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Finished Fuel Specification for Biodiesel – DRAFT Proposed B30

DRAFT proposal for a B30 specification used in research and development testing of onroad / offroad diesel engines

Engine Manufacturers Association
October 2026

Fuels Committee

Background

EMA is developing DRAFT requirements and limits for higher blend biodiesel fuels:

- Propose limits for blends up to B30; potential incorporation to Biodiesel Standard (D7467)
- No proposed limits for blends up to B100; data too limited to consider currently
- Propose limit updates for the B100 Blend Stock Standard (D6751) to align and support B30

EMA is planning to initiate the activity through the Biodiesel Task Force to support an industry-wide development process.

The Fuels Committee takes the following positions related to the biodiesel specification proposals:

- Specifications do not imply or constitute an endorsement for use of biodiesel
  - Specifications are not an approved national fuel standard
  - Specifications may change over time based on information
- Engine manufacturer support for these higher blends depends on an ASTM Specification that can be utilized to evaluate engine performance, influence on emission control systems, and customer acceptance
- To the extent new ASTM specifications are adopted, they will require:
  - Justification of the limit values defined
  - Consideration of whether new or updated test methods are needed

General Observations

EMA and its members are seeking industry input regarding the properties and limits proposed.

Existing standards may inform draft proposed limits:

References

- ASTM D975: Up to B5
- ASTM D7467: B6 to B20
- ASTM D6751: B100 Blend Stock

Black Font: Carry Over Requirement

Red Font: New Requirement

Red Italic Font: Implied Limit

Property	Test Method	B21 – B30 [incl. D7467]	B100 Blend Spec [D6751]
Flash Point (closed cup), [deg C, min]	D93	52	93
Distillation Temperature, (90% recovered), [deg C, max]	D86	343	360
Kinematic Viscosity, [mm^2/s (40 deg C)]	D445	1.9 – 4.1	1.9 – 6.0
Sulfur, [ppm, max (Grade 15)]	D5453	15	15
Ramsbottom carbon residue on 10% distillation residue	D524	0.35	0.050
Acid Number, [mg KOH/g, max]	D664	0.3	0.50
Biodiesel Content, percent (V/V)	D7371	21. – 30.	-
Oxidation Stability, [hours, min]	EN 15751	20	8
Water Content [mg/kg]	D6304	200	-
Water and Sediment, [% Volume, max]	D2709	0.05	0.050
Ash [percent mass, max]	D482	0.01	-
Copper Strip Corrosion [max]	D130	No. 3	No. 3
Cetane Number [min]	D613	40	47
(1) Cetane Index [min]	D976-80	40	-
(2) Aromaticity, percent volume [max]	D1319	35	-
Lubricity, HFRR @ 60°C, [micron, max]	D6079/D7688	520	-
Conductivity [pS/m]	D2624/D4308	25	-
Group I metals (Na + K) [max]	EN 14538	*1.0 (calculated)*	3.3
Group II metals (Ca + Mg) [max]	EN 14538	***1.0 (calculated)***	3.3
Total metals (Low Metals Option for ATS), [ppm, max]	EN 14538	*0.8 (calculated)*	2.7
Phosphorus, [ppm, max]	D4951	*0.00012% wt (calculated)*	0.0004% wt

Properties Under Review

- Metals
  - ULEDE Test Program set metals content at 2 ppm total metals; showed signs of NOx catalyst performance loss and soot management issues
    - 1 ppm Na / 1 ppm K; ASTM D6751 has 4 mg/kg Total Metals limit (5 mg/kg for Group I / II Metals)
    - No Ca or Mg
  - Previous work supported 4 ppm total for B100; equivalent to 0.8 ppm at B20 (blended)
    - Standard tests limit identification of metals content with resolution below 1 ppm
  - **Propose 2.7 ppm Total Metals for B100 Blend Specification (D6751)**
    - **Results in 0.8 ppm at B30 (blended)**
    - **Updated limits for Group I / II Metals to 3.3 ppm; equivalent to 1.0 ppm**
- Phosphorus
  - ULEDE Test Program set phosphorous content at 1 ppm
    - 1 ppm content is consistent with production fuel surveys (ref., NREL); ASTM D6751 has 10 ppm limit
    - Standard tests limit identification of phosphorous content with resolution below 1 ppm
  - **Proposed 4 ppm Phosphorus limit for B100 Blend Specification (D6751)**

Industry Input

- Water Content
  - Proposal to include Water Content Limits; **200 mg/kg Water Content limit for B30**
  - Standards for consideration for a water content limit:
    - EN590: maximum limit (B8) is 200 milligrams (mg) per kilogram (kg) of fuel, or 0.02%
    - EN14214 standards: maximum limit (B100) is 500 mg/kg, or 0.05 vol%

- Distillation Temperature
  - **Propose 343 deg C limit for B30**
    - Data is currently limited; expect reconsideration of limit upon industry testing

- Fuel Density
  - Consideration to include Fuel Density with Specification Limits
    - Critical limit within OEM specifications
      - Internal specifications exist among OEM members
      - Other standards include Fuel Density specifications; e.g., EN12185 (860 to 900 kg/m^3)

Properties Under Review

- Oxidation Stability
  - Consideration to set and update Oxidation Stability with Specification Limits
  - Standards for consideration for oxidation stability:
    - EN590: 20 hours
    - EN14214 (B100): 8 hours
  - **Propose 20-hour Oxidation Stability limit for B30**
    - **Additionally…**
      - **Propose 20-hour Oxidation Stability limit change for B6-B20 Specification (D7467)**
      - **Propose 8-hour Oxidation Stability limit change for B100 Blend Specification (D6751)**
    - Align with other Global Oxidation Stability Specifications

	US B100, D7651	**EU** EN 14214	**Indonesia** SNI 7182:2018	**Indian** Standard IS 15607:2016	**Brazil** BR-B100 RANP45 (08-2014, incluindo alterações pela RANP798-19)
Oxidation stability (at 110 °C) EN 14112 Hours, minimum	3	8	8	8	6 - prior to 1.11.2014 8 - 1.11.2014 to 31.8.2019 12 – after 1.9.2019[9]

9. An antioxidant must be used. For further details see [ANP 2019].

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Biodiesel Oxidation Stability Limits

Technical Justification Increasing Biodiesel Oxidation Stability Limits in ASTM D6751 / D7467

Increase Oxidation Stability Limits

EMA is proposing updates to increase oxidation stability limits that will improve the **storage stability** of biodiesel in the market.

- Allows longer storage of biodiesel limiting degradation
- Limits deposit formation to injection systems and potential for failure and related costs
- Better aligns biodiesel to standard diesel in terms of storage stability encouraging broader use of higher grades
- Addresses limitations of standard biodiesel aging tests that don't accurately reflect real-world aging conditions

Objectives

- 20-hour Oxidation Stability limit change (from 6 hours) for B6-B20 Specification (D7467)
- 8-hour Oxidation Stability limit change (from 3 hours) for B100 Blend Specification (D6751)

TECHNICAL PROPOSAL · FUEL STANDARDS HARMONIZATION & HPCR PROTECTION

Technical Justification for Increasing Biodiesel Oxidation Stability Limits in ASTM D6751 & ASTM D7467

Aligning North American Fuel Specifications with Modern Common Rail Operating Severity and International Benchmarks (EN 14214 & EN 590)

Core Standards Objective: Align US Specifications with Operating Severity & International Benchmarks

- ASTM D6751 (Neat B100): Increase Rancimat oxidation stability minimum from 3 hours to 8 hours (aligning with EN 14214).
- ASTM D7467 (B6–B20 Blends): Increase blend stability limit from 6 hours toward 20 hours (EN 590) and introduce baseline stability requirements in ASTM D975 (≤B5).

EXTREME HARDWARE DEMANDS
HPCR Operating Severity

▶ **Rail Pressure >2,000 bar | Fuel Return >90°C**

- **Severe Operating Environment:** Modern High-Pressure Common Rail (HPCR) injection architectures operate at rail pressures exceeding 2,000 bar and return temperatures above 90°C.
- **Thermal & Hydraulic Pre-Stressing:** Intense hydraulic shear and continuous recirculating thermal cycles pre-stress the fuel charge, accelerating radical formation prior to combustion.
- **Injector & Filter Failure Mitigation:** Prevents internal diesel injector deposits (IDID), tight-clearance needle lacquering, valve sticking, and premature fuel filter plugging.
- **Mandatory Stability Margins:** Higher initial induction thresholds ensure sufficient chemical antioxidant reserve remains active after prolonged vehicle recirculation duty.

CHEMICAL & PHYSICAL MECHANISMS
Degradation & Blend Kinetics

▶ **Non-Linear Nonconformities in >B20 Blends**

- **Direct Storage Correlation:** Rancimat induction time directly governs real-world fuel shelf life and bulk storage stability, allowing users to store fuel longer without degradation risk.
- **Feedstock Unsaturation Sensitivity:** Biodiesel fatty acid methyl ester (FAME) composition decisively dictates oxidation rates; strict specification baselines guarantee critical floor quality.
- **Hygroscopicity & Hydrolysis:** Biodiesel hygroscopicity drives higher moisture absorption under ambient humidity, catalyzing ester hydrolysis, TAN acid rise, and insoluble sludge dropout.
- **High-Blend Margin Depletion:** Blends exceeding B20 display a sharp rise in nonconformities as the natural radical-buffering capacity of fossil diesel is progressively diluted.

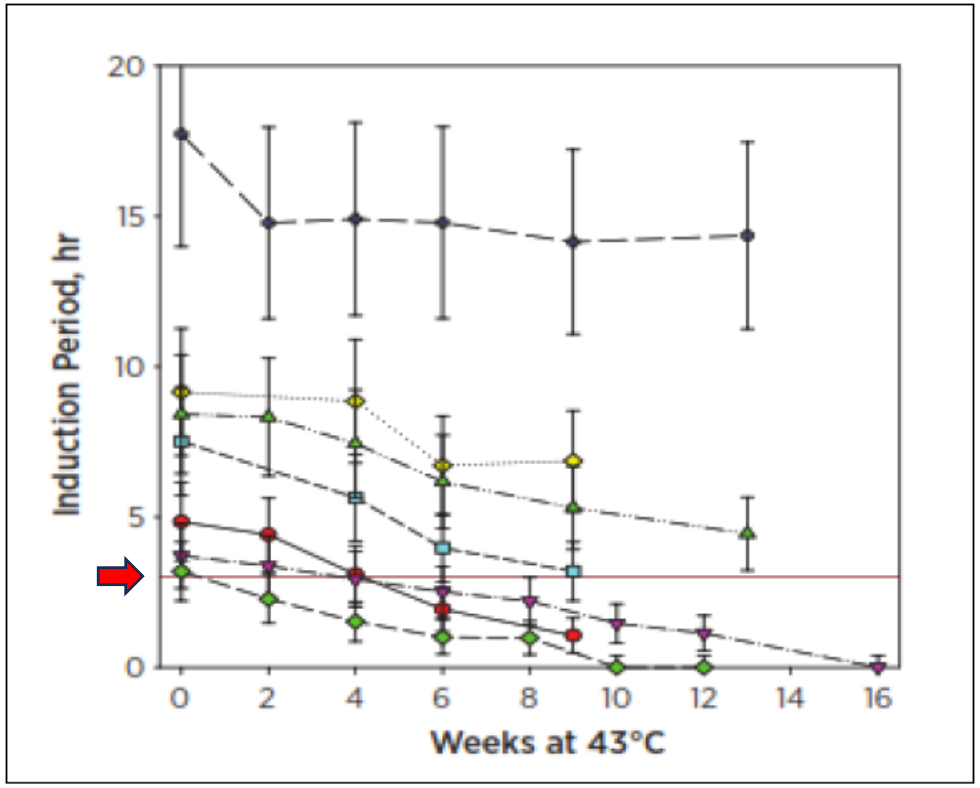
OEM DESIGN & USER VALUE
Engineering BOM & Fleet TCO

▶ **Reduced Vehicle BOM | Lower Fleet Downtime**

- **Prevents Costly BOM Over-Design:** Avoids costly over-engineering across fuel system elastomers, exotic thermal shielding, and supplementary chassis-mounted cooling loops.
- **Crankcase Lubricant Protection:** Protects engine oil from accelerated oxidation and sludging caused by unburned biodiesel dilution during active DPF post-injection regeneration.
- **Aftertreatment Catalyst Safeguards:** Shields DOC, DPF, and SCR catalysts from severe surface poisoning and thermal deactivation by organic acids and polymerization residues.
- **Fleet Reliability & Cost Reduction:** Simplifies handling by closing the operational gap with fossil diesel, eliminating recurring pre-fueling testing, roadside derates, and downtime.

NREL Storage Stability Test and Data

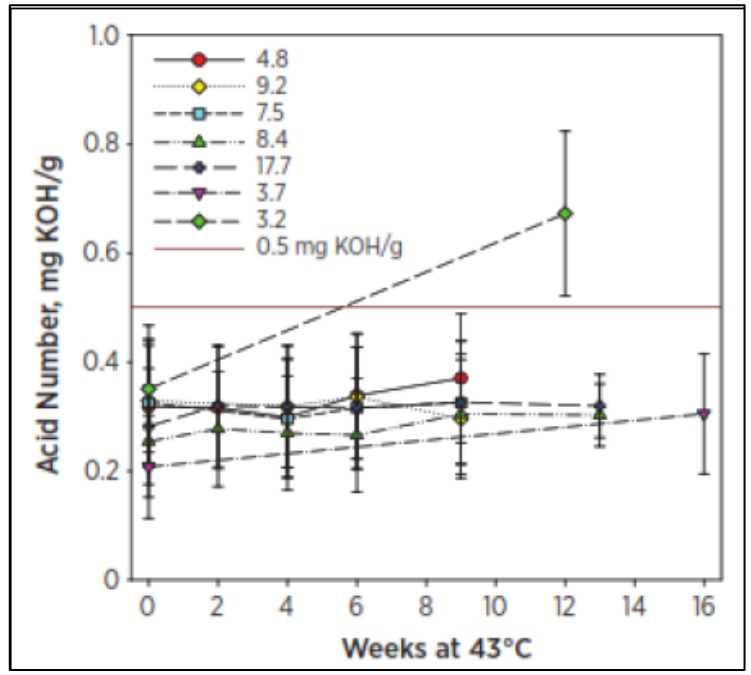
- ASTM D4625 Test simulates storage at ambient temperature (21°C / 70°F)
- Accelerated test, one week of storage at D4625 conditions simulates one month of storage at 21°C (70°F).
  - Data indicates that B100 will lose oxidation stability over time under these storage conditions
  - Higher initial induction period values can provide longer storage time before biodiesel goes out of specification
- Current 3-hour Induction Period showed the lowest storage stability duration

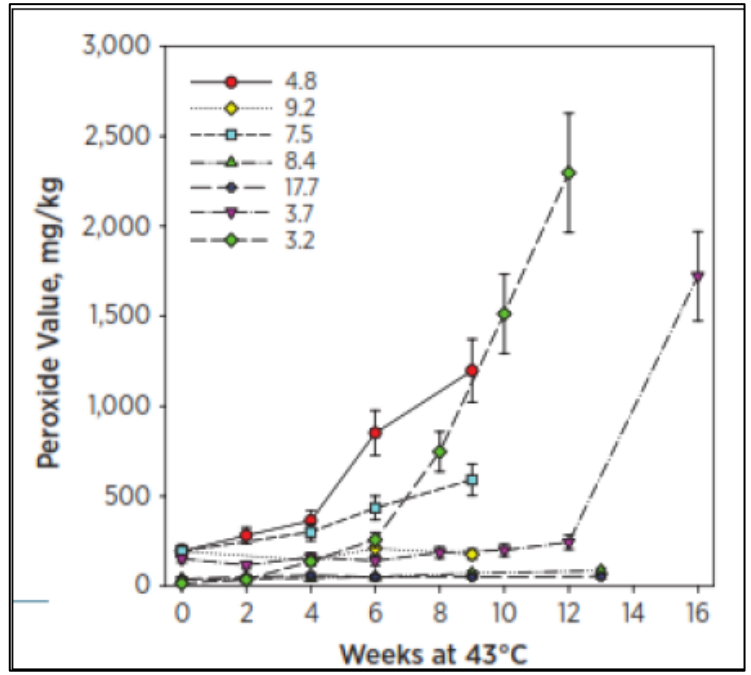


Reference: *Biodiesel Handling and Use Guide (Fifth Edition)*

NREL Storage Stability Test and Data, continued…

- Accelerated test, one week of storage at D4625 conditions simulates one month of storage at 21°C (70°F).
  - Note the impact on Acid Number as the fuel ages
  - As the oxidation stability is reduced to near zero, the material will oxidize due to a loss of “oxidation reserve”; evident in the increase in peroxide values





Reference: *Biodiesel Handling and Use Guide (Fifth Edition)*

Storage Stability for Biodiesel Blends, B5 and B20

- Increasing B100 induction period from 3 hours resulted in significant increase of storage stability of B5 and B20

B5 storage stability based on B100 oxidation stability

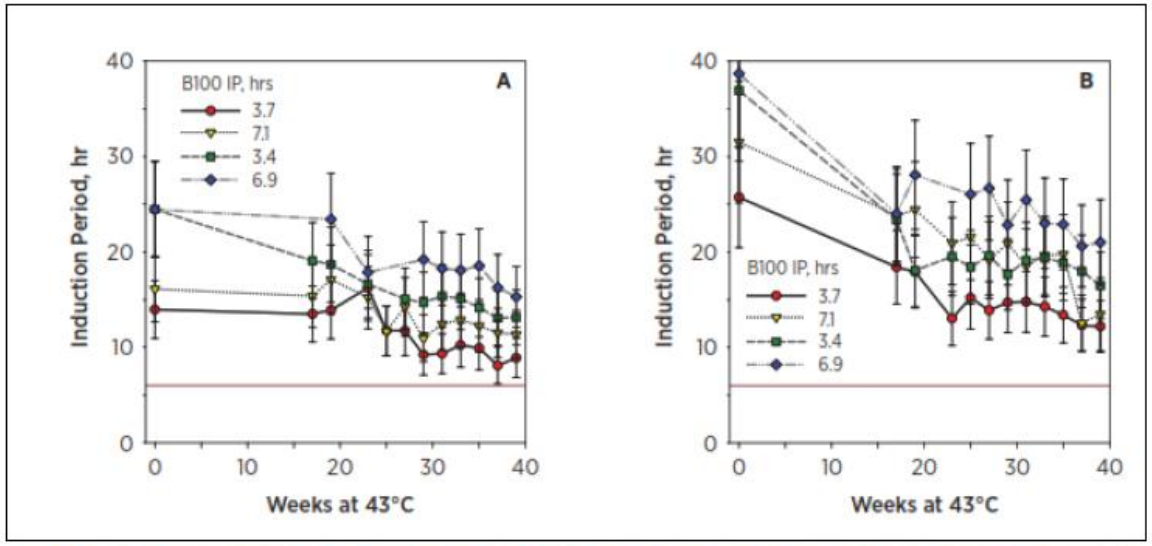


Figure 11. D4625 storage results for B5 blends made from B100 with varying levels of oxidation stability and two diesel fuels as measured by EN15751

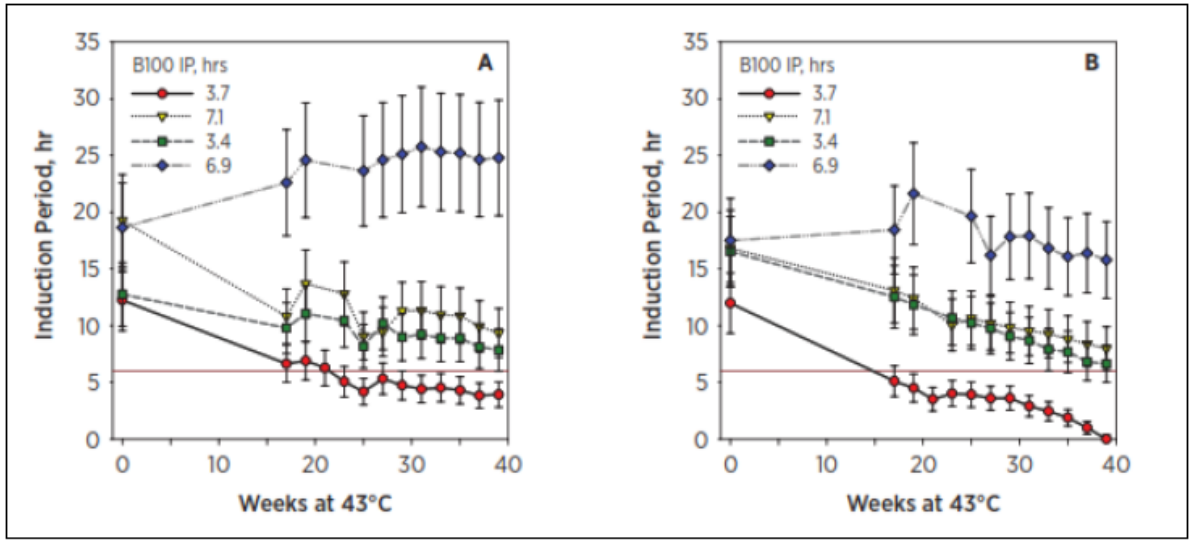


Figure 12. D4625 storage results for B20 blends made from B100 with varying levels of oxidation stability as measured by EN15751

B20 storage stability based on B100 oxidation stability

Reference: *Biodiesel Handling and Use Guide (Fifth Edition)*

Limitations of Standard Biodiesel Aging Tests

Standard accelerated laboratory test methods often fail to accurately replicate real-world scenarios due to oversimplified variables or extreme parameters.

Test Method	Limitation	Real-World Disconnect
Rancimat (EN 14112)	Unrealistic High Temperatures Alter the Chemical Pathways	Rancimat Severity Disconnect: Forced 110°C aeration induces artificial degradation pathways not representative of real-world ambient storage.
Rancimat (EN 14112)	Inability to Track Sedimentation and Sludge Formation	Induction Period Limitations: Measures only volatile acids, completely missing polar polymers and insoluble sludge that foul vehicle fuel systems.
ASTM D4625	Outdated Baseline Correlations for Modern Blends	The conventional petroleum rule (1 week @ 43°C = 1 month ambient) fails for FAME, which degrades non-linearly via rapid peroxide spikes and sudden polymerization.
Both Methods (EN14112 & D4625)	Exclusion of Critical Vehicle, storage & Environmental Factors	Misses Critical Field Stressors: Overlooks diurnal temperature swings, ambient tank venting/condensation, and catalytic metal contamination (Cu/Fe).
Both Methods (EN14112 & D4625)	Misleading Evaluations of Antioxidant Additives	Antioxidant Depletion in Storage: High-heat tests mask long-term additive depletion through solubility on water or microbial activity, leaving fuels vulnerable to sudden breakdown.

STUDY 1 · LABORATORY AGING & HUMIDITY EVALUATION

Amaral et al. (Fuel 2020) — High Ambient Humidity Accelerates Biodiesel Degradation & Sludge Formation

Study Objectives & Setup

- Evaluated natural aging and physicochemical stability of diesel/biodiesel blends (B5, B10, B15, B20) over 6 months in amber polyethylene containers.
- Compared two distinct feedstocks: pure soybean oil biodiesel vs. a quaternary mix (61.2% soybean, 15.6% beef tallow, 15.5% chicken grease, 7.7% swine grease).
- Simulated two microclimatic storage conditions: tropical low-humidity (System 1) vs. moist equatorial/Amazonian high-humidity (System 2).

Key Findings & Degradation

- Moisture Absorption: High humidity (System 2) sharply accelerated water uptake, driving hydrolysis of mono- and diglycerides into free fatty acids and free glycerol.
- Phase Segregation & Sludge: In B20 soybean blends, moisture triggered intense carotenoid bleaching and an adherent macromolecular polymer sludge film at bottle bottoms.
- Total Contamination Spikes: Aged samples exceeded the 24 mg/kg limit established by Brazilian fuel standards, even when visual appearance appeared clear.
- Feedstock Contrast: Saturated animal fat blends showed far higher initial stability (neat IP 11.6 h) than neat soybean FAME (neat IP 0.6 h).

Need for Higher Stability

- Unadditized soybean blends failed the standard 20-hour Rancimat Induction Period (IP) threshold right at t = 0.
- Higher blends (B15 and B20) rapidly degraded below acceptable limits during storage, proving higher blend mandates cannot rely on baseline point-of-sale specs.
- Strict Need for Antioxidants: Transitioning to B15/B20 in warm, humid regions is unfeasible without mandatory synthetic antioxidant stabilization and strict dry-handling controls.

Reference: *Amaral, B. E. do, Rezende, D. B. de, & Pasa, V. M. D. (2020). Aging and stability evaluation of diesel/biodiesel blends stored in amber polyethylene bottles under different humidity conditions. Fuel, 279, 118289. https://doi.org/10.1016/j.fuel.2020.118289*

STUDY 2 · REAL-WORLD FLEET IN-USE DURABILITY SURVEY

CARB / Durbin et al. (2010) — Fleet Durability Demonstrates Mechanical Feasibility but Exposes Blend Stability Risks

Survey Objectives & Scope

- Conducted an extensive survey of 40 municipal, school district, transit, and commercial fleets (operating B5 to B100, predominantly B20) across North America.
- Evaluated long-term vehicle impacts on engine durability, Fuel Injection Equipment (FIE), exhaust aftertreatment devices, and storage/handling routines.
- Synthesized existing literature and bench durability tests to establish regulatory recommendations for California's Low Carbon Fuel Standard (LCFS).

Key Fleet Learnings & Impacts

- Mechanical & FIE Durability: Over 50% of fleets monitored pumps and injectors with zero degradation; enhanced lubricity reduced engine wear in several fleets.
- Filter Plugging Prevalence: 22 of 40 fleets experienced fuel filter plugging, mainly during the initial transition period (solvency loosening old tank sludge) or with unadditized >=B20.
- DPF & Oil Dilution Vulnerability: Higher boiling range and larger droplet sizes cause cylinder wall wetting during late in-cylinder post-injection, causing engine oil dilution in 50–150 h.
- Cold Weather Operability: 9 fleets reported winter fuel gelling and filter plugging, requiring winter cold-flow additives and managed seasonal kerosene blending.

Need for Higher Stability

- Immediate Oxidation: Neat B100 without synthetic antioxidants begins oxidizing immediately upon storage and cannot be stored over a few months.
- Severe Specification Gaps: FIE manufacturers (Bosch, Delphi, Denso, Stanadyne) warned that ASTM D975 has no stability limit for <=B5, and ASTM D7467 requires only 6 h IP for B6-B20 (vs. 20 h in EN 590).
- Mandatory Standards: Elevated oxidation stability requirements, mandatory phenolic antioxidants, and BQ-9000 quality certification are vital to prevent organic acid corrosion and sticky injector deposits.

Reference: *Durbin, T. D., Miller, J. W., & Jiang, S. M. (2010). Biodiesel Fleet Durability Study (Draft Final Report, Grant No. G06-AF38). UC Riverside (CE-CERT) for California Air Resources Board (CARB).*

STUDY 3 · JOINT INDUSTRY IN-VEHICLE B10 STORAGE STUDY

CONCAWE / Lacey et al. (2010) — In-Vehicle Storage Accelerates Severe Oxidation & Insoluble Buildup in Passenger Cars

Study Objectives & Setup

- Evaluated real-world aging behavior of B10 diesel blends stored directly inside common-rail vehicle fuel tanks parked outdoors in Martigues, France for 27 weeks.
- Tested three light commercial vehicles (vans) and three passenger cars equipped with HDPE tanks, common-rail injection systems, and intermittent idle cycles.
- Tested three initial stability levels: High (50.3 h IP with 100 mg/kg BHT), Medium (28.9 h IP with 10 mg/kg BHT), and Low (16.1 h IP neat SME), alongside sealed drum controls.

Key In-Vehicle Findings

- Dramatic In-Vehicle Aging: Passenger cars aged fuel rapidly, losing up to 7 hours of Rancimat IP per week (~75% loss in first 10 weeks), far outpacing commercial vans and sealed drums.
- Massive Insoluble Formation: Low-stability B10 in passenger cars generated unprecedented insoluble sediments reaching 1,589 g/m^3 after 27 weeks (orders of magnitude above safe limits).
- Rapid Acidity Spike: Delta TAN acid formation exceeded Japanese stability limits after only 2 weeks (low stability) and 8 weeks (medium stability) of vehicle parking.
- Atmospheric Breathing Effect: Sealed steel drums showed minimal aging due to oxygen starvation, whereas vehicle tank breathing drove rapid degradation.

Need for Higher Stability

- Point-of-Sale Standards Fail In-Vehicle Storage: Baseline specifications (EN 590 20 h IP; ASTM 6 h IP) do not protect vehicles during extended parking, seasonal downtime, or low-mileage usage.
- Consumption Quality vs. Refinery Quality: Severe aging occurs inside the tank before combustion, causing filter plugging, lacquering, and common rail injector seizure.
- Higher Baseline Mandates: The automotive and fuel injection industries require significantly higher initial stability specifications and robust antioxidant treatment to ensure vehicle operability.

Reference: *Lacey, P., Greening, P., Rose, K., Omori, T., Kweekel, T., & Jean, E. (2010). Effect of in Vehicle Storage On B10 Diesel Quality: A Joint Industry Study. Delphi Diesel Systems, ACEA, CONCAWE, DENSO, KPR&T, & Intertek Caleb Brett.*

Thank you!

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