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D8073 Concerns: Supporting Documentation

Full data, citations, and technical details supporting the claims in the three-page “D8073 Concerns: A Test That Doesn’t Measure What it Claims” pamphlet (accessible via QR code). This document provides additional context and expands on each claim presented there.

Bottom Line: This is a Flight-Safety Issue

Filter-separators exist for one reason: to strip free water out of jet fuel before it reaches an aircraft. ASTM’s own standard defines a surfactant as a substance that can “disarm (deactivate) filter separator (coalescing) elements so that free water is not removed from the fuel in actual service” (ASTM D3948, §3.2.3). Water that gets past that point doesn’t just disappear, it freezes, feeds microbial growth, and corrodes tanks and fuel system components downstream, including in the aircraft itself**.**

D8073 is the test standing between that free water and a “pass.” Independent field data, independent bench data, and the manufacturer’s own published validation data all show the same thing: D8073 routinely reports a clean result on fuel that the established, physically-based methods (D3948, D7224) show has lost its ability to release water. It does this because it isn’t actually testing water separation — it’s reading the glow of a dye, a proxy chemical reaction, not a coalescing event.

For more than 60 years, the Micro-Separometer — the instrument behind D3948 and D7224 — has been the field-proven standard for rating the water separation characteristics of jet fuel. A competitor technology provider, which developed the underlying WSI technology, together with an instrument manufacturer, is now promoting D8073 as an alternative.

Two Fundamentally Different Tests

D3948 and D7224 mix fuel and water at high speed and force the resulting emulsion through real fiberglass coalescing media — the same class of material used in an aircraft filter-separator. A light-transmission reading of how much water made it through the media is a direct, physical measurement of how that fuel will behave in service.

D8073 does none of this. Fuel, water, and a fluorescent dye (sodium fluorescein) are mixed with a small ultrasonic wand. Part of the resulting sample is measured directly for fluorescence (the reference reading); the rest is passed through a small disposable cartridge and measured again. The two fluorescence readings are compared and reported on the same 0–100 scale used by D3948 — inviting a direct, apples-to-apples comparison that the underlying test does not support. No coalescing takes place in that cartridge, and no water is physically separated at any point in the procedure.

The "5th-Edition Filter Media" Claim Doesn't Hold Up

A competitor technology provider and an instrument manufacturer market the WSI cartridge as containing "5th Edition API certified materials" that "replicate true surfactant impact on fuel filterability" using "the same materials used in your filter stand." That language is meant to reassure the reader that the cartridge behaves like a real, qualified aircraft fuel filter/separator element. It doesn't.

API/EI Bulletin 1581 (5th Edition, 2002) is the industry specification that qualifies full-scale coalescer and separator elements — the ones installed in fuel depot vessels, into-plane trucks, and hydrant carts — through flow-rate, structural, and surfactant-challenge testing at real operating scale, hundreds of gallons per minute. It qualifies complete vessel-and-element systems, not standalone "materials," and it does not qualify benchtop test cartridges of any kind. A 230 mL bench sample cell has never been, and cannot be, tested to that protocol.

Independent teardown of the WSI cartridge found its contents to be dye-impregnated paper in a plastic housing — not a fiberglass coalescing element, and not a component that has undergone (or could undergo) EI 1581 qualification. "5th Edition" filter media, at best, describes a chemistry the paper's dye response is loosely modeled on. It is not a qualified filtration material, and running fuel through it does not reproduce how a real filter-separator element behaves.

What's Actually Inside the Cartridge

That same teardown found the cartridge to be a paper disc, pre-treated with the same dye used in the test itself. Two consequences follow. First, because the paper already carries dye before any fuel touches it, the "post-cartridge" reading is mixed with whatever background signal the pre-loaded dye contributes — a source of signal that has nothing to do with the fuel being tested. Second, the plastic housing around the paper holds a static charge. Even setting aside whether the paper could act as a coalescer at all, a charged housing would make any such behavior inconsistent from run to run — the same fuel could give different readings purely because of how charge built up in the housing that day.

Two Scoops From an Unmixed Bowl

D8073's result comes from comparing two small samples pulled from the same mixing chamber: one bypasses the cartridge entirely (the "reference"), the other passes through it on the way to the same detector. The instrument assumes both samples represent one uniform fuel/water/dye mixture, differing only because of whatever happened inside the cartridge. That assumption rests entirely on the sonicating wand producing a uniform mixture — and it doesn't.

A wand sonicator concentrates its energy within a few millimeters of the tip; agitation strong enough to disperse water and dye through the sample falls off sharply with distance. In a 230 mL chamber, large regions may see almost no real mixing during the roughly 3-minute sonication step. Picture stirring oil and vinegar with a toothpick for a few seconds, then comparing one spoonful scooped right next to the toothpick with another scooped from the far side of the bowl — that's a comparison of two random samples of an unmixed liquid, not a measurement of what happened to the liquid in between. D3948 and D7224 avoid this entirely: their mixer drives the full sample at high speed (roughly 16 m/s throughout a small syringe) to build one uniform emulsion before any reading is taken.

The instrument's water/dye metering adds a second layer of noise on top of this: per the D8073 standard itself, the dyed-water injection is specified at 0.06 mL ± 0.01 mL — as much as ±17% on a single run, meaning two runs could differ by roughly a third in how much dye was actually delivered. Because the fluorescence signal is directly proportional to how much dye was delivered, that variability adds noise on top of the chemistry and mixing problems described above.

How the Number Itself Gets Calculated

The exact algorithm that converts the reference and post-cartridge fluorescence readings into a single WSI score is not published — the D8073 standard calls it only "algorithm Version 1.0" (§12.1) and treats it as proprietary to the apparatus. What is published is how the scale itself is anchored: a reference fluid is spiked with known concentrations of a strong anionic reference surfactant (AOT), and the resulting WSI readings define the calibration curve (D8073, Table 1):

AOT dispersing agent (mL/L)	Resulting WSI
0.0	100.0
0.2	97.6
0.4	79.8
0.6	75.4
0.8	68.8

Every WSI number the instrument reports is anchored to this one curve, built entirely around one surfactant's chemistry. When a different surfactant barely changes the dye's fluorescence — because it doesn't produce the same acid/base shift AOT does (see chemistry section below) — the algorithm still maps that small difference onto the same AOT-based curve and returns a specific-looking number to the nearest 0.1. There is no way, from the WSI number alone, to distinguish "this fuel is genuinely clean" from "this particular contaminant doesn't register on this dye."

The Chemistry: Why the Dye Can be Blind to a Real Problem

Fluorescein isn't a neutral chemical stopwatch — its brightness swings sharply with the local acidity of its surroundings, and different surfactants push that local environment toward acidic or basic in different ways. AOT, the reference chemical D8073 is calibrated against, is a strong anionic soap that happens to make the environment acidic, which dims the dye and produces the large, easy-to-see signal drop the instrument is built to detect. Many other surfactants — including several jet fuel additives approved for everyday use — don't have that acid-forming effect, so they barely move the dye's brightness at all, even when they seriously hurt a fuel's real ability to separate water.

The Science Behind the Test

Sodium fluorescein is strongly fluorescent only in its higher-pH (dianion) form — the familiar bright-green peak near 512 nm — and this pattern holds across its weaker emission bands too (roughly 380–440 nm): quenched in acid, amplified in base. Anionic surfactants push the local environment acidic (quenching the dye); cationic and nonionic surfactants tend not to, leaving the reading largely unchanged regardless of the actual surfactant strength.

In short: D8073 isn't measuring how strong a surfactant is or how much it will hurt water separation — it's measuring one narrow chemical side effect that only some contaminants happen to produce.

Precision is Not Accuracy

A competitor technology provider and instrument manufacturer often point to D8073's precision as evidence that it is a better test than D7224. It is true that D8073 has tight repeatability and reproducibility: ASTM's own multi-lab study (Research Report RR:D02-1843, 2015 — eight instruments, individual operators, 16 samples in duplicate) backs that up, and the standard publishes explicit formulas for both (D8073 §14.2–14.3): Repeatability = 0.35 × (105.66 − x) WSI, and Reproducibility = 0.41 × (105.66 − x) WSI, where x is the average of the results being compared. At a WSI of 90, that works out to roughly ±5.5 WSI repeatability and ±6.4 WSI reproducibility — genuinely tight numbers.

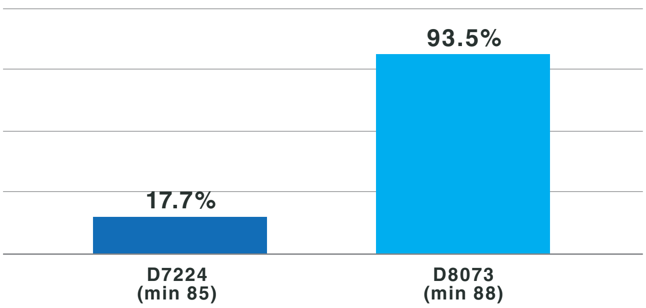
But precision and accuracy are different attributes, and treating one as proof of the other is the core problem with this defense. Precision asks whether a test agrees with itself — run it twice, do you get close to the same number? Accuracy asks whether a test agrees with reality — does that number actually reflect how the fuel will behave in an aircraft filter-separator? D8073's own standard makes the distinction explicit, if unintentionally: Section 14.4, titled "Bias," states that "the procedure in this test method has no bias because the value of WSI is defined only in terms of this test method." In plain terms, WSI is defined as whatever the instrument reports — so by that definition it cannot be "biased" relative to any external, physical measure of water separation, because no such comparison is built into the standard at all.

That is exactly why precision is the wrong metric to reach for here. A test can be extremely precise and still be measuring the wrong thing extremely consistently. The field and bench data below show precisely that: D8073 reliably and repeatably reports high scores on fuel that has demonstrably lost its ability to separate water. Repeatable wrongness is not a point in a test method's favor.

What the Field Data Shows

A government aviation organization ran D8073 and D7224 side by side on the same 62 fuel samples in 2019 (mostly in-service JP-8 / "F24" quality-surveillance samples). Using each method's own pass threshold, D8073 passed 93.5% of the samples — D7224 passed only 17.7% of the identical fuel.

SAME 62 FUEL SAMPLES, TESTED BOTH WAYS
(GOVERNMENT AVIATION ORGANIZATION, 2019)

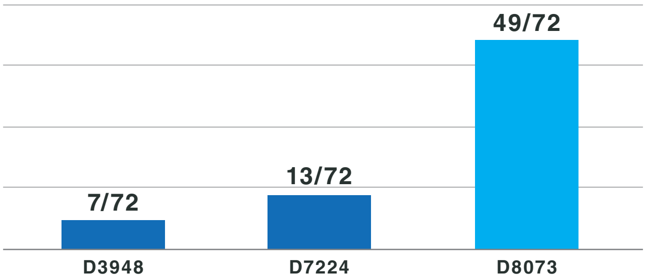


One case makes the gap concrete: a Jet A-1 sample tested by both methods within days of each other scored 0 on D7224 — complete failure to release water — and 75.2 on D8073, on the same fuel.

What the Bench Data Shows

An independent lab ran a controlled study: clean jet fuel (scoring 96–100 on all three methods) was deliberately blended with a range of surfactants and approved/unapproved additives, then re-tested on D3948, D7224, and D8073 (72 blends total). A "false pass" means the method still reported a clean result on fuel that had just been contaminated.

RATE OF PASSING FUEL THAT WAS DELIBERATIVELY CONTAMINATED (INDEPENDENT LAB, 72 BLENDS)



D8073 also registered zero false fails across all 72 tests — it never flagged a fuel as bad when it wasn't. Combined with a 68% false-pass rate, that isn't caution. It's insensitivity to real contamination.

Real-world contamination scenario	D3948	D7224	D8073
Microbial-growth simulant (DMPC), at 50 ppm	0	0–45	97.5–97.9
Approved military additive blend (SDA/CI/FSII), normal treat rate	n/a*	68–100	96.2–97.3
Same blend, at 4× normal treat rate	n/a*	46–50	96.8–97.5

DMPC (dimyristoylphosphatidylcholine) is a phospholipid — the same class of molecule that makes up microbial cell membranes — so bench studies use it as a stand-in for the surfactant-like film that real microbial contamination (the "bug" that fouls filters and corrodes tanks in fuel storage) leaves at the fuel-water interface, without having to culture live organisms for each test. That's why the Camin Cargo data labels it a "microbe mimic." At a modest 50 ppm, both physically-based reference methods report the fuel has completely lost its ability to separate water (D3948 reads 0 across every replicate; D7224 ranges 0–45). D8073 reports it as essentially perfect fuel (97.5–97.9). The additive blend rows show the same story for a standard, ASTM/DEF STAN–approved military package: D7224 declines as it's over-treated; D8073 barely moves. (D3948 isn't designed for additized fuel, so it's left out of those two rows.)

This directly undercuts the competitor technology provider's own defense of the design. The company has stated that D8073 deliberately disregards "weak" surfactants like SDA because they don't affect water separation, and that ignoring them "eliminates any false negatives." DMPC and the approved additive blend above are exactly the weak/approved surfactants D8073 is built to overlook — and both measurably, in DMPC's case completely, degrade water separation on the reference methods. A design that ignores a category of contamination that turns out to matter isn't eliminating false negatives. It's manufacturing them.

Even the Manufacturer's Own Data Makes the Case

This isn't only an outside critique. Competitors published their own validation report on D8073 (Rev. 13, 2020), additive by additive. Their own numbers show several ASTM/DEF STAN–approved additives requiring enormous overdoses — in some cases, dozens or hundreds of times the normal treatment level — before D8073 registers anything close to a fail (its threshold is 88):

Approved additive	Function	Normal treat rate	D8073 result at large overdose
Stadis-450 / AvGuard	Static dissipater	1–2 mg/L	"little effect … even at higher levels" (per report)
DCI-4A	Corrosion inhibitor	6 mg/L	93.2 at 10× — still a pass
DCI-6A	Corrosion inhibitor	6 mg/L	93.1 at 6× — still a pass
DiEGME (FSII)	Icing inhibitor	1,500 ppm	89.9 at 3× — still a pass; fails only past ~4×
DMD	Metal deactivator	5.7 mg/L	97.6 at ~103× — still a pass
Innospec AO-37	Antioxidant	10 mg/L	98.2 at 14× — never fails

Every additive in this table is a nonionic or weak surfactant — exactly the class the pH chemistry above predicts D8073 will struggle to see. (Not every approved additive is missed: Turboline+100, a thermal-stability additive with different surfactant chemistry, does show a graded response on D8073. The insensitivity is chemistry-specific, not universal — which is consistent with the mechanism, not in spite of it.)

What This Means For the Lab

A passing D8073 result is not confirmation that a fuel will separate water in an actual filter-separator — particularly for fuel containing common approved additive packages, microbial contamination, biodiesel cross-contamination, or unidentified surfactants, which is exactly where the data above shows D8073 missing real problems.

D3948 and D7224 remain directly tied to real coalescing performance and should be the method of record whenever water separation is in question. Water separation testing exists to keep free water out of aircraft fuel systems — a test method that reliably misses that condition is not a minor discrepancy. It is a flight-safety risk.