The Vehicle Suppliers Association

July 17, 2026

California Air Resources Board
1001 I Street
Sacramento, CA 95814

RE: MEMA, The Vehicle Suppliers Association – Comments on CARB's *Drive Forward Light-Duty Vehicle Program*

To Whom It May Concern:

MEMA, The Vehicle Suppliers Association (MEMA) appreciates the opportunity to provide comments on the California Air Resources Board's (CARB) *Drive Forward* proposal addressing non-exhaust emissions (NEE), including the proposed brake wear particulate matter (PM) emission standards for new vehicles.[1] MEMA supports CARB's continued research and stakeholder engagement regarding brake wear emissions. However, MEMA has significant concerns with the proposal as currently presented because CARB has not yet fully addressed the scientific basis for the proposed numerical standards, the certification pathway, testing capacity, implementation timing, enforcement mechanisms, and the potential implications for original equipment (OE) manufacturers, suppliers, and the aftermarket brake sector.

MEMA is the leading trade association in the U.S. for vehicle suppliers, parts manufacturers, and remanufacturers. MEMA represents the nation's vehicle suppliers, whose members design, engineer, and manufacture the technologies, systems, and components incorporated into nearly every vehicle produced for the North American market. MEMA members also manufacture replacement components that support the continued safe operation of the more than 295 million vehicles currently operating on U.S. roadways.

Through the Brake Manufacturers Council® (BMC), MEMA represents leading manufacturers of original equipment (OE) and aftermarket brake friction materials and braking system components. This perspective is particularly important because brake wear PM emissions are not determined by a single component alone, but by the interaction of friction materials, rotors or drums, brake system architecture, vehicle calibration, and operating conditions.

## I. MEMA Brake Manufacturers Council® and Prior Collaboration with CARB

MEMA has worked collaboratively with CARB for several years on issues related to NEE, including brake wear particulate emissions. For example, representatives of the BMC have actively participated in CARB's Project Advisory Committee (PAC) supporting the agency's *Characterization of Tire-Wear and Brake-Wear PM Emissions Under On-Road Driving Conditions* research project. MEMA has likewise supported the Coordinating Research Council's (CRC) complementary brake wear research efforts and has encouraged continued

[1] California Air Resources Board, *Drive Forward Light-Duty Vehicle Program*, https://ww2.arb.ca.gov/our-work/programs/drive-forward-light-duty-vehicle-program; https://ww2.arb.ca.gov/sites/default/files/2026 06/2026_06_22_Workshop_Presentation_ADA_English_Approved_3.pdf (last visited July 1, 2026).

technical collaboration among regulators, academia, and industry. However, MEMA's participation in these efforts should not be understood as a support for premature regulation. Rather, MEMA has participated to help ensure that CARB develops a complete and technically reliable record before establishing enforceable brake wear PM requirements.

MEMA and its BMC have consistently collaborated with CARB and other regulatory authorities on research-backed standards; most notably leading efforts to address the use of copper in brake pads. In 2015, MEMA and the BMC signed the "Copper Free Brake Initiative" Memorandum of Understanding to facilitate nationwide industry phase out of copper and other constituents in motor vehicle brake pads, modeled on previous requirements enacted in California.[2] As a result, MEMA developed the LeafMark™ certification program, which is designed to certify that brake friction materials manufactured by third parties have passed certain environmental composition standards.

The copper-free brake effort also illustrates an important distinction, as that program addressed the composition of brake friction materials through a comparatively direct compliance pathway. By contrast, brake wear PM emissions depend on system-level interactions and require measurement of a highly variable emissions output. As a result, the proposed brake wear PM program presents significantly different and more complex testing, certification, and enforcement issues than previous brake composition standards.

In comments submitted to CARB following the October 2025 *Drive Forward Light-Duty Vehicle Program* workshop,[3] MEMA encouraged the agency to continue developing the underlying technical record before proceeding with regulatory requirements. MEMA specifically urged CARB to continue expanding available research, improve understanding of brake wear measurement methodologies, and work collaboratively with industry to ensure that any future regulatory requirements are technically sound, scientifically supported, and practically implementable.[4] Those concerns remain central to MEMA's review of the current proposal.

Since MEMA's comments were submitted, CARB has continued developing its proposal and has now presented preliminary brake wear PM standards as part of the current *Drive Forward* process.[5] MEMA appreciates CARB's continued engagement with stakeholders. However, the June 2026 workshop materials raise new and more concrete questions because CARB has now identified specific numerical limits, a California-specific Brake Dynamometer Cycle (CBDC), and an apparent regulatory pathway before resolving several underlying technical and implementation issues.

MEMA supports continued research into approaches that may reduce brake wear PM emissions. However, MEMA does not believe the current proposal is sufficiently developed for

---

[2] *See* U.S. Environmental Protection Agency, *Copper-Free Brake Initiative*, https://www.epa.gov/npdes/copper-free-brake-initiative (last visited July 1, 2026).
[3] *See* MEMA, The Vehicle Suppliers Association, *Comments on CARB Drive Forward Light-Duty Vehicle Program* (submitted Nov. 21, 2025); https://content.govdelivery.com/accounts/CARB/bulletins/3f468ee (last visited July 1, 2026).
[4] *See id.*
[5] California Air Resources Board, Public Workshop-Drive Forward Light-Duty Vehicle Program (June 22, 2026).

final regulatory action. Before adopting enforceable standards, CARB should further develop the technical record, clarify the scope and certification pathway, assess testing capacity and compliance costs, address OE and aftermarket differences and implications, and explain how the program would be implemented and enforced.

## II. CARB Should Further Develop the Technical Basis for the Proposed Brake Wear PM Standards Before Proceeding

MEMA recognizes that CARB is considering methodologies related to United Nations Global Technical Regulation No. 24 (UN GTR No. 24)[6] and that international alignment may, in some circumstances, reduce duplicative testing. However, harmonization is beneficial only where the underlying standards, test cycles, product assumptions, and certification pathways are technically comparable. Euro 7 itself has raised substantial implementation concerns for suppliers and aftermarket participants in Europe, including testing burden, laboratory capacity, interoperability, and replacement part availability concerns. CARB therefore should not assume that Euro 7 provides a ready-made model for California without independently evaluating whether the approach is technically justified and practically achievable.

As presented during CARB's June 2026 *Drive Forward* workshop, the proposal would establish brake wear particulate matter emission limits of 11 milligrams per mile (mg/mi) for vehicles utilizing conventional or limited regenerative braking systems and 5 mg/mi for vehicles utilizing regenerative braking systems.[7] MEMA understands that these proposed standards would apply to new vehicles, but CARB should confirm the scope of the proposal and clearly state whether and how the requirements would affect replacement parts, service parts, or aftermarket brake components in future phases.

Although the proposed numerical limits appear generally consistent with Euro 7 levels after conversion from kilometers to miles,[8] CARB proposes to use the CBDC rather than the Worldwide Harmonized Light Vehicles Test Procedure (WLTP-BC)-based brake cycle associated with Euro 7 standards.[9] This distinction raises important threshold questions: whether the numerical limits developed under one brake duty cycle are technically appropriate if applied under a different cycle. MEMA does not take the position in these comments that any single conversion factor should be adopted. Instead, MEMA urges CARB to explain the technical basis for applying Euro 7 limits under the CBDC and to address whether the California cycle produces different brake work, thermal loading, or PM results.

The technical record also appears to remain under active development. MEMA understands that collaborative research initiatives relating to NEE continue to evaluate brake particulate measurement methodologies and generate additional real-world data. Continued investment in developing the underlying scientific basis reinforces the importance

---

[6] UNECE, Global Technical Regulation No. 24, *Laboratory Measurement of Brake Emissions for Light-Duty Vehicles* (2023).
[7] California Air Resources Board, *Drive Forward Light-Duty Vehicle Program Public Workshop*, June 22, 2026, Presentation Materials.
[8] Regulation (EU) 2024/1257 of the European Parliament and of the Council establishing Euro 7 emission standards for motor vehicles.
[9] CARB June 22, 2026, Workshop Presentation.

of ensuring that any enforceable numerical standards are supported by a sufficiently mature technical foundation before they are finalized.

Research comparing the CBDC and WLTP brake cycles suggests that the cycles could differ in ways that materially impact brake work and measured emissions.[10] Those findings reinforce the need for CARB to conduct or disclose its own technical analysis explaining why the proposed limits are appropriate under the CBDC. At a minimum, CARB should identify the data, assumptions, and methodology used to determine that the proposed 11 mg/mi and 5 mg/mi limits are feasible, repeatable, and equivalent in stringency to any international benchmark CARB considered.

*CARB Should Address Measurement Complexity, Repeatability, and Laboratory Capacity*

Brake wear PM emissions are difficult to measure consistently because emissions depend on the interaction of the friction couple, brake energy, thermal conditions, rotor or drum characteristics, vehicle calibration, and test procedure. European stakeholders have reported significant practical challenges with brake PM testing, including the need for new dynamometer test benches, limited technical-service capacity, and large variances in test results for the same component across test centers.[11] CARB should address these issues directly before adopting enforceable standards, including by explaining how it will ensure repeatability and reproducibility, what laboratories will be capable of conducting testing, whether manufacturers may self-test, and how CARB will conduct conformity or enforcement testing.

Accordingly, MEMA respectfully recommends that CARB provide the technical basis supporting the proposed numerical standards under the CBDC. Specifically, the rulemaking record would benefit from additional explanation regarding whether the proposed 11 mg/mi and 5 mg/mi standards provide an equivalent level of regulatory stringency to the Euro 7 standards after accounting for the different brake duty cycles, or whether further adjustment may be appropriate to account for the increased brake work associated with the California cycle. Where important technical research and validation efforts remain ongoing, MEMA encourages CARB to complete those efforts before establishing binding numerical compliance limits.

MEMA's intent is not to question CARB's objective of reducing brake wear emissions, or to discourage harmonization with international testing methodologies where feasible. Rather, MEMA seeks to ensure that equivalent environmental objectives are achieved through technically comparable testing conditions. If different brake duty cycles produce materially different brake work and particulate emissions, the associated numerical standards should

[10] FIGIE & FEFM, *Position Paper – Euro 7 Brake PM Emissions* (Sept. 16, 2025) (discussing differences between the California Brake Dynamometer Cycle (CBDC) and the Worldwide Harmonized Light Vehicle Test Procedure brake cycle (WLTP-BC), associated brake work, and implications for application of common numerical limits under different duty cycles).

[11] *See id.* (explaining that brake particulate performance depends upon properly developed friction couples and computability between brake pads and discs).

likewise reflect those differences to ensure that manufacturers are evaluated under technically equivalent compliance conditions.

For this reason, MEMA encourages CARB to further evaluate recently published research comparing the CBDC and WLTP brake cycles and to consider whether additional technical validation or adjustment of the proposed emission limits is warranted before finalizing the regulation. Doing so would strengthen the scientific basis of the proposal, improve transparency within the rulemaking record, and provide greater confidence that the resulting standards appropriately reflect California's chosen testing methodology.

## III. Outstanding Technical and Implementation Considerations

While MEMA appreciates CARB's technical work to date, several fundamental implementation issues remain unresolved. These issues are not minor, but reflect whether the proposed program can be certified, implemented, enforced, and complied with in a manner that is scientifically reliable, commercially feasible, and equitable to suppliers.

### *A. Vehicle-Level Standards and Component-Level Certification*

CARB's proposal appears to establish brake wear PM limits on a per-vehicle basis. However, the proposal does not clearly describe how compliance with those vehicle-level standards could be demonstrated during component-level or single-corner dynamometer testing. Brake wear emissions are generated by the interaction of the full braking system, including friction material, rotor or drum, caliper, hydraulic or electromechanical actuation, regenerative braking strategy, vehicle mass, axle load, front/rear brake balance, and vehicle calibration.

Accordingly, CARB should clarify whether the standard applies per vehicle, per axle, per brake corner, or through another certification unit. CARB should also explain how single-corner results would be aggregated or translated into vehicle-level compliance and what assumptions would control that calculation.

### *B. Brake Grouping and Certification Methodology*

The proposal also does not clearly explain how brake systems would be grouped for certification purposes. Brake PM emissions may vary based on friction materials, rotor or drum metallurgy, surface coatings, dimensions, caliper design, axle load, brake energy, regenerative braking strategy, and vehicle applications. A grouping methodology that is too broad could fail to reflect actual emissions performance and a grouping methodology that is too narrow could require excessive testing and create unnecessary barriers.

CARB should clarify whether certification groups would be based on friction materials, rotors or drum design, pad surface area, axle application, vehicle platform, brake system architectures, vehicle uses, or another set of criteria. CARB should also confirm whether any

grouping approach is intended only for OE systems or could affect aftermarket replacement components.

*C. CARB Should Clarify the Scope of the Proposal and Any Future Implications for Aftermarket Replacement Parts*

MEMA understands that CARB's current proposal is focused on new vehicles. However, the discussion of brake grouping, certification units, and international approaches raises important questions regarding potential future impacts for aftermarket replacement parts.

Brake PM emissions are determined by the friction pairing of pads and rotors, or shoes and drums, and not by a single component in isolation. The FIGIEFA/FEMFM position paper on Euro 7 implementation explains that, under a brake PM regulatory framework, compatibility between the disc and pad becomes decisive and may require correctly developed friction couples.[12] It also warns that consumers may face higher costs if functioning discs or drums must be replaced unnecessarily when pads are changed.[13] Therefore, CARB should clearly state whether the current proposal applies only to new vehicles certification and whether CARB intends to consider aftermarket or replacement parts in any future phase.

If CARB later evaluates aftermarket requirements, the agency should first conduct a separate technical and economic assessment addressing compatibility, access to OE technical information, consumer cost, independent repair, and competition.

*D. Use of Existing International Data Should be Permitted Only if Technically Representative*

MEMA encourages CARB to avoid unnecessary duplicative testing where existing data is technically valid and representative. However, CARB should not assume that Euro 7 or European test data automatically apply to California vehicles, California operating conditions, or North American brake products. Brake friction materials, rotor materials, vehicle platforms, and supplier configurations may differ across markets. CARB should establish a transparent pathway for demonstrating equivalency where existing data is relevant, while also identifying when additional California-specific validation would be required.

*E. CARB Should Evaluate Testing Burden, Laboratory Capacity, Cost, and Implementation Timing*

CARB's successful implementation of any brake wear PM standard will require significant engineering development, product validation, manufacturing investment, and certification planning throughout the vehicle supply chain. European stakeholders have warned that brake PM regulation may require new dynamometer test benches, additional emissions measurement equipment, substantial testing time, and expanded laboratory capacity.[14] They

[12] *See id.*
[13] *See id.* (explaining that premature replacement of otherwise serviceable discs or drums may increase repair costs and reduce consumer choice in the aftermarket).
[14] *See id.* (describing anticipated investments in brake dynamometer facilities, emissions measurement equipment, engineering resources, and certification testing necessary to implement Euro 7 brake particulate standards).

also estimate that testing burdens could require years of work if applied across numerous brake component families.[15]

CARB should evaluate these issues before finalizing any enforceable standard. Specifically, CARB should assess whether sufficient qualified laboratory capacity exists, whether manufacturers may rely on their own testing, whether independent third-party testing would be required, what equipment investments would be necessary, and how much time suppliers would need to design, validate, and certify compliant systems.

*F. CARB Should Explain How the Program Would Be Enforced*

CARB should also explain how it would enforce any final brake wear PM standard. Because brake PM emissions require specialized dynamometer testing and emissions measurement equipment, CARB should identify whether it intends to conduct confirmatory testing, rely on manufacturer certification data, required third-party testing, or use another enforcement model. CARB should also explain how it would address test variability, disputes regarding confirmatory results, replacement components, and in-use compliance.

*G. Ongoing Technical Collaboration*

MEMA encourages CARB to continue technical engagement with BMC members, vehicle manufacturers, brake system suppliers, friction materials manufacturers, testing laboratories, and aftermarket stakeholders before finalizing the proposal. Given the unresolved questions identified above, additional technical workshops or targeted working sessions would help CARB evaluate scientific, certification, enforcement, and implementation issues before finalizing regulatory text. Continued collaboration will improve both the technical foundation and the practical implementation of any future requirements.

## IV. Recommendations

MEMA respectfully recommends that CARB not finalize brake wear PM standards until the agency has addressed the following issues in the rulemaking record:

1. **Provide the technical basis for the proposed numerical standards.** CARB should explain why the proposed 11 mg/mi and 5 mg/mi limits are appropriate under the CBDC and whether those limits reflect equivalent stringency to any international benchmark considered.
2. **Address test-cycle differences before relying on Euro 7-derived limits.** CARB should evaluate whether differences between the CBDC and WLTP brake cycles affect brake work, thermal loading, and measured PM emissions.
3. **Clarify the certification unit.** CARB should state whether the standard applies per vehicle, per axle, per brake corner, or through another certification measurement.
4. **Define brake grouping criteria.** CARB should identify how brake systems would be grouped for certification and whether grouping would be based on friction material,

[15] *See id.*, discussing projected testing burdens across brake families, laboratory limitations, certification timelines, and implementation challenges associated with widespread brake particulate compliance testing.

rotor or drum characteristics, brake architecture, vehicle platform, axle load, or other factors.

5. **Clarify scope and aftermarket implications.** CARB should confirm that the current proposal applies only to new vehicle certification and should not extend any requirements to aftermarket replacement parts without separate technical and economic analysis.
6. **Evaluate testing burden, laboratory capacity, and implementation timing.** CARB should assess whether sufficient test equipment, qualified laboratories, and implementation time exist to support a workable certification program.
7. **Establish a pathway for technically representative existing data.** CARB should allow use of existing international or supplier data where technically justified but should not assume European data are automatically representative of California or North American brake systems.
8. **Explain enforcement.** CARB should describe how compliance would be verified, how confirmatory testing would be conducted, and how test variability would be handled.
9. **Continue stakeholder engagement before finalization.** CARB should convene additional technical discussions with brake manufacturers, vehicle manufacturers, suppliers, testing laboratories, and aftermarket stakeholders before adopting final standards

MEMA remains committed to working constructively with CARB to improve the scientific understanding of brake wear PM emissions and to evaluate technically sound approaches for reducing non-exhaust emissions. However, the current proposal raises substantial unresolved questions regarding the proposed numerical limits, test-cycle equivalency, certification methodology, grouping criteria, testing capacity, implementation timing, enforcement, and potential implications for OE and aftermarket suppliers. For these reasons, MEMA respectfully recommends that CARB continue developing the technical and implementation record before finalizing brake wear PM standards. MEMA welcomes continued engagement with CARB and would be pleased to provide additional technical information or participate in targeted working sessions with CARB staff and BMC members.

Respectfully Submitted,

Jennifer A. Lewis

Jennifer A. Lewis
Vice President of Regulatory Affairs
MEMA, The Vehicle Suppliers Association
jlewis@mema.org