Meeting EPA 2012 Tier 4 Interim And EU Stage IIIB Emissions

Customer FAQ (75-173 hp)

This Frequently Asked Question document is intended to help Cummins customers better understand the low emissions regulations commencing January 2012 which introduce clean diesel technology with exhaust aftertreatment to the off-highway industry. Information is provided on performance and operational characteristics applicable to the latest generation of ISB6.7, QSB4.5, and QSB3.3 engines covering the 75 to 173 horsepower (56-129 kW) range. This FAQ features the following sections:

Tier 4 Interim Emission Regulations

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Tier 4 Interim Emission Regulations

1. What is the Tier 4 Interim and Stage IIIB emission standard in 2012?

Tier 4 Interim is the U.S. Environmental Protection Agency (EPA) emission regulations for off-highway diesel engines in North America. Stage IIIB is nearly the equivalent emission regulations for the European Union (EU) member states. In terms of effect dates and emission levels, the EPA and EU are closely aligned.

The regulations commenced in January 2012 across the 75 to 173 horsepower (56-129 kW) category, requiring diesel engines to reduce PM exhaust emissions by over 90% and NOx exhaust emissions by approximately 30% compared with the current Tier 3 and Stage IIIA emission standards.

The emissions standards for this power category are: 3.4 g/kW-hr Oxides of Nitrogen (NOx) and 0.02 g/kW-hr Particulate Matter (PM).

Equivalent emissions regulations for Ministry of Land, Infrastructure, Transportation and Tourism (MLIT) in Japan will likely commence October 2013 or later for engines across the 75 to 751 hp (56-560 kW) powerband.

2. What is the Tier 4 Final and Stage IV emissions standard in 2015?

Beginning October 2014 for EU Stage IV and January 2015 for EPA Tier 4 Final, another major emissions reduction for diesel engines from 75 to 173 horsepower, both NOx and PM exhaust emissions will be reduced by 90% compared with current Tier 3 and Stage IIIA levels.

The emissions standards for this power category are: 0.4g/kW-hr Oxides of Nitrogen (NOx) and 0.02 g/kW-hr Particulate Matter (PM). These extremely low levels can be described as ‘near-zero’ emissions levels.

3. What are Oxides of Nitrogen (NOx) and Particulate Matter (PM)?

Oxides of nitrogen are a regulated gaseous emission which is a collective term for emissions composed of nitrogen and oxygen. Particulate matter is a regulated diesel emission composed primarily of carbon soot and other combustion by-products.

4. When will engines above 174 hp need to meet the low emissions regulations?

For engines within the 174-751 horsepower (130-560 kW) power category, Tier 4 Interim and Stage IIIB regulations went into effect in January 2011. The Tier 4 Final and Stage IV regulations will be applied in January 2014.

Emissions reductions are more stringent for this 174-751 horsepower category at Tier 4 Interim and Stage IIIB, which require Cummins to use a different solution. Details on Cummins technology solution for this power category were issued on a separate FAQ covering the 6-cylinder QSB6.7, QSL9, QSX11.9 and QSX15 (above 174 horsepower) engines and is available on cumminsengines.com.

Meeting Emissions With The Right Technology

5. How will Cummins meet the Tier 4 Interim emissions standards in 2012?

Cummins QSB6.7, QSB4.5, and QSB3.3 engines will meet the 2012 low emissions standards with an integrated Cummins Compact Catalyst exhaust aftertreatment and a cooled exhaust gas recirculation (EGR) system incorporated on the engine.

The cooled EGR system enables clean combustion with NOx reduced by over 30% compared to Tier 3, while the Cummins Compact Catalyst exhaust aftertreatment system reduces PM by over 90% from engine exhaust.

6. Will Cummins meet EU Stage IIIB and equivalent emissions regulations in Japan with the same technology used for North America?

Yes. Cummins will offer the right technology and engine platforms to meet the low emissions standards with an integrated Cummins Compact Catalyst exhaust aftertreatment and a cooled EGR system incorporated on the engine for the EU and Japan. For countries outside of these areas that will adopt equivalent low emissions regulations, Cummins will offer this same technology provided proper Ultra Low Sulfur Diesel Fuel is available.

7. Does Cummins design their own aftertreatment and other key systems?

Yes. We design the Cummins Compact Catalyst as an integrated system with the engine. Meeting Tier 4 Interim and Stage IIIB demands new levels of system integration in order to achieve very low emissions while improving performance.

Cummins has access to all the key enabling technologies within our design and manufacturing resources, from aftertreatment, fuel systems, filters and electronic control to turbocharging. This forms the basis of our ‘Right Technology’ approach to Tier 4 Interim.

8. Why is Cummins Tier 4 Interim approach better than others?

We believe Cummins has significant advantages over other engine manufacturers. We design, manufacture and integrate the complete Tier 4 Interim package from air-intake to exhaust aftertreatment. Only Cummins has all the key enabling technologies in-house and can therefore realize more effective integration with packaging and performance advantages.

9. Will Tier 4 Interim engine performance and fuel economy be the same as Tier 3?

It will be better. Cummins Tier 4 Interim engines will have up to 5% improved fuel efficiency compared to Tier 3, depending on rating and duty cycle. Tier 4 Interim equipment productivity is also enhanced with faster engine response.

Operators will also notice that Cummins Tier 4 Interim technology enables the equipment to work cleaner and quieter than before. And while CO_2 emissions are not regulated by the EPA and EU, Cummins fuel efficiency improvement at Tier 4 Interim translates into reduced CO_2 emissions, helping our customers reduce their carbon footprint at Tier 4 Interim.

10. How will equipment operating costs be impacted by Tier 4 Interim?

Overall operating costs for Cummins engines will be lower at Tier 4 Interim compared with Tier 3. Depending on duty cycle and application, up to 5% better fuel efficiency can be achieved which will more than offset the marginal cost increase associated with using ULSD fuel, low ash lube oil and our Cummins Compact Catalyst does not require a filter cleaning like competitive Diesel Particulate Filter technologies for this horsepower range.

11. How will Tier 4 Interim impact the cost of equipment?

Achieving very low levels of emissions for Tier 4 Interim has required a major investment in engine technology and involves the addition of systems such as Cummins Compact Catalyst aftertreatment. The cost of the equipment will therefore reflect the incorporation of a Tier 4 Interim technology system and in some cases more advanced cooling packages.

While Tier 4 Interim powered equipment will be inherently more expensive than Tier 3 equipment, the cost of achieving compliance will be helped by the lower overall operating costs offered by Cummins Tier 4 Interim engines.

With improved engine response and fuel economy, operators can also expect improved equipment productivity together with the benefit of cleaner and quieter operation.

12. Why is Selective Catalytic Reduction (SCR) less effective than cooled EGR and Cummins Compact Catalyst for Tier 4 Interim?

As part of Cummins Tier 4 Interim evaluation program, various combinations of Cummins Particulate Filter or Cummins Compact Catalyst with cooled EGR and SCR were extensively tested as possible technology paths. However, our development work proved that a Cummins Compact Catalyst in combination with cooled EGR provides the most effective Tier 4 Interim solution.

This solution will achieve the best operating value for our customers. It offers equivalent, or better fuel efficiency compared with using an SCR system for Tier 4 Interim off-highway applications.

13. Is SCR a technology option for Tier 4 Final?

While SCR can be considered premature for Tier 4 Interim, it becomes an effective solution when used in combination with cooled EGR at Tier 4 Final. The Tier 4 Final emission reduction is focused on reducing NOx by a further 45% to near zero emissions best achieved by a combination of SCR and Cooled EGR.

Cummins knows SCR technology better than any other engine manufacturer. Since 2006, Cummins launched on-highway engines certified to the Euro 4 and EPA 2010 standard using SCR with approaching 500,000 of these systems in operation to date.

In addition to this, Cummins is utilizing SCR technology together with cooled EGR and the Cummins Particulate Filter to meet North America EPA 2010 on-highway emissions.

Cummins Compact Catalyst

14. Why does Cummins use the Cummins Compact Catalyst 173 horsepower and below – but not for engines 174 horsepower and above?

Cummins provides value by offering the right technology for the right equipment. As a maintenance free, “fit and forget” system, the catalyst is ideally suited for compact equipment, typically used in the rental market. The Cummins Compact Catalyst also provides a simplified and flexible system installation for Tier 4 Interim, a key requirement for space constrained compact machines and material handling equipment below 174 horsepower.

Equipment with engines above 173 horsepower has more installation space and also needs to meet more stringent emissions regulations, which makes the Cummins Particulate Filter an ideal solution.

15. Has the Cummins Compact Catalyst aftertreatment been used before?

This technology is new to the off-highway equipment industry – but it is not new to Cummins. Cummins has been manufacturing Diesel Oxidation Catalyst technology since 1994 for on-highway bus applications, representing over 15 years of experience and a very high volume population in North America.

16. How does the Cummins Compact Catalyst remove PM?

The catalyst removes PM by a process of simple, passive oxidation.

17. Does the catalyst impact the operation of the machine or require any user intervention?

No. The catalyst operates automatically and is transparent to the operator and does not impact equipment performance.

18. Does the catalyst create more noise or heat compared to a muffler?

The catalyst will not create additional noise or heat compared with a standard muffler. The maximum skin temperature of the catalyst will be no higher than that of today's muffler.

19. Is an exhaust muffler also required?

Yes. Noise attenuation is still required. There will be options to purchase a Cummins Compact Catalyst without a muffler or with an integrated acoustic catalytic muffler. An integrated acoustic catalytic muffler would be somewhat smaller than a Diesel Particulate Filter, but installation flexibility is the key advantage with the option of separating the catalyst and muffler.

20. Does the catalyst need to regenerate, like a Diesel Particulate Filter (DPF)? Does it ever need to inject fuel in the exhaust to function?

No. The catalyst does not operate by either passive or active regeneration, which is typical of a Diesel Particulate Filter.

The catalyst works by a simpler process of continuous passive oxidation of the PM as it flows through the system. This oxidation is initiated by the normal temperature of the exhaust. No additional fuel injection is needed to increase this temperature.

21. How flexible are the installation requirements?

Based on our experience with this technology, oxidation catalysts are far more flexible in installation than a DPF due to not requiring active regeneration.

22. Is it really a "fit and forget" device?

Yes. Once installed the catalyst requires no user intervention or maintenance.

23. Why doesn't the Compact Catalyst require ash cleaning?

Because it is a flow through device that does not capture ash. A DPF does require ash cleaning because it is a wall flow filter.

24. Will fuel sulfur content higher than 15-ppm damage the catalyst?

An oxidation catalyst can tolerate diesel fuel sulfur up to 500-ppm. However, using 15-ppm fuel is the legal requirement for meeting EPA Tier 4 Interim and EU emission regulations.

25. How does the Cummins Compact Catalyst differ from a typical Diesel Oxidation Catalyst (DOC)?

Cummins Compact Catalyst represents the latest evolution of diesel oxidation technology specifically designed for Tier 4 Interim emissions and off-highway applications. The catalytic coating and substrate is unique to the QSB3.3, QSB4.5 and QSB6.7 to provide optimum performance.

26. Will the compact catalyst be used for engines above 160 horsepower and for all QSB6.7 engines?

The 6-cylinder QSB6.7 engine below 174 horsepower will utilize the Cummins Compact Catalyst and the QSB6.7 engine 174 horsepower and above will utilize a Cummins Particulate Filter. All other components for the QSB6.7 will be common.

27. What will the catalyst cost?

We supply the catalyst as part of a fully integrated system with the engine, leading to a competitive system price that offers superior value to the end customer and OEM.

Cummins Cooled Exhaust Gas Recirculation (EGR) System

28. How does cooled EGR reduce NOx emissions?

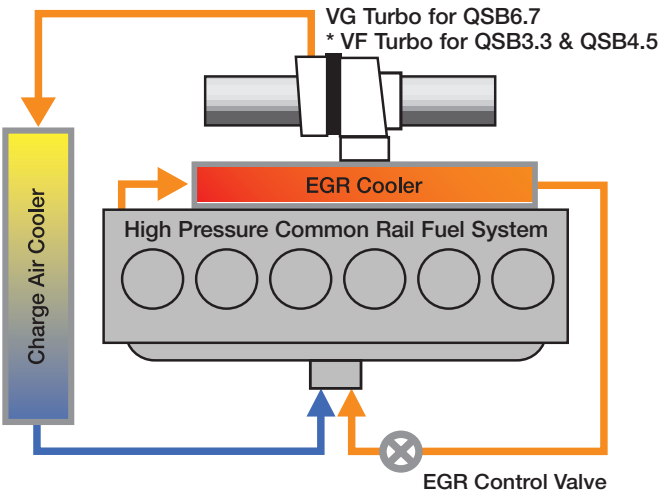
Cummins utilizes cooled EGR to effectively control NOx emissions. Cooled EGR works by re-circulating a varying proportion of the exhaust gas back to the cylinder. This reduces the oxygen content to a lower combustion temperature resulting in a reduction of NOx formation.

The exhaust gas is cooled as it flows through an EGR cooler, and then is mixed with the compressed fresh air from the turbocharger before entering the intake manifold. As the exhaust gas moves through the intake, the EGR reduces the amount of in-cylinder oxygen available for combustion while maintaining the same amount of air flowing through the engine. Exhaust gases present during the start of combustion are very stable and have a very slow reaction rate. They absorb heat during combustion, resulting in lower in-cylinder peak flame temperatures, and therefore, lower NOx emissions.

29. What are the key components of the EGR system?

The key components to the Cummins cooled EGR system are: EGR Valve, EGR cooler and either a Variable Geometry Turbocharger (VGT™) or Variable Flow Turbocharger depending on the horsepower. A schematic of the system is shown below:

Cooled-EGR Schematic



VGT™ and VFT Turbocharger

30. How does Cummins VGT™ improve performance?

Cummins will use a VGT Turbocharger for our Tier 4 Interim QSB6.7 engine both above and below 174 horsepower and a Variable Flow Turbocharger (VFT) for our Tier 4 Interim QSB4.5 and QSB3.3 products.

Cummins VGT Turbocharger has a patented one-piece sliding nozzle design that provides exact boost across the operating range. The sliding nozzle varies the exhaust gas flow into the turbine wheel to provide rapid boost at low engine rpm and then maintain high boost at higher rpm.

The VGT Turbocharger design combines the benefit of both a small and large turbocharger in a single unit, enabling Cummins Tier 4 Interim to achieve significantly improved

response compared to a Tier 3 engine demonstrated in customer field tests.

Manufactured by Cummins Turbo Technologies, the VGT™ Turbocharger is a key technology asset in not only meeting emissions but also in increasing engine performance and improving fuel efficiency. Introduced with Cummins on-highway EGR engines in 2002, the total VGT™ Turbocharger production is approaching three million units, demonstrating outstanding in-service reliability.

31. How does Cummins Variable Flow Turbocharger improve performance?

Cummins will use a VGT Turbocharger for our Tier 4 Interim QSB6.7 engine both above and below 174 horsepower and a Variable Flow Turbocharger for our Tier 4 Interim QSB4.5 and QSB3.3 products.

The Variable Flow Turbocharger drives cooled EGR and improves boost across a wider engine speed than our previous wastegate turbocharger to preserve transient response and low end torque. This turbo is proven with both high reliability and a simple mechanism variable turbine with both an inner and outer section. This simple turbine allows for lower complexity and fewer moving parts, which leads to higher durability.

The Variable Flow Turbocharger is integrated by Cummins and driven by Cummins electronics. At low speeds the valve is closed and exhaust gas flows into the inner section increasing boost pressure. At high speeds the turbo valve is modulated with integrated controls to allow exhaust gas to flow into both the inner and outer sections of the turbo.

Filtration Enhancements

32. What new filtration systems are used on Cummins Tier 4 Interim engines?

Engine filtration enhancements include a new Cummins Direct Flow™ air cleaner and Cummins crankcase ventilation system

with a highly-efficient coalescing filter, both manufactured by Cummins Filtration.

33. How is Cummins Direct Flow™ air cleaner different from other air-intake filters?

The new Cummins Direct Flow™ air cleaner was specifically developed for Tier 4 Interim to provide more performance in less space. The rectangular, low profile design can reduce space claim compared with typical cylindrical filters used for Tier 3. Air flow to the engine is improved and the highest levels of protection are assured with virtually 100 percent efficiency over the filter life.

34. Can Direct Flow™ extend filter change intervals?

The increased air flow efficiency of the Direct Flow™ air cleaner offers operators the opportunity to extend air filter element service intervals and potentially reduce air cleaner filter costs.

35. How does the crankcase ventilation filter improve the engine?

Tier 4 Interim requires that crankcase emissions, also known as blowby gases, be included in the overall regulated engine emissions. To control blowby gas emissions, Cummins engines incorporate a highly efficient coalescing filter. The filter returns the oil to the crankcase and provides the added benefit of removing oil mist and tiny

oil droplets, ensuring that the engine and powertrain remain cleaner than at Tier 3.

The crankcase filter requires a simple filter element change at 2,000 hour intervals.

Electronic Enhancements

36. How does the Electronic Control Module (ECM) differ from Tier 3?

The Tier 4 Interim engine management system is significantly upgraded with the latest Cummins CM2250 electronic control module providing 3 times faster processing power and double memory capacity compared to the Tier 3 module.

Cummins has a unique advantage in that we design the core programs and algorithms needed to precisely control the system from air-intake to exhaust aftertreatment as a single integrated system.

37. Does Cummins use the same electronic system for all engines?

Yes. Cummins latest generation CM2250 electronic control module will be incorporated on all Tier 4 Interim engines to ensure electronic commonality across equipment ranges.

38. Will electronic diagnostic tools change for Tier 4 Interim?

Cummins popular and easy-to-use electronic diagnostic tools such as InSite™ software and QuickCheck™ handheld device are already upgraded and available for use with Tier 4 Interim engines and aftertreatment.

Service Requirements

39. Will Tier 4 Interim equipment uptime remain the same as Tier 3?

Yes. Cummins testing has demonstrated that our Tier 4 Interim engines are able to achieve the same very high level of uptime availability as equipment powered with our current Tier 3 engines.

40. What service does the Cummins Compact Catalyst require?

Unlike a Diesel Particulate Filter, which has an EPA mandated ash cleaning interval of 3,000 hours for engines 75-173 horsepower (56-129 kW), the Cummins Compact Catalyst is a completely service-free, “fit and forget” aftertreatment system.

41. What is the life of the Cummins Compact Catalyst?

The Cummins Compact Catalyst is designed to last the life of the engine without maintenance. This “fit and forget” aftertreatment is specially strengthened against high levels of vibration and shock loading.

Fuel Requirements

42. Is ULSD fuel legally required for Tier 4 Interim engines?

Yes. In North America and European Union, Ultra Low Sulfur Diesel fuel is legally required for Tier 4 Interim/Stage IIIB engines. The ULSD must contain 15 parts-per-millions (ppm) or less sulfur content.

43. Does the European Union have the same fuel requirements for Stage IIIB engines?

In the European Union, Ultra Low Sulfur Diesel (ULSD) must legally be 10-ppm at the point of manufacture and is expected to be 15-ppm at the point of use.

44. Will ULSD be available outside of North America and the European Union?

Availability of ULSD is very limited outside of North America and the European Union – so it is critical to not operate an engine requiring ULSD in a country without an available ULSD supply. Using high sulfur content fuel will damage the engine and aftertreatment system.

45. Could today's greater than 15-ppm fuel be used in Tier 4 Interim engines?

Tier 4 Interim engines must use ULSD. It is not possible to comply with the legally required PM emissions standard with today's off-highway fuel which has a higher sulfur content.

46. What happens if higher sulfur fuel is inadvertently used?

An oxidation catalyst can tolerate diesel fuel sulfur up to 500-ppm. However, using 15-ppm fuel is the legal requirement for meeting EPA Tier 4 Interim and EU emission regulations.

A one-time inadvertent tank of diesel fuel from over 500-ppm sulfur content will not damage the engine and aftertreatment system. The system will clean itself out when ULSD is re-introduced.

However, continued improper fuel use of high sulfur levels greater than 500-ppm with Cummins Tier 4 Interim engines can permanently damage the engine and Cummins Compact Catalyst within a short period of time. This damage could possibly cause the engine to be inoperable and cause unplanned downtime and expenses.

47. Is the engine warranty affected if ULSD is not used?

Yes. Improper fuel use of sulfur levels greater than 15-ppm with Cummins Tier 4 Interim engines can result in denial of warranty coverage for any damage caused by using fuel with sulfur content greater than 15-ppm.

48. Can ULSD be used in Tier 3 or other engines?

Yes. Tier 3 and other emission level engines will work fine on ULSD. It is backwards compatible.

49. When will ULSD fuel be available?

ULSD is available today. ULSD was widely introduced in North America in 2006 and more recently in the European Union for emission compliant on-highway engines. ULSD for off-highway applications will be widely available for Tier 4 Interim 174-751 horsepower engines in 2011. Both the EPA and EU have a schedule in place with fuel producers and distributors to ensure ULSD will be available at this time.

50. Can biodiesel fuel be used with Cummins Tier 4 Interim engines?

Cummins Tier 4 Interim electronic engines are compatible with Biodiesel blends up to B20 as long as the fuel does not exceed 15-ppm sulfur content.

Warranty

51. Does Cummins Tier 4 Interim technology change the current warranty coverage?

Cummins current engine warranty will become a broader engine and system warranty for Tier 4 Interim by incorporating the Cummins Compact Catalyst and Direct Flow™ air cleaner housing. The warranty hours, terms and conditions remain unchanged for Tier 4 Interim.

52. What happens if Tier 4 Interim engines are exported and operated outside of their intended emissions region?

Tier 4 Interim engines and aftertreatment systems which are exported and operated outside of their intended emissions region will not carry a warranty. The very low emissions levels for Tier 4 Interim require specific technology that is not appropriate for regions with less severe standards.

Cummins is committed to manufacturing engines that provide optimal performance for their users as well as meeting emissions regulations. Since emissions standards vary across the world, Cummins designs its products to meet the standards of an individual country and/or emissions region. Equipment manufacturers, dealers and customers should carefully select the correct engine to meet the emissions requirements of their respective country.

Field Test Experience

53. What experience does Cummins have for the Tier 4 Interim 75-173 horsepower category?

Tier 4 Interim represents the most extensive development, concept installation and field test program that Cummins has ever undertaken with off-highway engines. Cummins started our Tier 4 Interim field test program for this power category in 2009 and we have been deliberate in selecting specific customer field tests to cover the widest possible spectrum of machine types and duty cycles.

54. How are the Tier 4 Interim engines performing?

The message from the operators is that Cummins Tier 4 Interim solution is dependable, reduces their operating costs and improves the performance of their machines. Operators preferred the Tier 4 Interim powered machine for its responsiveness and improved productivity.

55. To what extent are you working with equipment manufacturers?

Cummins is deeply involved with our OEM partners in the machine integration of Tier 4 engines and aftertreatment in off-highway equipment. We had over 350 installations completed for Tier 4 Interim powered equipment. We had hundreds of OEMs engaged in virtual prototypes. Our OEM installations combined with concept and field test activity represents a broader range of equipment experience with Tier 4 Interim than anyone else in the industry.

U.S. EPA

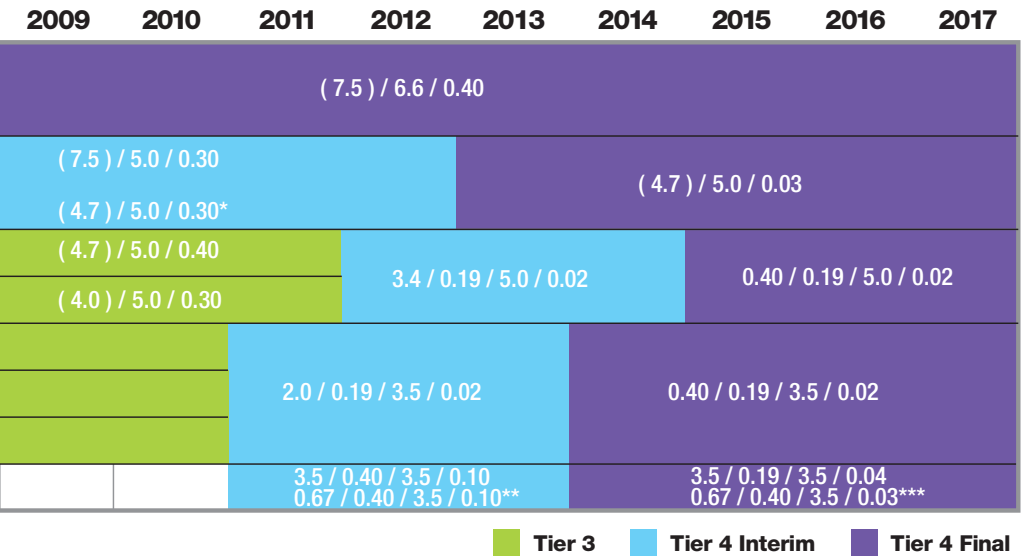
kW	(HP)	2005	2006	2007	2008
0 - 7	(0 - 10)				
8 - 18	(11 - 24)				
19 - 36	(25 - 48)				
37 - 55	(49 - 74)				
56 - 74	(75 - 99)				
75 - 129	(100 - 173)				
130 - 224	(174 - 301)				(4.0) / 3.5 / 0.20
225 - 449	(302 - 602)				(4.0) / 3.5 / 0.20
450 - 560	(603 - 751)				(4.0) / 3.5 / 0.20
>560	(>751)				

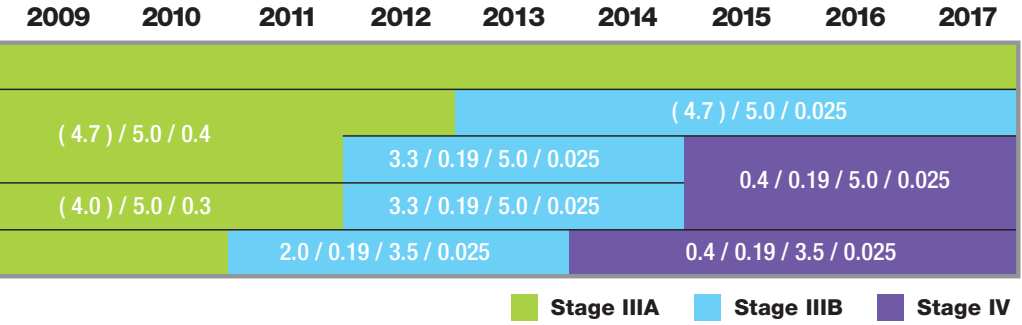
EUROPE

kW	(HP)	2005	2006	2007	2008
18 - 36	(24 - 48)			(7.5) / 5.5 / 0.6	
37 - 55	(49 - 74)				
56 - 74	(75 - 99)				
75 - 129	(100 - 173)				
130 - 560	(174 - 751)				(4.0) / 3.5 / 0.2

NOx/HC/CO/PM (g/kW-hr)
(NOx+HC)/CO/PM (g/kW-hr)
(Conversion: [g/kW-hr] x 0.7457 = g/bhp-hr)

The chart above is displayed for reference purposes only and does not depict the various options available to engine and equipment manufacturers. See the appropriate regulations for specific details and options related to that region's emissions standards and implementation dates.





*Tier 4 Interim Option 1 PM Standard
**Applies to portable power generation >1200 hp
***Applies to portable power generation >751 hp

Glossary

Advisor

A Cummins proactive tool for OEMs and technical support to select and design installations that maximize engine-to-machine performance for the end customer.

B20

A fuel blend of 20% biodiesel and 80% diesel.

CARB

California Air Resources Board. Implements and enforces air pollution control rules and regulations in the state of California.

CO_2

Carbon Dioxide. Classified as the major greenhouse gas and emitted proportional to amount of fuel consumed. With inherently higher fuel efficiency, diesel engines produce lower levels of CO_2. The EPA does not regulate CO_2 emissions from diesel engines.

CO

Carbon Monoxide. A regulated diesel emission produced by incomplete combustion. CO is emitted at very low levels from diesel engines.

Common-Rail Fuel Injection

Fuel delivery system that maintains a high injection pressure regardless of engine speed, using high-pressure fuel stored in a single “common” rail that connects to every fuel injector on the engine.

Cummins Emission Solutions

A world leader in the design and manufacture of catalytic exhaust aftertreatment systems, including DPF, SCR and DOC systems.

Cummins Filtration

A world leader in the design and manufacture of filtration and exhaust systems, including Fleetguard products.

Cummins Turbo Technologies

A world leader in the design and manufacture of turbochargers for diesel engines, including the Holset VGT™.

Cummins Fuel Systems

Develops and manufactures advanced fuel systems and electronic controls.

DOC

Diesel Oxidation Catalyst. Consists of a catalytic coating on a honeycomb substrate for oxidizing particulate matter (PM). Operates in a passive-only mode without active regeneration, so is less efficient at PM reduction than the DPF.

DPF

Diesel Particulate Filter. Captures particulate matter (PM) in a semi-porous medium as they flow through the exhaust system. Available in “passive” or “active” configurations. Active DPFs use a control system to actively promote regeneration events.

EGR

Exhaust Gas Recirculation. Technology that diverts a percentage of the exhaust gas back into the cylinder, lowering combustion temperatures and reducing NOx.

EPA

Environmental Protection Agency. Among many duties, the U.S. government agency is responsible for governing engine emissions.

Exhaust Aftertreatment

Any technology which removes emissions in the exhaust flow.

HPCR

High Pressure Common Rail fuel system.

INSITE™

Diagnostic software tool with real-time monitoring of everything from fuel burned to boost pressure and coolant temperature. Reads fault codes, provides rapid repair directions, and enables adjustable parameters and calibrations.

NMHC

Non-Methane Hydrocarbons. A regulated diesel emission which is primarily unburned fuel in the exhaust stream. Commonly described as Hydrocarbons (HC).

NOx

Oxides of Nitrogen. A regulated diesel emission which is a collective term for gaseous emissions composed of nitrogen and oxygen.

NOx Adsorber

Aftertreatment technology that uses a catalyst to capture and then convert NOx to harmless nitrogen gas and water vapor.

NRTC

Non-road transient composite test cycle introduced for Tier 4 emissions certification.

PM

Particulate Matter. A regulated diesel emission composed primarily of carbon soot and other combustion by-products.

PowerMatch

A Cummins calibration delivery system allowing quick and easy tailoring of electronic calibrations for a new application.

SCR

Selective Catalytic Reduction. An aftertreatment technology that uses a chemical reductant (urea) injected into the exhaust stream where it transforms into ammonia and reacts with NOx on a catalyst, converting the NOx to harmless nitrogen gas and water vapor.

Sulfur

A natural element in diesel fuel which has been linked to particulate matter and acid formation in the atmosphere.

Terms for Approximately Equivalent Standards

U.S. EPA ..... EU (European Union)
Tier 1..... Stage I
Tier 2..... Stage II
Tier 3..... Stage IIIA
Tier 4 - Interim..... Stage IIIB
Tier 4 - Final..... Stage IV

ULSD

Ultra-Low Sulfur Diesel. Diesel fuel which contains less than 15 parts per million by volume of sulfur. Mandated October 2006 for EPA on-highway, September 2010 for EPA off-highway and expected in 2009 in the EU.

Urea

A chemical usually made from natural gas, which is commonly used in fertilizers. Urea solution used for SCR aftertreatment breaks down into ammonia and reacts with NOx in the SCR system to produce harmless nitrogen gas and water vapor.

VGT

Variable Geometry Turbocharger. Turbochargers that constantly adjust the amount of airflow into the combustion chamber, optimizing performance and efficiency.

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