

**ENVIRONMENTAL PROTECTION
AGENCY**

[FRL-8979-4]

**Control of Emissions From New
Highway Vehicles and Engines:
Approval of New Scheduled
Maintenance for Selective Catalyst
Reduction Technologies**

AGENCY: Environmental Protection
Agency (EPA).

ACTION: Notice.

SUMMARY: This notice announces that EPA has granted certain manufacturers new and limited variations in emission-related scheduled maintenance intervals for the replenishment of the nitrogen-containing reducing agent for Selective Catalyst Reduction (SCR) technologies used in light-duty and chassis certified diesel vehicles for model years 2009–2010, and used in heavy-duty diesel vehicles and heavy-duty diesel engines for model years 2009–2011. SCR replenishment is considered critical emission-related maintenance.

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SUPPLEMENTARY INFORMATION: EPA adopted new emission standards for

light-duty vehicles and trucks on February 10, 2000 (65 FR 6698). Similarly EPA adopted new requirements for heavy-duty highway engines and vehicles on January 18, 2001 (66 FR 5002). Diesel engine and vehicle manufacturers have examined the use of several different types of NO_x reduction technologies in order to meet these requirements, including SCR systems which can achieve up to 90% NO_x conversion efficiencies. We expect that most manufacturers will use SCR systems to meet the NO_x reduction requirements for their diesel engines. SCR systems use a nitrogen containing reducing agent that usually contains urea and is known as diesel exhaust fluid (DEF). The DEF is injected into the exhaust gas and requires periodic replenishment by refilling the DEF tank.

Under 40 CFR 86.1834–01(b)(7)(ii) and 86.094–25(b)(7)(ii), a manufacturer must submit a request for approval for any new scheduled maintenance it wishes to recommend to purchasers and perform during durability testing. “New scheduled maintenance” is that maintenance which did not exist prior to the 1980 model year, including that which is a direct result of the implementation of new technology not found in production prior to the 1980 model year. In this instance EPA believes the maintenance of performing DEF refills on SCR systems should be considered as “critical emission-related scheduled maintenance.” EPA believes the existing allowable schedule maintenance mileage intervals applicable to catalytic converters are generally applicable to SCR systems which contain a catalyst, but that the DEF refills are a new type of maintenance uniquely associated with SCR systems. Therefore, the 100,000-mile interval at 40 CFR 86.1834–01(b)(4)(ii) for catalytic converters on diesel-cycle light-duty vehicles and light-duty trucks (and any other chassis-certified vehicles) and the 100,000-mile interval (and 100,000 mile intervals thereafter) for light heavy-duty diesel engines and the 100,000-mile interval (and 150,000 mile intervals thereafter) for medium and heavy heavy-duty diesel engines at 40 CFR 86.004–25(b)(4)(iii) are generally applicable to SCR systems. As noted, the SCR systems are a new type of technology designed to meet the newest emission standards and the DEF refill intervals represent a new type of scheduled maintenance; therefore, EPA believes that manufacturers may request from EPA the ability to perform the new scheduled maintenance of DEF refills. Requests from manufacturers for new

scheduled maintenance intervals must include: (1) Detailed evidence supporting the need for the maintenance requested and (2) supporting data or other substantiation for the recommended maintenance category and for the interval suggested for the emission maintenance. Any emission-related maintenance must be technologically necessary to assure in-use compliance with the emission standards since minimum service intervals are established in part to ensure that the control of emissions is not compromised by a manufacturer's overly frequent scheduling of emission-related maintenance.

EPA has received information from the Alliance of Automobile Manufacturers (the Alliance)¹ indicating that it is technologically necessary and otherwise appropriate for light-duty vehicles and light-duty trucks to refill the DEF at intervals equal to the applicable vehicle's scheduled oil change interval for the 2009 and 2010 model years. The Alliance maintains that such vehicles do not yet have the carrying and storage capacity required for the quantity of DEF needed to satisfy the much longer maintenance intervals such as the 100,000 mile scheduled maintenance interval generally applicable to catalytic converters. In addition to the limited space available on vehicles for a large DEF tank, the Alliance also indicates that vehicles will be designed and equipped to ensure vehicle compliance with emission standards, DEF will be readily available and accessible to drivers, and that maintenance is likely to be performed.

EPA generally receives “new scheduled maintenance” requests, under 40 CFR 86.1834–01(b)(7)(ii) and 86.094–25(b)(7), from individual manufacturers. However, as discussed below EPA knows of no SCR technology for any light-duty or chassis certified vehicle that is yet capable of attaining higher mileage without a DEF refill. For example, one SCR light-duty vehicle in current production must find space to accommodate an 8 gallon DEF tank in addition to the separate fuel tank of 21 gallons in order to meet the oil change interval target. Assuming an oil change interval even of 10,000 miles in an 8 gallon DEF tank scenario, then a DEF tank size of 80 gallons would be required to meet a 100,000 mile DEF refill maintenance interval. Even a 16–20 gallon DEF tank (to meet a 2 oil

change interval) would interfere with the space that is necessary for typical light-duty vehicle design and transportation needs of the consumer. Interior cabin volume and cargo space are highly valued attributes in light-duty vehicles. Manufacturers have historically strived to optimize these attributes, even to the point of switching a vehicle from rear-wheel drive to front-wheel drive to gain the extra interior cabin space taken up by where the drive shaft tunnel existed, or switching the size of the spare tire from a conventional sized tire to a small temporary tire to gain additional trunk space. Thus any significant interior, cargo or trunk space used to store a DEF tank would be unacceptable to customers. There are also packaging concerns with placing a large DEF tank in the engine compartment or in the vehicles undercarriage. Most vehicle undercarriages are already crowded with the engine, exhaust system, including catalytic converters and mufflers, fuel tank, *etc.* limiting any available space for a DEF tank.

In addition to the inherently space constrained areas on the vehicle to place both fuel tanks and DEF tanks (an additional 8 gallon tank represents a very significant demand for space) the addition of the weight associated with the DEF represents significant concerns (*e.g.* performance and efficient operation) on the operation of the vehicle. For example, assuming a density of 9 lb/gallon, an 8 gallon DEF tank represents an additional 72 lbs on a vehicle already looking to optimize performance. Adding additional DEF tank size to even accommodate a two-oil change interval is not feasible given these weight constraints. EPA expects manufacturers to face similar and significant engine or fuel tank compartment size and configuration constraints and to expend substantial effort to accommodate similar DEF tank and fuel tank size ratios. Therefore, EPA finds it appropriate to approve the DEF refill interval as requested for all light-duty vehicle and light-duty truck and other chassis certified vehicles in the 2009 or 2010 model years for manufacturers that are members of the Alliance of Automobile Manufacturers. For any manufacturers of light-duty vehicles and light-duty trucks that are not members of the Alliance of Automobile Manufacturers that introduce SCR technology in the 2009 or 2010 model years, such manufacturers would need to request this schedule separately, but we would expect to grant a similar maintenance schedule, based on the fact that SCR systems operate in

¹ The Alliance of Automobile Manufacturers represents BMW Group, Chrysler Group, Ford Motor Company, General Motors, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche, Toyota, and Volkswagen Group of America.

a similar manner that would similarly implicate the maintenance interval issues discussed above.

EPA believes it important to note that while not a specific criteria under paragraph (b)(7) of the regulations, because the DEF refill maintenance is considered "critical emission-related maintenance," paragraph (b)(6) requires that there be a reasonable likelihood that the DEF maintenance refill will be performed in use. See §§ 86.1834–01(b)(6)(ii) and 86.094–25(6)(ii). EPA finds that it is likely such maintenance will be performed. A number of means are available to make this showing, including a clearly displayed visible signal system approved by the Administrator or data is presented which establishes for the Administrator a connection between emissions and vehicle performance such that as emissions increase due to lack of maintenance, vehicle performance will simultaneously deteriorate to a point unacceptable for typical driving.

As discussed in EPA's Dear Manufacturer Letter of March 27, 2007 ("Certification Procedure for Light-Duty and Heavy-Duty Diesel Vehicles and Heavy-Duty Diesel Engines Using Selective Catalyst Reduction (SCR) Technologies" reference number CISD–07–07 (LDV/LDT/MDPV/HDV/HDE), an SCR system utilizing a reducing agent that needs to be periodically replenished would meet the definition set forth in §§ 86.094–22(e)(1) and 86.1833–01(a)(1) and could be considered an adjustable parameter by the Agency. The regulations establish the requirements for determining the physically adjustable ranges of parameters, and EPA issued non-binding guidance in the March 27, 2007 Dear Manufacturer Letter concerning the determination under the regulations of whether operation without DEF is within the scope of such range for the particular engine. SCR design and manufacturer submitted information in that context can be used to assure that the DEF levels remain at proper ranges during the operation of the engine.

In addition, EPA notes that DEF refill maintenance interval being equivalent and occurring with the oil change interval is a fairly long interval (e.g. 7,500 to 12,500 miles) and is not likely to result in the overly frequent maintenance under typical vehicle driving. EPA also believes that an adequate DEF supply will be available to perform the DEF refills at the stated intervals. EPA believes it important to also consider when, where and how often vehicle owners or operators are most likely to perform the DEF refill maintenance. For light-duty vehicles

and light-duty trucks EPA believes the requested DEF refill interval's association with the oil change interval is appropriate given the likelihood of DEF availability at service stations and the likelihood that DEF refill would occur during such service. The Agency has limited this approval to 2009 and 2010 model years due to the expectation that SCR related technologies and the urea infrastructure will continue to develop and mature and EPA plans to revisit this category of vehicles to determine appropriate future intervals. Should manufacturers continue to believe that the identified interval or other intervals are technologically necessary or otherwise appropriate after the 2010 model year we expect them to take this up with the Agency in a timely manner.

EPA has also received requests from Volvo Powertrain, Cummins, and from the Engine Manufacturers Association² seeking a series of DEF refill maintenance intervals for certain categories of heavy-duty engine applications. For vocational vehicles such as dump trucks, concrete mixers, refuse trucks and similar typically centrally fueled applications, the manufacturers believe the DEF tank refill interval should equal the range (in miles or hours) of the vehicle operation that is no less than the vehicle's fuel capacity (i.e., a 1:1 ratio). For all other vehicles equipped with a constantly viewable DEF level indicator (e.g. a gauge or other mechanism on the dashboard that will notify the driver of the DEF fill level and the ability to warn the driver of the necessity to refill the DEF tank before other inducements (noted below) occur), the DEF tank refill interval must provide a range of vehicle operation that is no less than twice the range of vehicle's fuel capacity (i.e., a 2:1 ratio) and for all other vehicles that do not have a constantly viewable DEF level indicator the DEF tank refill interval must provide a range of vehicle operation that is no less than three times the range of the vehicle's fuel capacity (i.e., a 3:1 ratio).

EPA believes it is reasonable to base the DEF refilling event on diesel

refueling intervals given that it is likely that the DEF refill maintenance would be undertaken at the time of fuel refill due to DEF infrastructure developed at diesel refueling stations. EPA agrees with manufacturers that the DEF refilling intervals requested are technologically necessary. EPA knows of no SCR technology for any heavy-duty engine application that is yet capable of attaining higher mileage without a DEF refill. As an example, assuming that 25,000 gallons of diesel fuel were consumed to reach a 150,000 mile interval, the amount of DEF required (assuming a 3% DEF consumption rate) would require 750 gallons of DEF weighing approximately 6,750 lbs. A line-haul truck is allowed a maximum gross vehicle weight of 85,000 lbs of which approximately 45,000 pounds is for cargo carrying. A DEF tank of this size would reduce the cargo-carrying capacity by 15%. Another example from the line haul industry suggests that a DEF tank size of over 900 gallons would be needed, to reach the 150,000 mile interval, for a common highway vehicle with a diesel fuel capacity of 200 gallons and achieving 6.5 miles per gallon fuel efficiency. Similarly, a medium heavy-duty engine ("chassis cabs") example would require 375 gallons of DEF weighing 3,275 lbs to meet a 150,000 mile interval. EPA believes that such tank sizes are clearly not technologically feasible in light of the weight and space demands and constraints on heavy-duty trucks and the consumer demand for as much cargo carrying capacity as possible.

The Agency has also received information demonstrating that longer intervals than those requested by the manufacturers would require DEF tanks that are too large or too heavy to be feasibly incorporated into vehicles. Manufacturer representatives note that available data show that heavy-duty engines equipped with SCR-based systems will consume DEF at a rate that is approximately 2%–4% of the rate of diesel fuel consumption. Because of inherent space and weight constraints in the configuration and efficient operation of heavy-duty vehicles, there are size limits on the DEF tanks. Currently, there are truck weight limits that manufacturers must address when making, adding or modifying truck designs. EPA expects and believes that manufacturers are taking significant and appropriate steps in order to install reasonably sized DEF tanks to achieve the DEF refills intervals noted. For example, manufacturers are taking such steps as reducing the number of battery

² The Engine Manufacturers Association (EMA) represents, among others, American Honda Motor Company, Inc., Briggs & Stratton Corp., Caterpillar Inc., Chrysler LLC, CNH Global N.V., Cummins Inc., Daimler Trucks North America LLC, Deere & Company, Deutz Corporation, Dresser Waukesha, Fiat Powertrain Technologies S.p.A., Kohler Company Inc., Komatsu Ltd., Kubota Engine America Corp., MTU Detroit Diesel Inc., Ford Motor Company, General Motors Corp., Hino Motors Ltd., Isuzu Manufacturing Services of America, Navistar Inc., Onan—Cummins Power Generation, PACCAR Inc., Scania CV AB, Volkswagen of America Inc., Wartsala North America, Inc., Yamaha Motor Corporation, and Yanmar America Corporation.

packs on vehicles despite customer demands or designing space saver configurations, in some instances extending an already very limited frame rail distance to incorporate the DEF tanks and SCR systems, moving compressed air tanks inside the frame rails, redesigning fuel tank configurations at significant cost, and otherwise working with significant size and weight constraints to incorporate DEF tanks. EMA notes that there are several factors that support the good engineering judgment that underlies the recommended DEF refill intervals. The great majority of heavy-duty engines produced will provide a range of vehicle operation that is no less than twice the range of the vehicle's fuel capacity; thus, the DEF tank size will provide at least double the vehicle's operating range as provided by the fuel tank. EMA notes that vehicle operators will generally refill DEF at the same time and location that they refill the tanks; thus, these vehicles will already be carrying twice as much DEF as the SCR system could ever consume between refills.

EPA was provided with examples of the consequences of requiring heavy-duty vehicles to accommodate a DEF refill interval of 5:1, and the information provided to the Agency strongly suggested that great compromises would be required in cost, weight and utility. Increased tank sizes and weights on the magnitude of 150 to 325 lbs. would be required and in some cases diesel fuel volumes would need to be reduced. The extra weight associated with the DEF required to meet the 2:1 or 3:1 refill intervals (again, operators are expected to refill the DEF and each diesel fuel refilling event) represents a significant challenge to manufacturers seeking to meet both weight and size requirements for their vehicle designs. EPA believes that in light of the existing tight space constraints and the overall desire to maximize cargo-carrying capacity to minimize emissions and meet consumer operational demands, and the built-in DEF tank size buffer to insure DEF refills, that the tank DEF tank sizes associated with the 2:1 refill and 3:1 intervals are technologically necessary. EPA believes that requiring tank sizes above these ratios will cause increases in space constraints and weight that would not be appropriate for these vehicles. Similarly, manufacturers note that only a small number of applications will employ the 1:1 refilling ratio and that such vehicle applications have very limited vehicle space available to house surplus DEF. Such applications (e.g., a garbage truck, concrete mixer, beverage

truck, or airport refueler) will also be refueled daily at central locations. At approximately 0.134 ft³ per gallon, any extra DEF would displace significant space available to vehicle components and subsystems on both the vocational trucks at the 1:1 refill interval as well as the 2:1 and 3:1 vehicles.

After reviewing this data and information, EPA believes that longer refill intervals than those noted above would require larger and heavier DEF tanks, and the design and engineering work performed by manufacturers thus far indicate that the recommended DEF refill intervals noted above approximate the maximum feasible maintenance intervals associated with reasonable DEF tank sizes. The maintenance intervals recommended ensure that the functions and operational efficiency of such vehicles are not overly compromised. Based on this information we believe the intervals noted above are warranted.

Therefore, EPA finds it appropriate to approve the DEF refill intervals as requested by Volvo, Cummins, and for all heavy-duty engine manufacturers that are represented by EMA. For any manufacturers of heavy-duty engines that are not members of EMA that introduce heavy-duty engines with SCR technology, such manufacturers would need to request this schedule separately. EPA expects it would grant a similar maintenance schedule based on the fact that SCR systems run in a similar manner that would similarly implicate the maintenance interval issues discussed above. In addition, to make use of the intervals noted above, manufacturers must indicate their intention in the applications for certification, including how the above requirements will be met.

The Agency has limited this approval to model years 2009 to 2011 due to the expectation that SCR-related technologies and the urea infrastructure will continue to develop and mature, and EPA plans to revisit this category of vehicles to determine appropriate future intervals. Should manufacturers continue to believe that the identified interval or other intervals are technologically necessary or otherwise appropriate after the 2011 model year, we expect them to take this up with the Agency in a timely manner.

EPA believes it important to note that while not a specific criteria under paragraph (b)(7) of the regulations, there are a number of factors helping to provide confidence that the DEF refill maintenance intervals noted above are likely to be properly performed. First, because DEF refills are considered "critical emission-related maintenance,"

manufacturers are "required to show the reasonable likelihood of such maintenance being performed in use." (See §§ 86.1834(b)(6)(ii) and 86.094–25(6)(ii)). A number of means are available to make this showing, including a clearly displayed visible signal system approved by the Administrator, or data is presented which establishes for the Administrator a connection between emissions and vehicle performance such that as emissions increase due to lack of maintenance, vehicle performance will simultaneously deteriorate to a point unacceptable for typical driving.

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Dated: November 3, 2009.

Gina McCarthy,

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