

State of California  
AIR RESOURCES BOARD

**Updated Informative Digest**

**PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE  
CALIFORNIA DIESEL FUEL REGULATIONS**

**Sections Affected:** Amendments to sections 2281, 2282 and 2701(a), and adoption of sections 2284 and 2285, title 13, California Code of Regulations (CCR); amendments to section 1961(d) and the incorporated “California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles” as last amended September 5, 2003, title 13, CCR. Adoption of section 93114, title 17, CCR.

**Background**

The Air Resources Board (ARB or Board) administers regulations that since 1993 have limited statewide the allowable sulfur content of motor vehicle diesel fuel to 500 parts per million weight (ppmw) and the aromatic hydrocarbon content to 10 percent with a 20 percent limit for small refiners. The regulation limiting aromatic hydrocarbon content allows refiners to comply by selling a certified alternative formulation that has an aromatic hydrocarbon content greater than the basic limits. Most refiners have taken advantage of the regulation’s flexibility to produce alternative diesel formulations that provide the required air quality benefits at a lower cost.

In order to be certified, an alternative formulation must be shown to result in the same emission benefits as the 10 percent aromatic standard (or in the case of small refiners, the 20 percent standard). The regulation requires the determination of the values of five properties – sulfur, aromatic hydrocarbon, polycyclic aromatic hydrocarbon, and nitrogen contents, and cetane number – of the candidate fuel submitted by a refiner for certification. The values for the candidate fuel then become the required specifications for the alternative formulation. Candidate fuel formulations are tested in a laboratory engine for emission equivalency against a defined reference fuel. They must be shown to be equivalent or better than the reference fuel. In comparing emissions, a statistical margin of safety is required but an allowable tolerance is provided so that a truly emission-equivalent candidate fuel will always qualify.

ARB regulations also establish test procedures for evaluating whether new motor vehicles and engines may be certified as meeting the California motor vehicle emission standards. These test procedures identify the specifications of the “certification fuel” to be used in exhaust emission testing. The ARB’s current specifications for diesel fuel used to certify passenger cars, light-duty trucks and medium-duty vehicles include an allowable range of sulfur content from 100 ppmw to 500 ppmw and limits or allowable ranges for other fuel

properties, including an aromatic hydrocarbon content of 8-12 volume percent (vol.%). Manufacturers may also certify California diesel engines using certification fuel meeting the federal certification fuel specifications established by the U.S. Environmental Protection Agency (U.S. EPA) and incorporated into the ARB's test procedures.

There is currently no government or industry standard controlling diesel fuel lubricity in the United States. Refiners in California have maintained a voluntary minimum lubricity level consistent with the recommendation of a 1994 Governor's Task Force that was created during the statewide introduction of 500-ppmw sulfur California reformulated diesel. This voluntary level is a Ball-on-Cylinder Lubricity Evaluator (BOCLE) scuffing load (SL) of 3,000 grams or higher. The American Society for Testing and Materials (ASTM) has been working since 1993 to develop a lubricity specification for its D-975 specifications for diesel fuel but to date has not been successful.

The California diesel fuel regulations are a necessary part of the state's strategy to reduce air pollution through the use of clean fuels and lower emitting motor vehicles and off-road equipment. The most recent proposed and adopted regulations to reduce diesel exhaust emissions, exposure, and risk will require the use of low sulfur diesel fuel to be effective.

In October 2001, the ARB adopted the new stringent exhaust emissions standards that were adopted in January 2001 by the U.S. EPA for 2007 and subsequent model year heavy-duty highway diesel engines and vehicles. The new emission standards represent a 90% reduction of emissions of oxides of nitrogen (NOx), a 72% reduction of emissions of non-methane hydrocarbon (NMHC), and a 90% reduction of emissions of particulate matter (PM) compared to the emission standards that apply starting in the 2004 model year. The new emissions standards will require the use of catalyzed diesel particulate filters, NOx after-treatment and other advanced after-treatment based technologies that could not achieve the required efficiency with diesel fuel sulfur levels higher than 15 ppmw.

In August 1998, the ARB identified particulate matter emitted from diesel engines (diesel PM) as a Toxic Air Contaminant (TAC) and in September 2001, approved the Diesel Risk Reduction Plan to reduce public exposure to diesel PM. The plan identified air toxic control measures and regulations that will set more stringent emissions standards for new diesel-fueled engines and vehicles, and establish retrofit requirements for existing engines and vehicles where determined to be technically feasible and cost-effective. The sulfur content of diesel fuel must not exceed 15 ppmw because at higher concentrations, the effectiveness of the emissions control systems is so reduced that the desired emissions reductions for NOx and PM cannot be achieved.

Although the ARB's vehicular diesel fuel regulations do not apply to diesel fuel used in stationary engines, complying "CARB diesel" is used in the great majority of stationary engines because of California's single fuel distribution network. Also, several districts have established best available control technology requirements for diesel-fueled stationary engines that specify the use of CARB diesel. Portable engines registered under ARB's Statewide Portable Equipment Registration program are required to use CARB

diesel. In practice, transportation refrigeration unit (TRU) diesel engines, fueled in California, are normally fueled with California vehicular diesel fuel, but this is not required by existing law. Locomotive and most marine diesel engines are examples of other applications that are not required to use California vehicular diesel fuel. Locomotive diesel engines fueled in California primarily burn diesel fuel complying with the U.S. EPA sulfur content regulation ( $\leq 500$  ppmw) for diesel fuel used in on-road engines. Passenger-fleet, marine diesel engines are required by statute to use California vehicular diesel fuel. It is believed that high-sulfur ( $\leq 5000$  ppmw) diesel fuel is burned in most of the rest of the marine diesel engines fueled in California.

### **Comparable Federal Regulations**

Since 1993, a U.S. EPA regulation – 40 CFR § 80.29 – has imposed a maximum sulfur content limit of 500 ppmw on diesel fuel sold or supplied for use in on-road motor vehicles. In addition, the regulation requires on-road motor-vehicle diesel fuel to have a cetane index of at least 40 or have an aromatic hydrocarbon content of no greater than 35 percent by volume (vol. %). Diesel fuel not intended for on-road motor-vehicle use must contain dye solvent red 164.

On January 18, 2001, the U.S. EPA published a final rule requiring refiners, beginning June 1, 2006, to produce highway diesel fuel that meets a maximum sulfur standard of 15 ppmw. (66 F.R. 5002; 40 C.F.R. §§ 80.500 et seq.). All 2007 and later model year diesel-fueled vehicles must be fueled with this new low sulfur diesel. The federal regulations contain temporary compliance options and flexibility provisions not offered in the ARB's proposed amendments. The temporary federal compliance option, which includes an averaging, banking and trading component, begins in June 2006 and lasts through 2009, with credit given for early compliance before June 2006. Under this temporary compliance option, up to 20 percent of highway diesel fuel may continue to be produced at the existing 500 ppmw sulfur maximum standard. Highway diesel fuel marketed as complying with the 500 ppmw sulfur standard must be segregated from 15 ppmw fuel in the distribution system, and may only be used in pre-2007 model year heavy-duty vehicles. The federal regulation also provides additional hardship provisions that the U.S. EPA believes will minimize the economic burden of the small refiners in complying with the 15-ppmw sulfur standard.

### **The Amendments Adopted in This Rulemaking**

**15-ppmw sulfur limit for vehicular diesel fuel starting in 2006.** Following a July 24, 2003 hearing, the ARB has adopted an amendment that will reduce the maximum allowable sulfur content of vehicular diesel fuel from 500 ppmw to 15 ppmw. This fuel sulfur requirement will apply to diesel fuel sold for use in both on-road and off-road motor vehicles. The 15-ppmw sulfur limit will apply to all diesel supplied from production and import facilities starting no later than June 1, 2006. The limit applies 45 days later – starting July 15, 2006 – to all downstream facilities except bulk plants, retail outlets, and bulk purchaser-consumer facilities. After another 45 days – starting September 1, 2006 –

the 15-ppmw sulfur limit applies throughout the distribution system. These phase-in dates are substantially identical to those in the U.S. EPA regulation. There is an extended phase-in for low-throughput purchaser-consumer facilities and retail outlets.

The ARB has adopted the 15-ppmw sulfur content limit for two primary reasons: to enable the effective use of the emissions control technology that will be required by heavy-duty diesel vehicles and engines that must meet the new PM and NOx emission standards adopted by the U.S. EPA and ARB; and to enable the use of the exhaust treatment technologies that will be required by new and retrofitted diesel engines to meet the diesel PM reduction targets proposed in the diesel risk reduction plan. Current sulfur levels in diesel fuel will prevent effective operation of both the NOx and PM emissions control technologies.

**Revising the procedures for certifying alternative diesel formulations.** The ARB has also adopted the following amendments to the procedures for new certifications of alternative formulations to the 10-percent aromatic hydrocarbon standard: (1) requiring that the reference and candidate fuels meet the proposed 15-ppmw sulfur standard, starting August 2004; (2) requiring that the candidate fuel properties meet the same property ranges and limitations as those required for the reference fuels and be within half the range of each reference fuel property; (3) reducing the allowable tolerance values for each pollutant by half its current value; and (4) eliminating a provision which reduces candidate fuel particulate matter emissions by the lesser of a calculated indirect sulfate difference or the actual measured sulfate content of the emissions.

Various studies have shown that the emissions characteristics of diesel fuel blends may be affected by diesel fuel properties, such as density, that are not among the five specified for alternative fuel formulations. This means that an applicant has been permitted to blend a candidate fuel that has a property such as density that is significantly different from that of the reference fuel. The difference between the two fuels could contribute to an improved emissions performance by the candidate fuel even though there is no assurance that the value of that property in diesel fuels produced commercially under the alternative formulation would be comparable to that of the candidate fuel. The amendments to the alternative diesel formulation provisions are needed to ensure that certified alternative formulations results in equivalent emissions to the candidate fuel formulations tested in the laboratory.

**Add a new “equivalent limits” compliance mechanism in the regulation limiting the aromatic hydrocarbon content of vehicular diesel fuel.** The ARB has adopted an amendment that adds a new alternative compliance mechanism as an option to meeting the 10 vol.% aromatic hydrocarbon limit. A refiner using this mechanism for a batch of diesel fuel has to meet the following specifications:

| Property                    | Equivalent Limit                            |
|-----------------------------|---|
| Aromatic Content (% by wt.) | ≤ 21.0                                      |
| PAH Content (% by wt.)      | ≤ 3.5                                       |
| API Gravity                 | ≥ 36.9                                      |
| Cetane Number               | ≥ 53  |
| Nitrogen Content (ppmw)     | ≤ 500                                       |
| Sulfur (ppmw)               | ≤ 160 before 6/1/06<br>≤ 15 starting 6/1/06 |

This new compliance mechanism will provide additional flexibility for refiners or importers and potentially allow more diesel fuel to be imported into the California market. The new equivalent limits are based on the average properties of certified formulations and should therefore preserve the actual emission benefits of California diesel fuel.

**Revising the sulfur specification for diesel engine certification fuel.** The ARB has established a new sulfur content range of 7 to 15 ppmw by weight for California diesel certification fuel for passenger cars, light-duty trucks, and medium-duty engines, starting in the 2007 model year. This is identical to the sulfur content of federal certification fuel. The specifications for the other fuel properties have not been changed. Manufacturers retain the options to certify diesel engines using certification fuel meeting the federally established certification fuel specifications or an alternative certification test fuel provided they can demonstrate that this test fuel will be the predominant in-use fuel. The new sulfur content range will be representative of the in-use commercial fuel, and as noted above the stringent new standards for 2007 and subsequent model vehicles are predicated on the ability to operate on fuel with the reduced sulfur content.

**Adoption of a diesel fuel lubricity standard.** The ARB has adopted a fuel lubricity standard that will be phased in for all California motor vehicle diesel fuel starting January 1, 2005. The new standard is a High Frequency Reciprocating Rig (HFRR) maximum wear scar diameter (WSD) of 520 microns. This standard is sunsetted if it is adopted by the ASTM and becomes enforceable by the Division of Measurement Standards in the Department of Food and Agriculture. The Board has directed that a technology review be conducted by staff to determine whether a more stringent standard – HFRR maximum WSD of 460 microns or other appropriate standard – should be implemented on the same schedule as the proposed 15-ppmw sulfur limit for diesel fuel.

The ARB believes that a diesel fuel lubricity standard is necessary to ensure that California diesel fuel provides adequate lubrication for fuel systems of existing and future diesel engines. Fuel lubricity levels are expected to be reduced by the more severe hydrotreating that will be needed to lower the sulfur content of diesel fuel to meet the new 15-ppmw sulfur limit. Fuels of low lubricity do not provide adequate lubrication and will contribute to excessive wear resulting in reduced equipment life and performance. A more stringent

second-phase standard may be needed to protect the advanced high-pressure fuel injections systems that will become more prevalent within the next few years.

**ATCM for nonvehicular diesel fuel.** The ARB has also adopted a new Airborne Toxic Control Measure (ATCM) which will ultimately require that California nonvehicular diesel fuel meet the same ARB standards as California vehicular fuel, once air districts have had the opportunity to adopt their own ATCM on the subject. There is an exception for diesel fuel used in locomotives and marine vessels. The ARB's new ATCM will complement and enable the use of high-efficiency, PM emission-control devices for non-vehicular diesel engines.

**Other Amendments.** The ARB has also adopted additional amendments to clarify the requirements of the diesel fuel regulations and to ensure that the regulations work effectively. One amendment replaces the current x-ray fluorescence test method for determining sulfur (ASTM D2622-94) with an ultraviolet fluorescence method (ASTM D5453-93) that will provide a more suitable detection limit and better precision. An exemption from the diesel fuel requirements is established for military-specification diesel fuel used in qualifying military vehicles, closely paralleling provisions in the U.S. EPA regulations. Another amendment revises the definition of "diesel fuel" to include any mixture of predominately liquid hydrocarbons that is sold or represented as suitable for use in internal combustion, compression ignition (diesel cycle) engines. This will clarify the applicability of the diesel fuel regulations and make the definition functionally consistent with the definition for fuel for internal combustion, spark ignition (gasoline) engines. A conforming amendment has also been made to the definition of diesel fuel in the verification procedure and in-use compliance requirements for in-use strategies to control emissions from diesel engines. This amendment will assure that the current effect of the requirements for the verification procedure regulation will not be changed by the expansion of the definition of diesel fuel.