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August 30, 2018

VIA EMAIL AND FEDERAL EXPRESS
Mr. Patrick Patterson
Regional Director
PADEP Southeast Regional Office
2 East Main Street
Norristown, PA 19401

Re: Richard E. Pierson Material Corporation
Existing Hanson Quarry located at 2205 North Rockhill Road, Sellersville, Bucks County, PA
General Permit Applications for Hot Mix Asphalt Plant and Diesel Engines
Response to letter from East Rockhill Township Board of Supervisors Dated August 20, 2018

Dear Mr. Patterson:

As you know, our firm represents the Richard E. Pierson Materials Corporation ("Pierson") which filed general permit (GP) applications to operate a hot mix asphalt plant and temporary diesel engines at the existing Hanson Quarry located at 2205 North Rockhill Road in Sellersville, Bucks County. Those applications are currently undergoing review by your office. Pierson recently received a copy of a letter, dated August 20, 2018, sent to you by Marianne Morano, the Township Manager for East Rockhill Township ("East Rockhill"). In its letter, East Rockhill did the following: (1) Requested copies of several pieces of correspondence referenced in my letter to you dated August 10, 2018; (2) Provided technical comments on the GP applications; and (3) Took exception to my use of the term "red herrings" in addressing the Township's prior request that the Department apply its land use policy to the review of these Applications. Pierson asserts that its GP Applications are in full compliance with the applicable regulations and that none of the comments provided by East Rockhill provide any basis for delaying the review and approval of those GP Applications.

As to East Rockhill's request for copies of correspondence, I want to let you know that copies of the requested correspondence were previously provided by our office to the

Township's Solicitor, Patrick Armstrong, Esq. It is unclear why the Township Manager needs to ask you for copies, when they already have them in their possession. Nevertheless, by copy of this letter to Attorney Armstrong, we will provide him with additional copies of the referenced letters if he needs them.

As to East Rockhill's technical comments on the GP applications, Pierson provides the following technical responses:

Comment 1: The revised application purports to revise the prior emission estimate based on "actual rated capacity" of the hot mix asphalt plant at 250 tons per hour and 500,000 tons per year. Pierson has likewise reduced its initial estimate of NOx emissions associated with proposed diesel engine 1, using a lower emission factor, but does not explain the basis for its revision in this regard. The Township is concerned that these reduced emission estimates are not practically enforceable through the general permit; specifically, Pierson does not offer any explanation of the means by which it will ensure compliance with the reduced hourly production rates. Given that operation at the maximum production capacity (even at reduced hours of operation) would cause the facility to exceed the major threshold for NOx, the Township believes that Pierson should not be allowed to operate pursuant to the general permit, and instead should be required to apply for an individual plan approval and operating permit that would be precisely tailored to its proposed operation. Further, in light of the significant revision to Pierson's initial General Permit Application and in order to fully consider the revised application and these comments thereto, the Township requests that the Department commence its thirty-day review period for the application as the date of its receipt of the revised application package.

Response: Condition Number 5 of GP-13 states that "the potential to emit of any HMA plant proposing to operate under this General Permit shall be limited by hours of operation, production rate and other relevant specifications in the application." For this reason, Pierson is required to set limitations on its operation. Specifically, Pierson has requested 2000 hours of operation during any rolling 12-month period and a maximum production rate of 500,000 tons during any rolling 12-month period. In addition, Pierson has requested that the temporary engines not operate more than 1040 hours. For compliance demonstration purposes, a rolling 12-month period (i.e., every consecutive 12-month period) is used and would require Pierson to demonstrate compliance 12 times a year rather than once as would be required if the period in question were a calendar year.

The emission factors for the two larger engines (800 kW and 200kW) have been revised in order to better reflect the actual emissions from the engines. The revised emissions of NOx are based upon the certification levels (CERT) of emissions for the specific engine

family for each engine. Copies of the Executive Orders issued by the California Air Resources Board (CARB) were included in the Application and are shown in Attachment 1. For the 200 kW engine, the Emission Standard Category is "Tier 4 Final/ALT 5% NOx." As described in Attachment 2, as an alternative to introducing the required percentage of Tier 4-compliant engines, the manufacturer has certified the engine to an "alternative NOx limit" for this model which is allowed during the Tier 4 phase in period. The alternative NOx standard is 2.0 grams/kW-hour (1.5 grams/hp-hour). The engine family was actually certified to perform at a level lower than the alternative standards and the CERT level is under the standard at 1.83 g/kW-hour (1.37 g/hp-hour) and was used to calculate the NOx emissions.

The annual average hourly production rate of 250 tons is an estimate, is not a specific limit and is not intended to be enforceable and does not relate to any specific standards. Rather, as mentioned above, the enforceable limits will be 2000 hours of operation and 500,000 tons of HMA production during any rolling 12-month period which will be used to monitor compliance with the applicable NOx limit. Pierson will be required to monitor and record, at least on a monthly and annual basis, the hours of operation and production of the HMA plant. As outlined in Conditions 14(a) and (c), specific requirements and emission limits have been established which Pierson has to meet. In addition, Condition 15 requires that detailed stack tests be performed to quantify the emission rates of NOx, CO, VOC and PM. Compliance with the specific emission limits must be demonstrated. Finally, as shown in Condition 16 of the general permit, specific operating parameters have to be monitored and recorded including, as mentioned above, the hours of operation and the production rate. Through these specific conditions, Pierson will demonstrate compliance with all applicable emissions limits and operational restrictions.

In conclusion, Pierson will be able to meet the applicability requirements and all the other requirements established in the general permit and, therefore, will not have to apply for a plan approval.

Comment 2: Mr. Bolstein contends in his letter that the GP-9 would not require stack testing of proposed engine 1, which has a rated capacity greater than 500 horsepower, because "the proposed engine is a Tier 4 engine and the best available technology requirements have been applied." The Township requests that the Department carefully review this contention because the conditions of the GP-9 do not appear to exempt a Tier 4 engine from otherwise applicable stack testing requirements.

Response: Condition 7 of the general permit establishes emissions limits for diesel engines. Condition 8 deals with performance testing which may be required to demonstrate compliance with the established emissions limits. As was stated in my August 10, 2018 letter, the performance testing required under Condition 8(b) of the general permit only applies to engines that do not have the best available technology. Tier 4 engines use the best available technology and are pre-certified by the US EPA and the California Air Resources Board (CARB) to meet the established federal emissions standards and avoid the need for stack testing. Since this Tier 4 engine has been pre-certified and uses the best available technology, stack testing will not be required.

Lastly, East Rockhill took exception to my use of the term "red herrings". Let me be clear. I am not saying that the Department should ignore any comments submitted by East Rockhill. To the contrary, as you have seen from the technical responses included in this letter and the prior letters I have submitted in response to letters submitted by the Township, Pierson contends that every one of the technical comments submitted by the Township are easily addressed. None of them should delay the Department's review of the applications and issuance of the GPs. I used the term "red herrings" because anyone who quickly thumbed through the Land Use Policy would readily see that it does not apply to the review of these GP applications. As proof, Section II of the Land Use Policy specifically states: "Any authorization not appearing on the list is not required to undergo the land use review outlined in this policy." GP-9 and GP-13 do not appear anywhere on the list, so the Land Use Policy clearly and unambiguously does not apply. I'll also point out to you that rock processing operations have already been approved by the Department at this very same quarry, pursuant to a GP which was issued on 3/14/18, and allows for the use of a jaw crusher, rock crusher and screens to process extracted noncoal minerals, and the review of that GP application was not subjected to the Land Use Policy. Again, because the GPs are not on the list.

Under Governor Wolf and Secretary McDonnell, the Department recently announced plans to streamline and modernize permitting practices to cut review timelines. These GP applications are not that complicated. East Rockhill has provided no basis whatsoever for delaying the review. Pierson's position continues to be that the GP applications fully comply with the applicable regulations and the Department should issue the GPs without delay.

If you have any questions or would like to discuss this matter further, please feel free to contact me.

Sincerely,

M. Joel Bolstein

MJB:ajw
Attachments
cc: Robert W. Gundlach, Jr., Esq. (via email)
Sachin Shankar, Assistant Regional Director, DEP Southeast Regional Office (via email)
James Rebarchak, Air Quality Program Manager, DEP Southeast Regional Office (via email)
Patrick Armstrong, Esq., Township Solicitor (via email)
Marianne K. Morano, Township Manager and Zoning Officer (via email)
Michael D. Logan, Vice President, Compliance Plus Services (via email)
Craig Holdefer, Program Manager, Compliance Plus Services (via email)
Richard E. Pierson, President, Richard E. Pierson Materials Corporation (via email)
Curtis Mitchell, Facility Director, Richard E. Pierson Materials Corporation (via email)

Attachment 1

California Environmental Protection Agency Air Resources Board	CATERPILLAR INC.	EXECUTIVE ORDER U-R-001-0486 New Off-Road Compression-Ignition Engines

Pursuant to the authority vested in the Air Resources Board by Sections 43013, 43018, 43101, 43102, 43104 and 43105 of the Health and Safety Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-02-003;

IT IS ORDERED AND RESOLVED: That the following compression-ignition engines and emission control systems produced by the manufacturer are certified as described below for use in off-road equipment. Production engines shall be in all material respects the same as those for which certification is granted.

MODEL YEAR	ENGINE FAMILY	DISPLACEMENT (liters)	FUEL TYPE	USEFUL LIFE (hours)
2014	ECPXL27.0HYA	27.0	Diesel	8000

SPECIAL FEATURES & EMISSION CONTROL SYSTEMS	TYPICAL EQUIPMENT APPLICATION
Electronic Direct Injection, Turbocharger, Charge Air Cooler, Engine Control Module, Exhaust Gas Recirculation	Generator

The engine models and codes are attached.

The following are the exhaust certification standards (STD), or family emission limit(s) (FEL) as applicable, and certification levels (CERT) for hydrocarbon (HC), oxides of nitrogen (NOx), or non-methane hydrocarbon plus oxides of nitrogen (NMHC+NOx), carbon monoxide (CO), and particulate matter (PM) in grams per kilowatt-hour (g/kw-hr), and the opacity-of-smoke certification standards and certification levels in percent (%) during acceleration (Accel), lugging (Lug), and the peak value from either mode (Peak) for this engine family (Title 13, California Code of Regulations, (13 CCR) Section 2423):

RATED POWER CLASS	EMISSION STANDARD CATEGORY		EXHAUST (g/kw-hr)					OPACITY (%)		
			HC	NOx	NMHC+NOx	CO	PM	ACCEL	LUG	PEAK
560 kW < GEN ≤ 900 kW	Interim Tier 4	STD	0.40	3.5	N/A	3.5	0.10	N/A	N/A	N/A
		FEL	N/A	3.3	N/A	N/A	N/A	N/A	N/A	N/A
		CERT	0.14	3.1	--	0.6	0.05	--	--	--

BE IT FURTHER RESOLVED: That the family emission limit(s) (FEL) is an emission level declared by the manufacturer for use in any averaging, banking and trading program and in lieu of an emission standard for certification. It serves as the applicable emission standard for determining compliance of any engine within this engine family under 13 CCR Sections 2423 and 2427.

BE IT FURTHER RESOLVED: That for the listed engine models, the manufacturer has submitted the information and materials to demonstrate certification compliance with 13 CCR Section 2424 (emission control labels), and 13 CCR Sections 2425 and 2426 (emission control system warranty).

Engines certified under this Executive Order must conform to all applicable California emission regulations.

This Executive Order is only granted to the engine family and model-year listed above. Engines in this family that are produced for any other model-year are not covered by this Executive Order.

Executed at El Monte, California on this 30th day of October 2013.

Erik White, Chief
Mobile Source Operations Division

California Environmental Protection Agency **Air Resources Board**	CATERPILLAR INC.	EXECUTIVE ORDER U-R-001-0506 New Off-Road Compression-Ignition Engines

Pursuant to the authority vested in the Air Resources Board by Sections 43013, 43018, 43101, 43102, 43104 and 43105 of the Health and Safety Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-14-012;

IT IS ORDERED AND RESOLVED: That the following compression-ignition engines and emission control systems produced by the manufacturer are certified as described below for use in off-road equipment. Production engines shall be in all material respects the same as those for which certification is granted.

MODEL YEAR	ENGINE FAMILY	DISPLACEMENT (liters)	FUEL TYPE	USEFUL LIFE (hours)
2015	FCPXL7.01HPF	7.01	Diesel	8000

SPECIAL FEATURES & EMISSION CONTROL SYSTEMS	TYPICAL EQUIPMENT APPLICATION
Electronic Direct Injection, Turbocharger, Charge Air Cooler, Diesel Oxidation Catalyst, Engine Control Module, Exhaust Gas Recirculation, Periodic Trap Oxidizer	Generator, Motorgrader, Feller Buncher

The engine models and codes are attached.

The following are the exhaust certification standards (STD), or family emission limit(s) (FEL) as applicable, and certification levels (CERT) for hydrocarbon (HC), oxides of nitrogen (NOx), or non-methane hydrocarbon plus oxides of nitrogen (NMHC+NOx), carbon monoxide (CO), and particulate matter (PM) in grams per kilowatt-hour (g/kw-hr), and the opacity-of-smoke certification standards and certification levels in percent (%) during acceleration (Accel), lugging (Lug), and the peak value from either mode (Peak) for this engine family (Title 13, California Code of Regulations, (13 CCR) Section 2423):

RATED POWER CLASS	EMISSION STANDARD CATEGORY		EXHAUST (g/kw-hr)					OPACITY (%)		
			HC	NOx	NMHC+NOx	CO	PM	ACCEL	LUG	PEAK
130 ≤ kW ≤ 560	Tier 4 Final/ALT 5% NOx	STD	0.19	0.40	N/A	3.5	0.02	N/A	N/A	N/A
		FEL	N/A	2.00	--	N/A	N/A	N/A	N/A	N/A
		CERT	0.03	1.83	--	0.2	0.004	--	--	--

BE IT FURTHER RESOLVED: That the family emission limit(s) (FEL) is an emission level declared by the manufacturer for use in any averaging, banking and trading program and in lieu of an emission standard for certification. It serves as the applicable emission standard for determining compliance of any engine within this engine family under 13 CCR Sections 2423 and 2427.

BE IT FURTHER RESOLVED: That for the listed engine models, the manufacturer has submitted the information and materials to demonstrate certification compliance with 13 CCR Section 2424 (emission control labels), and 13 CCR Sections 2425 and 2426 (emission control system warranty).

Engines certified under this Executive Order must conform to all applicable California emission regulations.

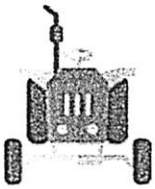
This Executive Order is only granted to the engine family and model-year listed above. Engines in this family that are produced for any other model-year are not covered by this Executive Order.

Executed at El Monte, California on this 14TH day of November 2014.

[signature]

FOR Annette Hebert, Chief
Emissions Compliance, Automotive Regulations and Science Division

Attachment 2



US: NONROAD: EMISSIONS

OVERVIEW

Emissions standards for non-road engines exempt locomotives, marine vessels, underground mining equipment, and small hobby engines. US Tier 4 came fully into effect for non-road engines in 2015, and the state of California has imposed standards that are stricter than those of the federal government.

Standard type
Conventional pollutant emission limits

Regulating Body
US Environmental Protection Agency (EPA)

Current Standard
Tier 4

Applicability
New nonroad vehicles and equipment

Contents

Categories

UNITED STATES NONROAD

HISTORY

Tier 1-3 Standards – The first federal standards (Tier 1, 40 CFR Parts 9 and 89) for new nonroad (or off-road) diesel engines were adopted in 1994 for engines over 37 kW (50 hp) and phased-in from 1996 to 2000. In 1996, a Statement of Principles (SOP) for nonroad diesel engines was signed between EPA, California ARB and engine makers. On August 27, 1998, EPA signed the final rule reflecting the provisions of the SOP and introduced Tier 1 standards to be phased in between 2000 and 2008 for equipment under 37 kW (50 hp) with subsequent, stricter Tier 2 and Tier 3 standards for all equipment. Tier 1-3 standards were met through advanced engine design, with no or limited use of exhaust gas aftertreatment (oxidation catalysts). Tier 3 standards for NOx+HC are similar in stringency to the 2004 standards for highway engines, however Tier 3 standards for PM were never adopted.

Tier 4 Standards – On May 11, 2004, EPA adopted Tier 4 emission standards to be phased-in between 2008 and 2015. Tier 4 standards require emissions of PM and NOx be reduced by 90% from Tier 1-3 standards. Tier 4 standards can be achieved through the use of control technologies – including advanced exhaust gas aftertreatment – similar to those required by the 2007-2010 standards for heavy-duty highway engines. Detailed information about the Tier 4 regulations is available at the EPA Tier 4 website.

California – The federal Clean Air Act Amendments of 1990 preempted California's authority to control emissions from new farm and construction equipment under 175 hp. Clean Air Act Section 209 (e) required California's rules for other off-road sources to be approved by EPA. Additional information on California's interaction with EPA can be found at the California Waiver Federal Register website.

TECHNICAL STANDARDS

APPLICABILITY

The nonroad standards cover mobile nonroad diesel engines of all sizes used in a wide range of construction, agricultural and industrial equipment. The EPA definition of the "nonroad engine" is based on the principle of mobility / portability, and includes

engines installed on (1) self-propelled equipment, (2) on equipment that is propelled while performing its function, or (3) on equipment that is portable or transportable, as indicated by the presence of wheels, skids, carrying handles, dolly, trailer, or platform. In other words, nonroad engines are all internal combustion engines except motor vehicle (highway) engines, stationary engines (or engines that remain at one location for more than 12 months), engines used solely for competition, or engines used in aircraft. Examples of regulated applications include farm tractors, excavators, bulldozers, wheel loaders, backhoe loaders, road graders, diesel lawn tractors, logging equipment, portable generators, skid steer loaders, or forklifts. Further information can be found in the legislative text.

California – Effective May 14, 2003, the definition of nonroad engines changed to also include all diesel powered engines – including stationary ones – used in agricultural operations in California. This change applies only to engines sold in the state of California; stationary engines sold in other states are not classified as nonroad engines.

Exemptions – The nonroad diesel emission regulations are not applicable to all nonroad diesel engines. Exemptions include:

- Engines used in railway locomotives – Subject to separate EPA regulations. See the US Locomotive Emissions page.
- Engines used in marine vessels – Subject to separate EPA regulations. Marine engines below 37 kW (50 hp) are subject to Tier 1-2, but not Tier 4, nonroad standards. Certain marine engines that are exempted from marine standards may be subject to nonroad regulations. See the US Marine Emissions page.
- Engines used in underground mining equipment – Diesel emissions and air quality in mines are regulated by the Mine Safety and Health Administration (MSHA).
- Hobby engines (below 50 cm^3 per cylinder)

Emission standards listed in the tables below must be met over the entire useful life of the engine. See Engine Useful Life below for more information.

TIER 1-3 EMISSION STANDARDS

Tier 1 standards were phased-in from 1996 to 2000, Tier 2 from 2001 to 2006, and Tier 3 from 2006 to 2008 (Tier 3 standards apply only for engines with 37-560 kW).

A new definition of a compression-ignition (diesel) engine was used in the regulatory language starting with Tier 2 that was consistent with definitions established for highway engines. The definition focuses on the engine cycle, rather than the ignition mechanism, with the presence of a throttle as an indicator to distinguish between diesel-cycle and otto-cycle operation. Regulating power by controlling the fuel supply in lieu of a throttle corresponds with lean combustion and diesel-cycle operation. This language allows the possibility that a natural gas-fueled engine equipped with a sparkplug is considered a compression-ignition engine.

The regulations include several other provisions, such as averaging, banking and trading of emission credits and maximum "family emission limits" (FEL) for emission averaging.

Tier 1-3 emissions limits are listed below. Nonroad regulations are in the metric system of units, with all standards expressed in grams of pollutant per kWh. Engines of all sizes must also meet smoke standards of 20/15/50% opacity at acceleration/lug/peak modes, respectively.

EPA Tier 1-3 Nonroad Diesel Engine Emission Standards, g/kWh (g/bhp·hr)

Engine Power	Tier	Year	CO	HC	NMHC+NOx	NOx	PM
kW < 8 (hp < 11)	Tier 1	2000	8.0 (6.0)	–	10.5 (7.8)	–	1.0 (0.75)
	Tier 2	2005	8.0 (6.0)	–	7.5 (5.6)	–	0.8 (0.6)
8 ≤ kW < 19 (11 ≤ hp < 25)	Tier 1	2000	6.6 (4.9)	–	9.5 (7.1)	–	0.8 (0.6)
	Tier 2	2005	6.6 (4.9)	–	7.5 (5.6)	–	0.8 (0.6)
19≤ kW < 37 (25 ≤ hp < 50)	Tier 1	1999	5.5 (4.1)	–	9.5 (7.1)	–	0.8 (0.6)
	Tier 2	2004	5.5 (4.1)	–	7.5 (5.6)	–	0.6 (0.45)
37 ≤ kW < 75 (50 ≤ hp < 100)	Tier 1	1998	–	–	–	9.2 (6.9)	–
	Tier 2	2004	5.0 (3.7)	–	7.5 (5.6)	–	0.4 (0.3)
	Tier 3	2008	5.0 (3.7)	–	4.7 (3.5)	–	-†
75 ≤ kW < 130 (100 ≤ hp < 175)	Tier 1	1997	–	–	–	9.2 (6.9)	–
	Tier 2	2003	5.0 (3.7)	–	6.6 (4.9)	–	0.3 (0.22)
	Tier 3	2007	5.0 (3.7)	–	4.0 (3.0)	–	-†
130 ≤ kW < 225 (175 ≤	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	–	9.2 (6.9)	0.54 (0.4)
	Tier 2	2003	3.5 (2.6)		6.6 (4.9)		0.2 (0.15)

Engine Power	Tier	Year	CO	HC	NMHC+NOx	NOx	PM
hp < 300)	Tier 3	2006	3.5 (2.6)	–	4.0 (3.0)	–	-†
225 ≤ kW < 450 (300 ≤ hp < 600)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	–	9.2 (6.9)	0.54 (0.4)
	Tier 2	2001	3.5 (2.6)	–	6.4 (4.8)	–	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	–	4.0 (3.0)	–	-†
450 ≤ kW < 560 (600 ≤ hp < 750)	Tier 1	1996	11.4 (8.5)	1.3 (1.0)	–	9.2 (6.9)	0.54 (0.4)
	Tier 2	2002	3.5 (2.6)	–	6.4 (4.8)	–	0.2 (0.15)
	Tier 3	2006	3.5 (2.6)	–	4.0 (3.0)	–	-†
kW ≥ 560 (hp ≥ 750)	Tier 1	2000	11.4 (8.5)	1.3 (1.0)	–	9.2 (6.9)	0.54 (0.4)
	Tier 2	2006	3.5 (2.6)	–	6.4 (4.8)	–	0.2 (0.15)

Notes:
† Not adopted, engines must meet Tier 2 PM standard.

1998 Consent Decrees

On 22 October 1998, the Department of Justice and the EPA announced a settlement with seven major manufacturers of diesel engines who will spend more than one billion dollars to resolve claims that they installed illegal computer software on heavy duty diesel engines that turned off the engine emission control system during highway driving. Manufacturers who signed the 1998 Consent Decrees with EPA were potentially required to meet Tier 3 standards one year ahead of schedule (i.e. beginning in 2005).

Blue Sky Series Engines

In 2002, EPA established a stricter set of voluntary "Blue Sky" standards, listed below. Blue Sky Series Engines have lower emission levels than the mandatory standards—usually at least 40 percent cleaner. Meeting this voluntary standard earns manufacturers a Blue Sky Series designation for these engines. Manufacturers who choose to get this certification agree to keep these engines at Blue Sky levels throughout their useful life. Blue Sky Series exist for the following engines:

- land-based nonroad diesel engines (40 CFR part 89)
- recreational and commercial marine diesel engines (40 CFR part 94)

- land-based nonroad spark-ignition engines over 25 hp (40 CFR part 1048)

EPA Blue Sky Voluntary Emission Standards for Nonroad Diesel Engines, g/kWh (g/bhp·hr)

Rated Power (kW)	NMHC+NOx	PM
kW < 8	4.6 (3.4)	0.48 (0.36)
8 ≤ kW <19	4.5 (3.4)	0.48 (0.36)
19 ≤ kW <37	4.5 (3.4)	0.36 (0.27)
37 ≤ kW < 75	4.7 (3.5)	0.24 (0.18)
75 ≤ kW <130	4.0 (3.0)	0.18 (0.13)
130 ≤ kW < 560	4.0 (3.0)	0.12 (0.09)
kW ≥ 560	3.8 (2.8)	0.12 (0.09)

TIER 4 EMISSION STANDARDS

The phase-in of Tier 4 emission standards began in 2008 and will be fully in effect in 2015. Tier 4 standards introduce substantial reductions of NOx (for engines above 56 kW) and PM (above 19 kW), as well as more stringent HC limits. CO emission limits remain unchanged from Tier 2-3. Tier 4 emission standards for engines up to 560 kW are listed below.

Tier 4 Emission Standards—Engines up to 560 kW, g/kWh (g/bhp-hr)

Engine Power	Year	CO	NMHC	NMHC+NO_x	NO_x	PM
kW < 8 (hp < 11)	2008	8.0 (6.0)	–	7.5 (5.6)	–	0.4[a] (0.3)
8 ≤ kW < 19 (11 ≤ hp < 25)	2008	6.6 (4.9)	–	7.5 (5.6)	–	0.4 (0.3)
19 ≤ kW < 37 (25 ≤ hp < 50)	2008	5.5 (4.1)	–	7.5 (5.6)	–	0.3 (0.22)
	2013	5.5 (4.1)	–	4.7 (3.5)	–	0.03 (0.022)
37 ≤ kW < 56 (50 ≤ hp < 75)	2008	5.0 (3.7)	–	4.7 (3.5)	–	0.3[b] (0.22)
	2013	5.0 (3.7)	–	4.7 (3.5)	–	0.03 (0.022)
56 ≤ kW < 130 (75 ≤ hp < 175)	2012-2014[c]	5.0 (3.7)	0.19 (0.14)	–	0.40 (0.30)	0.02 (0.015)
130 ≤ kW ≤ 560 (175 ≤ hp ≤ 750)	2011-2014	3.5 (2.6)	0.19 (0.14)	–	0.40 (0.30)	0.02 (0.015)

Notes:a – hand-startable, air-cooled, DI engines may be certified to Tier 2 standards through 2009 and to an optional PM standard of 0.6 g/kWh starting in 2010
b – 0.4 g/kWh (Tier 2) if manufacturer complies with the 0.03 g/kWh standard from 2012
c – PM/CO: full compliance from 2012; NOx/HC: Option 1 (if banked Tier 2 credits used)—50% engines must comply in 2012-2013; Option 2 (if no Tier 2 credits claimed)—25% engines must comply in 2012-2014, with full compliance from 2014.12.31
d – PM/CO: full compliance from 2011; NOx/HC: 50% engines must comply in 2011-2013

MY 2011 compliance requirements are referred to as 'Interim Tier 4' (or 'Tier 4i'), 'transitional Tier 4' or 'Tier 4 A,' while the final standards (NOx/HC compliance) are sometimes referred to as 'Tier 4 B.'

As an alternative to introducing the required percentage of Tier 4-compliant engines, manufacturers may certify all their engines to an *alternative NOx limit* in each model year during the phase-in period. These alternative NOx standards are:

Engines 56-130 kW:

- Option 1: NOx = 2.3 g/kWh = 1.7 g/bhp-hr (Tier 2 credits used to comply, MY 2012-2013)
- Option 2: NOx = 3.4 g/kWh = 2.5 g/bhp-hr (no Tier 2 credits claimed, MY 2012-2014)

Engines 130-560 kW:

- NOx = 2.0 g/kWh = 1.5 g/bhp-hr (MY 2011-2013)

Tier 4 Emission Standards—Engines Above 560 kW, g/kWh (g/bhp-hr)

Year	Category	CO	NMHC	NO_x	PM
2011	Generator sets > 900 kW	3.5 (2.6)	0.40 (0.30)	0.67 (0.50)	0.10 (0.075)
	All engines except gensets > 900 kW	3.5 (2.6)	0.40 (0.30)	3.5 (2.6)	0.10 (0.075)
2015	Generator sets	3.5 (2.6)	0.19 (0.14)	0.67 (0.50)	0.03 (0.022)
	All engines except gensets	3.5 (2.6)	0.19 (0.14)	3.5 (2.6)	0.04 (0.03)

OTHER PROVISIONS

- Existing Tier 2-3 smoke opacity standards and procedures continue to apply in some engines. Exempted from smoke emission standards are engines certified to

PM emission standards at or below 0.07 g/kWh (because an engine of such low PM level has inherently low smoke emission).

- The Tier 4 regulation does not require closed crankcase ventilation in nonroad engines. However, in engines with open crankcases, crankcase emissions must be measured and added to exhaust emissions in assessing compliance.

- Similarly to earlier standards, the Tier 4 regulation includes such provisions as averaging, banking and trading of emission credits and FEL limits for emission averaging.

- Tier 4 nonroad engines will also have to meet not-to-exceed (NTE) standards, which are measured without reference to any specific test schedule. The NTE standards are effective for engines above 130 kW in 2011; 56-130 kW engines in 2012; and engines below 56 kW in 2013. In most engines, the NTE limits are set at 1.25 times the regular standard for each pollutant (in engines certified to NOx standards below 2.5 g/kWh or PM standards below 0.07 g/kWh, the NTE multiplier is 1.5). NTE standards apply to engines at the time of certification and throughout the useful life of the engine. The purpose of the added testing requirements is to prevent the possibility of "defeating" the test cycle by electronic engine controls and producing off-cycle emissions.

TEST CYCLES AND FUELS

Nonroad engine emissions are measured on a steady-state test cycle that is nominally the same as the ISO 8178 C1, 8-mode steady-state test cycle. Other ISO 8178 test cycles are allowed for selected applications, such as constant-speed engines (D2 5-mode cycle), variable-speed engines rated under 19 kW (G2 cycle), and marine engines (E3 cycle).

The 1998 rule for Tiers 2 and 3 changed from measuring total hydrocarbons to measuring nonmethane hydrocarbons (NMHC). Since there is no standardized EPA method for measuring methane in diesel engine exhaust, manufacturers can either use their own procedures to analyze nonmethane hydrocarbons or measure total hydrocarbons and subtract 2% from the measured hydrocarbon mass to correct for methane.

Transient Testing – Tier 4 standards have to be met over both the steady-state test and the Nonroad Transient Cycle, (NRTC). The transient testing requirements begin with MY 2013 for engines below 56 kW, 2012 for 56-130 kW, and 2011 for 130-560 kW engines. Engines above 560 kW are not tested on the transient test. Also constant-speed, variable-load engines of any power category are not subject to transient testing. The NRTC protocol includes a cold start test. The cold start emissions are weighted at 5% and hot start emissions are weighted at 95% in calculating the final result.

; – Fuels with sulfur levels no greater than 0.2 wt% (2,000 ppm) are used for ication testing of Tier 1-3 engines. To enable sulfur-sensitive control nologies in Tier 4 engines – such as catalytic particulate filters and NOx adsorbers \ mandated reductions in sulfur content in nonroad diesel fuels, to be phased-in een 2007 and 2010:

) ppm effective June 2007 for nonroad, locomotive and marine (NRLM) diesel

ls

ppm (ultra-low sulfur diesel) effective 2010

GINE USEFUL LIFE

sion standards must be met over the entire useful life of the engine. EPA requires pplication of deterioration factors (DFs) to all engines covered by the rule. The DF ictor applied to the certification emission test data to represent emissions at the of the useful life of the engine.

engine useful life and the in-use testing liability period, as defined by EPA for sion testing purposes, are listed below for different engine categories. The Tier 4 naintains the same engine useful life periods.

Useful Life and Recall Testing Periods

ower ating	Rated Engine Speed	Useful Life		Recall Testing Period	
		hours	years	hours	years
19 kW	all	3000	5	2250	4
1-37 kW	constant speed engines ≥3000 rpm	3000	5	2250	4
	all others	5000	7	3750	5
37 kW	all	8000	10	6000	7

PACTS AND EVALUATION

Regulation – At the time of signing the 1998 rule, EPA estimated that by 2010 emissions would be reduced by about a million tons per year, the equivalent of g 35 million passenger cars off the road. The costs of meeting the emission lards were expected to add under 1% to the purchase price of typical new oad diesel equipment, although for some equipment the standards may cause increases on the order of 2-3%. The program was expected to cost about $600 on of NO_x reduced.

Regulation – When the full inventory of older nonroad engines are replaced by engines, annual emission reductions are estimated at 738,000 tons of NOx and ons of PM. By 2030, 12,000 premature deaths would be prevented annually o the implementation of the proposed standards. The estimated costs for added

emission controls for the vast majority of equipment was estimated at 1-3% as a fraction of total equipment price. For example, for a 175 hp bulldozer that costs approximately $230,000 it would cost up to $6,900 to add the advanced emission controls and to design the bulldozer to accommodate the modified engine. EPA estimated that the average cost increase for 15 ppm S fuel will be 7 cents per gallon. This figure would be reduced to 4 cents by anticipated savings in maintenance costs due to low sulfur diesel.

LINKS

Regulatory Documents

- Title 40, Part 89, EPA emission standards for nonroad diesel engines
- Tier 4 regulatory text
- Tier 2 and Tier 3 regulatory text
- Tier 1 regulatory text

Additional Resources

EPA Tier 4 website

EPA Nonroad Summary page