How Emissions Standards Affect Our Products and Customers
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations for Diesel Engines</td>
<td>1</td>
</tr>
<tr>
<td>Technologies</td>
<td>2</td>
</tr>
<tr>
<td>Kubota Solutions by Horsepower Class</td>
<td>3</td>
</tr>
<tr>
<td>Explanation of Each Technology</td>
<td>4-8</td>
</tr>
<tr>
<td>i. DPF – Diesel Particulate Filter</td>
<td></td>
</tr>
<tr>
<td>ii. EGR – cooled Exhaust Gas Recirculation</td>
<td></td>
</tr>
<tr>
<td>iii. CRS – Common Rail fuel injection System</td>
<td></td>
</tr>
<tr>
<td>iv. SCR— Selective Catalytic Reduction</td>
<td></td>
</tr>
<tr>
<td>Emissions Control Component Location</td>
<td>9</td>
</tr>
<tr>
<td>The Operator Experience</td>
<td>10</td>
</tr>
<tr>
<td>How is Regeneration Controlled?</td>
<td>11-12</td>
</tr>
<tr>
<td>i. What does the Operator Need to Do?</td>
<td></td>
</tr>
<tr>
<td>ii. Lamps &amp; Switches</td>
<td></td>
</tr>
<tr>
<td>Emissions Information Summary</td>
<td>13</td>
</tr>
<tr>
<td>The Kubota Dealer’s Role</td>
<td>14</td>
</tr>
<tr>
<td>Warranty &amp; Dealer Support</td>
<td>15</td>
</tr>
<tr>
<td>About Kubota</td>
<td>16-17</td>
</tr>
</tbody>
</table>
Regulations for Diesel Engines

The Environmental Protection Agency (EPA) has introduced standards to reduce air pollution from Diesel engines in stages or “Tiers”. The Tiers depend on engine horsepower (HP) and year of manufacture. The goal is to reduce black exhaust smoke (Particulate Matter or PM), Hydrocarbons (HC), Nitrous Oxides (NOx, a major component of smog), and Carbon Monoxide (CO). The following chart shows Tier implementation by year and horsepower group.

Beginning with engines manufactured in 2013, all Kubota diesel engines that are rated at less than 75 Horsepower (HP) must meet Final Tier 4 regulations. Engines rated at 75 HP and above must meet interim Tier 4 (iT4) regulations.*

By 2015, all diesel engines manufactured by Kubota must meet Final Tier 4 regulations.*

*Certain exclusions apply
Technologies

The need to reduce black smoke (PM) and limit NOx at the same time was a challenge for Kubota engineers. Diesel fuel burns more efficiently when combustion temperatures are high, leading to less unburned fuel (soot) emitted through the exhaust pipe. On the other hand, high combustion temperatures also increase the production of NOx, a key component of photochemical smog. Kubota’s solution to conquer both problems includes the following technologies:

- **DPF** – Diesel Particulate Filter
- **EGR** – Exhaust Gas Recirculation
- **CRS** – Common Rail fuel injection System

An additional technology that Kubota is not presently using is called Selective Catalytic Reduction (SCR).

An explanation of each technology appears on pages 4 – 8.
Kubota Solutions by Horsepower Class

Kubota is implementing different solutions — depending on engine horsepower, applications, and emission Tiers. Small engines under 25 HP can comply with Tier 4 through Kubota’s design and efficient control of the combustion process and without need for DPF mufflers. Larger engines require one or more of the technologies explained on the subsequent pages. This table shows which technologies apply by Horsepower Class.

<table>
<thead>
<tr>
<th>Engine Horsepower Class</th>
<th>Technology</th>
<th>To Meet</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25.5 HP</td>
<td>Kubota engine design</td>
<td>Tier 4</td>
</tr>
<tr>
<td>25.5 to 35 HP</td>
<td>Kubota engine design + EGR + DPF</td>
<td>Tier 4</td>
</tr>
<tr>
<td>36 to 75 HP</td>
<td>Kubota engine design + EGR + CRS + DPF</td>
<td>Tier 4</td>
</tr>
<tr>
<td>76 to 135 HP</td>
<td>Kubota engine design + EGR + CRS + DPF</td>
<td>Interim Tier 4</td>
</tr>
</tbody>
</table>

Note: Certain Kubota models are not presently utilizing these technologies, as the EPA has allowed manufacturers to use existing engine designs for a limited time.
Diesel Particulate Filter (DPF)

The DPF removes black soot (Particulate Matter) from the exhaust gas, so that there is no longer any visible smoke from the exhaust pipe. There are two major parts - the Diesel Oxidizing Catalyst (DOC) and the Diesel Particulate Filter (DPF).
The DOC has two jobs. First, any Hydrocarbons (HC) or Carbon Monoxide (CO) are converted into water and CO2. Secondly, the DOC provides the heat necessary to activate the Regeneration Cycle.

The DPF element catches particulate matter (soot) before the exhaust reaches the atmosphere. After approximately 15 to 20 hours of operation, the accumulated soot must be burned away (the time depends on operating conditions).

Regeneration is the process of burning the accumulated soot from the DPF. Kubota customers can choose automatic regeneration or can choose to delay regeneration until the equipment is located in a non—combustible area outdoors. It depends on the engine load, but regeneration typically takes about 20 minutes. Equipment operation can usually continue during regeneration.

After regeneration is complete, there will be a small amount of unburned material, called ash, remaining in the DPF. Ash consists of Iron, Copper, Calcium, Zinc, and other trace materials that will not burn. The primary source of ash is engine wear, but fuel and lubricants also contribute. After hundreds of regeneration cycles and about 3000 hours of engine operation, the accumulation of Ash will reach a point that will require an off machine cleaning of the DPF.
Exhaust Gas Recirculation (EGR)

Nitrous Oxides (NOx) are a significant cause of smog; the brown layer of air that hangs over many of our cities. EGR reduces NOx by cooling off the combustion process with the introduction of small amounts of cooled exhaust gas into the intake manifold. This system was first used by Kubota in the United States with the introduction of the M108S common rail engine in 2007.
Common Rail System (CRS)

The Common Rail System (CRS) electronically controls the fuel injection quantity and timing, enabling high pressure injections in stages rather than all at once. Combustion rate is thus optimized for more power, increased fuel economy, greater efficiency, and lower engine noise.

Electronic Fuel Injectors  
CRS Pump

High Pressure Fuel Rail  
Engine Control Unit (ECU)
Selective Catalytic Reduction (SCR)

SCR is a technology that injects a urea/water solution through a catalyst into the exhaust stream of a diesel engine. The urea sets off a chemical reaction that converts NOx into nitrogen and water, which is then expelled through the exhaust pipe.

SCR is best suited for higher horsepower, heavily loaded engines, where the constant load minimizes the production of particulate matter. Kubota equipment is more commonly used intermittently, in applications with varying load levels.

For those types of usage patterns, the DPF/EGR/CRS solution is more appropriate. Future emissions standards may require a combination of SCR and DPF/EGR/CRS for some applications.
Component Location (typical)

- DPF
- EGR Valve
- EGR Cooler
- CRS Pump
- Fuel Rail
- Fuel Filter
The Operator Experience—Clean Power

When an operator starts the engine of a Kubota machine equipped with a DPF, a pleasant surprise is the complete absence of visible exhaust smoke, even when the engine is at full power. The days of black smoke clouds billowing from a diesel engine are history. The lack of smoke does not mean a reduction of power. Rather, the Kubota design—EGR, CRS, and DPF, provides increased power, fuel efficiency, and lower noise compared to a mechanically injected engine, while at the same time exceeding government standards for reduction of PM, NOx, HC, and CO.

How is Regeneration Controlled?

Kubota allows the operator to choose when and where to regenerate the DPF. If the machine is operated outdoors and in a non-combustible environment, automatic regeneration is recommended. If an Auto button is provided, it should be pushed when the engine is started to allow for automatic regeneration. Equipment without an Auto button defaults to automatic regeneration, which then can be stopped by pressing the inhibit switch.
What does the Operator Need to Do?

If the machine is operated outdoors, and in a non-combustible environment, Auto Regeneration is recommended. Here’s how to do it.

**Tractors so equipped:**

- **Press Auto Button**
  
  Press immediately after starting the engine. Make sure it is lit at all times, unless you want to stop Regeneration.

**Equipment without Auto button:**

- **Check Inhibit Switch**
  
  Default is Auto operation (lamp OFF). Push if you want to stop Regeneration. Otherwise, leave switch alone.

**All Equipment:**

- **Raise Engine RPM Lamp or Display**
  
  Maintain high enough engine RPM to keep this lamp or display OFF.
Layout of Lamps & Switches
(typical, location varies by model)

**Tractor**

- Raise Engine RPM Lamp
- Auto Button (if so equipped)

**Compact Track Loader**

- Inhibit Switch
- Raise Engine RPM Lamp

**Excavator**

- Inhibit Switch
- Raise engine speed
  Now HP limited
- Raise Engine RPM Message
Emissions Information Summary

• The EPA has mandated that diesel engines become cleaner, and has introduced standards for all engine manufacturers.
• Kubota is fully compliant, and has chosen appropriate technologies to meet the standards.
• For most engines, a DPF (Diesel Particulate Filter) is used to reduce soot emissions (also called Particulate Matter or PM).
• The DPF replaces the standard muffler, and is located in about the same place.
• The accumulated soot must be removed (burned) approximately every 15 to 20 hours, in a process called “Regeneration”. The actual time depends on operating conditions.
• Kubota recommends Automatic Regeneration, if the equipment is used outdoors and in a non combustible environment.
• The engine RPM must be raised to enable regeneration (until the “raise RPM” lamp goes off).
• Regeneration takes about 20 minutes.
• If the operator does not enable regeneration in due time, a dealer service call may be necessary.
• When regeneration is underway, a small amount of white smoke may be observed emitting from the exhaust pipe.
• During regeneration, the exhaust temperature will rise. Therefore, regeneration should only take place when the machine is in a non combustible area and outdoors.
The Kubota Dealer’s Role

Kubota has produced a series of operational brochures in both English and Spanish (tractors only). These are available from the Kubota Fulfillment Center. It is the Kubota dealer’s obligation to provide this brochure during product delivery and explain the emissions control system and its operation. Every Operator’s Manual also has detailed information, and each tractor or construction machine has a decal to alert operators.
Warranty

Kubota provides all customers a 5 year/3000 hour (whichever occurs first) warranty on certain emissions control system components, such as the CRS, EGR, and DPF. It is important to note that DPFs which cannot be regenerated due to operator misunderstanding, are not warrantable. Therefore, it is critical that both the dealer and Kubota customer review and understand the DPF operating procedures before delivery of the equipment to the final customer.

Dealer Support

Kubota maintains fully staffed training and service departments to support our dealers. Our mission is to provide maximum reliability for our customers, by training our dealers in the proper diagnosis and repair of emissions control and other systems. This effort includes:

- Annual classes at Kubota Training Centers.
- Online courses from Kubota University.
- Expert advice through the Kubota Tech Center.
- Publications to help customers understand the new systems and their operation.
Kubota Corporation was established in 1890, and has been forward-thinking ever since. With companies and affiliates in more than 130 countries, Kubota Corporation based in Osaka, Japan, has become an international brand leader in a variety of products; full-size, sub-compact and compact tractors, gasoline and diesel engines, construction machinery, pipes, valves, pumps, and air-conditioning equipment.

Kubota introduced the L200, the first compact tractor with big tractor features, to the United States market in 1969. Based on the enthusiastic response to this innovative product, Kubota’s commitment to the United States market has been on a steep growth curve since that time, with Kubota USA affiliates now including research, manufacturing, distribution, credit and insurance operations - all developed to better serve Kubota dealers and customers.
Kubota Tractor Corporation, with headquarters in California, has four division offices providing sales, marketing, distribution, finance, service and parts support for Kubota dealers in their respective areas.

Today, you can find Kubota products hard at work mowing, gardening, landscaping, farming, hauling, towing and transporting across America.

The Kubota Promise
• Produce state-of-the-art, quality products
• Lead the industry in engineering and technological firsts
• Respect the environment and protect our customers’ safety
• Provide uncompromising service
• Listen and respond to customer needs
• Value each customer relationship with integrity and respect
• Support professional dealers
• Manage with vision and leadership

with a Strong Tradition of Innovation
Every Operator Must Remember

Kubota recommends Auto Regeneration, *if the machine is operated outdoors and in a non combustible environment.*

**For Tractors with Auto Button, remember STAR**

- **ST** art engine
- Press **A**uto button—will light up (when operating outdoors and in non-combustible environment)
- **R**aise RPM until lamp goes OFF

**For Machines without Auto Button**

- **ST** art engine
- **R**aise RPM until lamp goes OFF

Note: Inhibit switch should be OFF, when operating outdoors and in non-combustible environment.

- Use only Ultra Low Sulfur Diesel Fuel.
- If Bio Diesel is used, maximum content is 5%.
- Use only Kubota engine oil, or engine oils that meet API CJ-4 specifications.