

Jeffrey Lowry  
Staff Specialist  
Off-Road Control Section  
California Air Resources Board

**Re: Potential Amendments to the Off-Road Diesel New Engine Regulations**

Dear Mr. Lowry,

The Association of Equipment Manufacturers (AEM)<sup>1</sup> appreciates the opportunity to comment on California's Air Resources Board (CARB), *Potential Amendments to the Diesel Engine Off-Road Emissions Standards: Tier 5 Criteria Pollutants and CO2 Standards*, hereafter referred to as the Initial Concepts. We look forward to working more closely with CARB to share the expertise and technical knowledge of our industry sectors. We believe it is critically important when developing regulations that the interests of all stakeholders be considered and understood.

**U.S. Environmental Protection Agency (EPA) Federal Pre-emption Request:**

CARB staff requested U.S. EPA cooperation with the Tier 5 rulemaking, specifically regarding the promulgation of new emissions regulations under the Federal Preemption clause in the Clean Air Act. AEM and its members are supportive of EPA's engagement with CARB officials throughout this rulemaking process. Producing engines and equipment compliant with global emission rules represents one of the more costly and challenging endeavors an OEM undertakes. Having various distinct engine emissions standards in the U.S. would present a tremendous compliance burden on industry, especially with smaller manufacturers with lower sales volumes. Consequently, the off-road equipment manufacturing industry strongly encourages and supports the development of harmonized emissions rules throughout the United States.

**Potential Tier 5 Criteria Emissions Standards:**

CARB staff proposed requiring equipment <19 kW to be zero emission. Equipment powered from these small diesel engines have strenuous work patterns, often work in areas with little to no electrical charging infrastructure and are used in unsupervised applications where battery exchange is not possible. Furthermore, the compact size of smaller equipment that utilize engines below 56 kW generally makes the installation of more complex emission control systems, such as SCR and DEF supply, infeasible. AEM requests that CARB conduct a thorough feasibility study to determine which equipment types are suitable for alternative powertrain solutions and which are not.

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<sup>1</sup> AEM is the North American-based international trade group representing NRMM equipment manufacturers and suppliers with more than 1,000 member companies and over 200 product lines in the construction, agriculture, mining, forestry and utility industries. The equipment manufacturing industry in the United States supports 2.8 million jobs and contributes roughly \$288 billion to the economy every year. Our industries remain a critical part of the U.S. economy and represent 12 percent of all manufacturing jobs in the United States. Our members develop and produce a multitude of technologies in a wide range of products, components, and systems that ensure NRMM equipment remains safe and efficient, while at the same time reducing carbon emissions and environmental hazards. Finished products have a life cycle measured in decades and are designed for professional recycling of the entire product at the end of life. Additionally, our industry sectors strive to develop climate friendly propulsion systems and support robust environmental stewardship programs around the world.

**Off-Road Low Load Application Cycle (LLAC):**

CARB staff proposed the introduction of a Low Load Cycle (LLC) for off-road engines citing data showing the current Nonroad Transient Cycle (NRTC) does not adequately represent low load operations in real-world duty cycles. CARB collected data on 27 pieces of construction equipment, gathering load/speed data at 1 Hz for at least 4 weeks for each engine.

AEM represents hundreds of different equipment manufacturers with over 200 unique product lines, operating in wide-ranging and extreme environments, with varied engine types. The study performed by CARB on 27 different engines is too narrow to adequately represent duty cycles of the entire off-road equipment industry. To truly understand the real-world duty cycles in off-road equipment, AEM recommends that CARB staff expand the study to include a larger sample size than 27 engines. AEM also recommends that any new certification cycle be developed through an international body, such as the UNECE process.

**Dedicated Off-Road Hybrid Powertrain Certification Procedure:**

AEM requests clarification on the scope of CARB's request regarding the introduction of an off-road hybrid powertrain certification procedure. With the diversity of functions, applications and end uses found in the off-road equipment industry, OEM's may apply hybrid power technology to different systems in a single product. As an example, certain mining vehicles utilize downhill regenerative braking to utilize the stored kinetic energy through a variety of different systems. Would the hybrid powertrain certification account for these types of applications, or remain strictly limited to the hybrid powertrain concepts found in the on-road industry?

Furthermore, in many on-road vehicles, the engine is downsized to account for the inclusion of the battery, yet the electric storage component does not come with its own certification. Any proposed hybrid powertrain certification requirement would fundamentally expand the requirement from an engine certification to a whole vehicle certification. Additionally, due to the wide variety of products and applications in the off-road market, each machine form would have its own type of optimization. Unlike the on-road market, a single certification on hybrid powertrains could not possibly cover each potential end use application. AEM strongly encourages continued dialogue and clarity with CARB on this topic.

**Feedback on whether the heavy-duty on-road hybrid powertrain certification procedure is sufficient for certifying off-road hybrid powertrains:**

Similar to the previous question, AEM requests clarification on the scope of the off-road hybrid powertrain certification concept. The work profile of heavy-duty off-road equipment does not translate well to traditional on-road hybrid vehicle applications. Unlike on-road vehicles, off-road equipment does not have a period of acceleration followed by 10 hours of operating at 20% power. Power applications for off-road equipment is usually short, but continually applied, as demonstrated in plowing work. If the scope of this proposal moves traditional on-road hybrid powertrain concept to other applications, it will likely prove insufficient to properly certify off-road hybrid technology. AEM encourages continued dialogue and clarity with CARB on this topic.

**Extension of the Engine's Useful Life:**

CARB staff introduced a proposal to increase the useful life requirements for off-road vehicles by almost 50%, from 8,000 hours to 12,000 hours for engines rated between 56-560 kW. AEM believes that the information used by CARB, as represented in the presentation of Initial Concepts on November 3, 2021, to develop this proposal is based on incomplete and narrow data that is not representative of infield operations. AEM suggests that CARB collect a more robust dataset from engines in the field from a broader scope of machines (especially at lower engine powers) in different end use applications to develop a more complete picture to inform this decision. AEM believes CARB should use this data to justify the additional effort and cost for manufacturers before promulgating a rule on the extension of an engine's useful life.

**Extended Warranty Period:**

CARB workshop data on extended warranty did not appear to represent a large cross section of non-road equipment. In general, longer warranty periods are expected to drive higher cost but not significant improvement to in-use emissions. Furthermore, the off-road equipment sector's wide variety of machine forms and applications make any costs implications around extended emissions warranty requirements difficult to estimate. AEM suggests CARB gather more information to study this issue further.

**Off-Road Idling Proposals:**

CARB staff requested feedback on potential restrictions on prolonged engine idling or establishing an off-road diesel idling standard. Many off-road machine types engage machine operation functions while idling that require a certain amount of power from the engine to perform their intended function. Unlike on-road engine idling, off-road equipment performs functions that can be vital to the end user while in a variety of extreme and potentially dangerous environments. In many cases requiring an automatic shutdown for prolonged idling could reduce essential functionality of the machine. Therefore, AEM requests further dialogue with CARB to ensure these vital operating conditions are accommodated in any idle reduction proposal.

**Potential Inducements Beyond Selective Catalytic Reduction:**

CARB expressed concerns over vehicle operators failing to maintain their SCR systems, and the need to develop additional inducements to curb potential abuse. AEM requests clarification from CARB staff regarding real world data on abuses occurring in the field. Additionally, AEM requests that whichever option CARB chooses, that they ensure this effort is harmonized with U.S. EPA rulemaking. Multiple standards across the U.S. market would introduce a tremendous challenge for the industry to address.

**On-Board Diagnostic Requirements:**

CARB staff introduced potential On-Board Diagnostic (OBD) requirements for off-road equipment. AEM is very interested in further discussions on this topic, but requests more time, beyond the February 1<sup>st</sup> comment deadline, to develop a comprehensive response. Although AEM requests more time to comment, we see that any on-board diagnostic rule will create significant impacts on equipment design. OBD would require changes to electronic systems, harnesses, components, and connections, all of which result in higher maintenance costs and lower the durability of the machine. Due to the absence of existing global standards for OBD systems in off-road equipment, the time and resource costs to implement any OBD system across the industry will be significant, especially considering the wide breath of machine forms offered to the off-road equipment market.

**Manufacturer Run Off-Road In-Use Testing Program:**

The OEM's ability to access equipment in the field is limited, costly, and resource intensive. There are distinct differences between on-road and off-road equipment, with specific regard to the ability to perform in-use testing. OEMs do not have the same level of access to equipment that the on-highway industry has. Smaller equipment, especially in the <56 kW range, will prove difficult to test in the field due to size limitations of the machine. Other equipment operating in extreme off-road environments will be inaccessible to testing equipment and require extensive field work to ensure the testing is functional. Furthermore, certain technologies may offer better real-world data from the field and provide more reporting flexibility than a manufacturer run program. An in-use testing program must provide information that truly represents real world emissions data, for this reason AEM wishes to maintain a dialogue with CARB to ensure the process, technology and resources allocated by OEM's and their customers are at an appropriate level under any proposed manufacturer run off-road in-use testing requirement.

**Flexibility/Transitional Program for Equipment Manufacturers (TPEM):**

Equipment manufacturers are very interested in this program and would like to comment on the specifics of this proposal when a more defined proposal is released. Based on the proposals suggested by CARB during this initial rulemaking discussions, there will likely be a very large impact on equipment design, and therefore we see TPEM allowances being needed by manufacturers. AEM will not be able to comment on the appropriate size of this program until we have a more defined proposal of the amendments from CARB.

AEM Appreciates your consideration of these comments. Please feel free to contact me at [Jmalcore@aem.org](mailto:Jmalcore@aem.org) if you have any questions or require any further information.

Best Regards,



Jason Malcore  
Director, Global Standards & Compliance  
Association of Equipment Manufacturers (AEM)