastic pollution, and field data shows macroplastic debris on a farm positively correlates with microplastic soil contamination on that same land [20] — this is why polyethylene agricultural mulch film is specifically prohibited under the supply-chain scope, rather than farm-level material choices being treated as outside a product certification's boundary.

Water filtration requirements in the supply-chain scope (< 0.1 µm nominal pore size) are set from the physics of reverse-osmosis size exclusion: an RO membrane's effective pore size (~0.1 nm) is roughly three orders of magnitude smaller than even the smallest reported nanoplastic particles, which is the mechanism behind reported removal rates near 99.9% in controlled studies [19].

9. Human Health Context — What the Evidence Currently Supports

MPFREE certification makes no health-outcome claims, and this section explains why that boundary is drawn where it is, rather than leaving it unstated.

The WHO's 2019 review of 50 studies on microplastics in drinking water found no data suggesting overt health concern from the particles themselves at then-current exposure levels, a low concern from associated chemicals, and no evidence of risk from biofilm-forming microorganisms — while explicitly calling for standardized methods and further research as a precondition for a more confident assessment [3].

Since that review, detection studies have advanced considerably: microplastic particles were first documented in human placental tissue in 2021 [4], and a 2024 study found them in all 62 placenta samples tested, at concentrations from 6.5 to 790 µg/g of tissue [5]. These are detection findings, not health-outcome findings — they establish that particles are present and measurable in tissue previously assumed relatively protected, not a specific causal health effect, dose-response relationship, or safety threshold.

This is precisely why the Standard's claims are scoped to tested thresholds rather than safety assertions: toxicology in this area is an active, fast-moving research question, and a certification mark that implied a settled health conclusion ahead of that research would be a liability the moment the science moved — in either direction.

10. Conclusion

A credible microplastic certification standard has to be built on three commitments that are each individually falsifiable and none of which MPFREE controls unilaterally: a stated method and matrix for every claim, a threshold set and revised by a body structurally independent from the certification's commercial interest, and a claims policy that never overstates what a detection limit can actually prove. This paper has documented the basis for each. The full, current numeric thresholds, lab roster, and Scientific Advisory Board disclosures are maintained on the Standards page as the live, authoritative version of everything summarized here.

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