

PREPARE FOR TIER 4

A greener mower can mean two things: It's more environmentally friendly to use, and it costs more to buy. Both are true with the new mowers that meet Tier 4 emission standards.

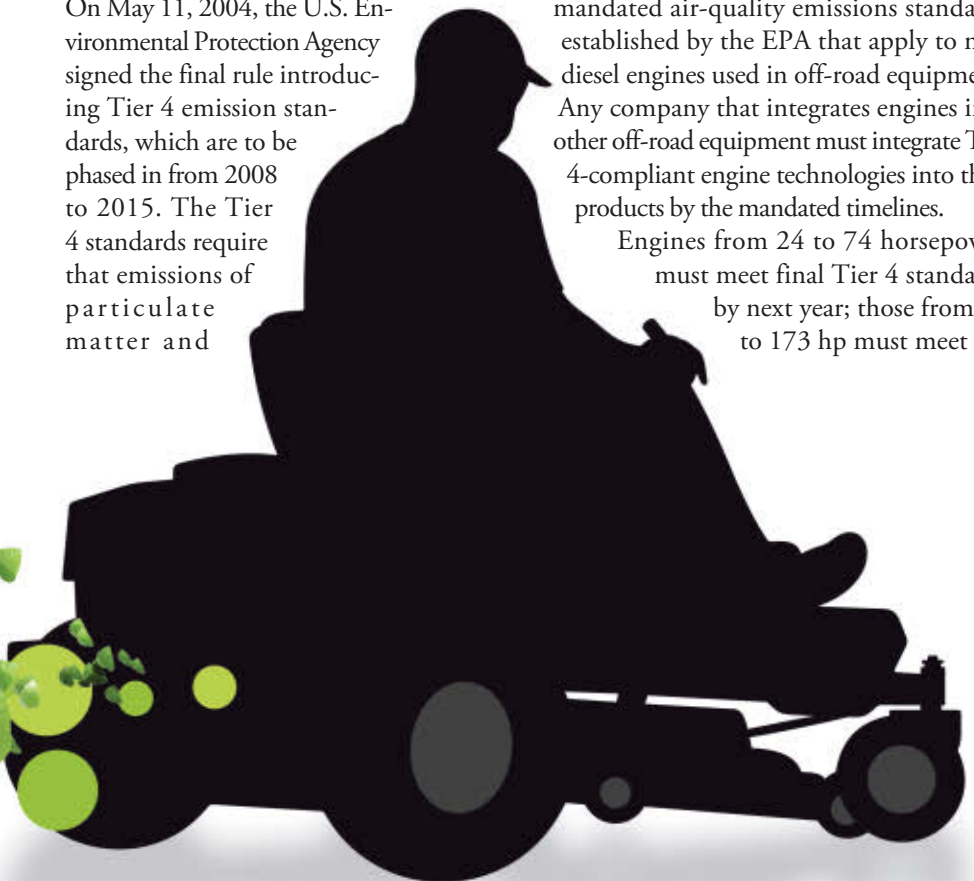
The law of the land

On May 11, 2004, the U.S. Environmental Protection Agency signed the final rule introducing Tier 4 emission standards, which are to be phased in from 2008 to 2015. The Tier 4 standards require that emissions of particulate matter and

nitrogen oxides — as well as emissions of non-methane hydrocarbons, carbon monoxide, sulfur oxides and air toxics — be reduced by 50 to 96 percent compared to existing diesel engines. Such emission reductions can be achieved through control technologies, including advanced exhaust gas aftertreatment.

Tier 4 refers to a defined level of federally mandated air-quality emissions standards established by the EPA that apply to new diesel engines used in off-road equipment. Any company that integrates engines into other off-road equipment must integrate Tier 4-compliant engine technologies into their products by the mandated timelines.

Engines from 24 to 74 horsepower must meet final Tier 4 standards by next year; those from 75 to 173 hp must meet the



standards by 2015; and those from 174 to 751 hp must be compliant by 2014.

The EPA has adopted a comprehensive national program to reduce emissions from future non-road diesel engines by integrating engine and fuel controls as a system to gain the greatest emission reductions. To meet these standards, manufacturers are producing engines with advanced emission-control technologies similar to those expected for highway trucks and buses.

These reductions will provide public health benefits. The EPA estimates that controlling these emissions will prevent 12,000 premature deaths, 8,900 hospitalizations and one million work days lost annually by 2030.



Manufacturers work to meet Tier 4 emission standards; *superintendents to pay more for mowers.* BY JOHN WALSH

For Toro, Tier 4 engines will require many changes to equipment — including changes to mowers' cooling packages, electronic controllers, exhaust routing and other plumbing.

Cleaner burning engines

Research, engineering and development costs have and will be spent by engine and turf equipment manufacturers to ensure their ability to meet these emission standards.

“This is a must-do to stay in the game,” says Rachel Luken, a product manager at Jacobsen. “All manufacturers that want to continue to sell diesel engines and powered products must comply.”

Standards for diesel exhaust emissions become more stringent from tier to tier. In previous tiers, the adaptation of new compliant engines into equipment was more streamlined, so implementation costs were typically higher at the engine manufacturer.

“With the upcoming Tier 4 final engines, the weight has shifted to the turf equipment manufacturers,” Luken says. “Many more components and systems external to the engine need to be re-engineered, retooled, re-integrated and retested.”

In terms of diesel engine use, John Deere Golf primarily uses Yanmar in its mowing and

maintenance equipment; Jacobsen uses Kubota to power its 25-plus-hp diesel equipment; and Toro uses a mix of Briggs & Stratton, Kubota, Kohler, Honda, Kawasaki and Subaru.

A redesign

But final Tier 4 compliance is much more than just an engine change. There are many other subsystems and areas on mowers that it will need to adapt. Compliant turf equipment will be equipped with new engines and exhaust systems with advanced electronic controls, additional filtration or after-treatment and updated cooling systems, to name a few, Luken says. To accommodate these additional and larger components, many frames, chassis and engine compartments require redesign.

For Toro, Tier 4 engines will require many changes to equipment — including changes to mowers' cooling packages, electronic controllers, exhaust routing and other plumbing — but most of those will be unnoticed from a performance standpoint, says Grant Young,

Continued on page 16

Continued from page 15

senior product marketing manager for Toro.

Tier 4 engines may require some modification to the size of the hood on John Deere equipment because of the added components on the engines, says Tracy Lanier, product manager for John Deere.

Retrofitting equipment to meet the standard isn't an option because of the significant changes required in the engine and exhaust after-treatment systems. Toro doesn't anticipate any retrofit solution that will convert a current product to a compliant Tier 4 product, Young says. However, products purchased before the compliance date are grandfathered in.

The financial costs

The lower emission standards were designed to be enforced in progressive phases over sev-

eral years to provide adequate lead time for the engine and equipment manufacturers to meet them.

"We've been working toward the Tier 4 regulation for many years," Lanier says. "We can't speak about the total cost, but we can say it's a regulation we've been working toward, even before it was signed into law in 2004."

As the market approaches the final Tier 4 regulation, Jacobsen is investing significant resources in product development and portfolio decisions. With each of the product subsystem changes, there are design, development, sourcing, testing, prove-out, production change over and sales-education resources required.

"The cost is an investment in our company's future," Luken says.

Certification to meet the emission requirement must come from engine manufacturers because they have to certify their engines to meet the requirement before selling them to the turf equipment manufacturers, Young says, adding that the total cost for Toro to meet the standard is significant.

The cost to meet that compliance (engineering, technology, etc.) is most often passed onto the equipment manufacturer in the price of the new engine. From there, the equipment manufacturer incurs more costs to commercialize the product. Those costs include additional design and engineering (i.e. cooling system, electronics, etc.) and are included in the final price of the product to golf course superintendents.

Based on significant research in other industries that have been required to meet the Tier 4 standard — such as agricultural and construction equipment — it wasn't uncommon for prices to increase 10 to 18 percent, according to Toro. The estimated costs for added emission controls for most equipment was estimated at 1 to 3 percent as a fraction of total equipment price.

Most noticeably, achieving compliance will appear in the cost of the product. Some of the diesel solutions contain rare earth metals, which are expensive. In addition to the materials, the engineering expense is more costly.

"While specific turf equipment market price implications aren't available yet, an increase can be expected," Luken says.

"Industries that already have gone through

John Deere has been working toward the Tier 4 standards since before 2004, when it was signed into law, John Deere's Tracy Lanier says.





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compliance have experienced anywhere from a 10 to 20 percent increase in price,” Young says.

End results

Tier 4-compliant engines and equipment will require the use of ultra-low sulfur diesel fuel, which has no more than 15 parts per million sulfur. ULSD fuel has been used since 2006 in highway vehicles and is widely available. (For more information about clean diesel fuel requirements, visit clean-diesel.org.)

Tier 4 engines using a diesel particulate

filter will need to be removed and cleaned at about 3,000 to 5,000 hours. No other special maintenance is required. Normal maintenance intervals for oil and filter changes may be extended compared to today’s engines.

Most Tier 4 engines use electronically controlled fuel injection systems that require training and new diagnostic tools, according to Toro. While these capabilities and tools might require additional training, they also have the potential to save time and simplify maintenance. The mechanical aspects of the engine design aren’t significantly different.

According to Toro, Tier 4-compliant equipment will have:

- ▶ all new engine and exhaust systems
- ▶ more sophisticated electronic controls
- ▶ after treatment for removal of nitrogen oxide and particulate matter
- ▶ redesigned frames and engine compartments to accommodate larger engine/exhaust system modules
- ▶ updated cooling systems.

“We wouldn’t expect the customer to see a reduction in performance of their machines,” Luken says. “While the engine is a major part of the machine, there are other factors — for

Continued on page 18

Though the engine may be changing, Jacobsen’s Rachel Luken says not to expect any changes in performance or operation.

Some diesel fuels aligned with Tier 4 regulations contain expensive rare earth metals, affecting price.

TIER 4

EMISSION STANDARDS

Pros

- ▶ Advancements in fuel injection systems resulting in clean operating diesel engines, which reduces, or virtually eliminates, pollutants into the environment.
- ▶ Improvements in engine noise, sound levels, performance, diagnostic capabilities, making for more operator comfort.
- ▶ Lower operating costs. When fuel combusts more thoroughly, less fuel is needed to run the engine and feedback sensors monitor amount of fuel delivered, improving fuel economy.
- ▶ Better performance. Creating more energy during combustion results in more torque output from the engine.

Cons

- ▶ Advancements needed in engines and other systems external to the engine (cooling, filtration and electrical) for emission compliance will add expense. As a result, market prices are expected to increase.
- ▶ The level of engine maintenance required will more than likely increase because of new components added to help meet the regulation.
- ▶ Every dollar that engine and equipment manufacturers spend on compliance is one less dollar spent on strategic product development.

Continued from page 17

example, the reel cutting unit and attaching systems — that are at the heart of the machines' cutting performance. And, operation of the machines are expected to be similar to today's operation."

Equipment distributors can continue to sell inventories of equipment from the previous generation of technology (Tier 3) until the inventory is depleted. Existing equipment is grandfathered in and doesn't need to be replaced until the normal end-of-life cycle. The Tier 4 requirements apply only to new engines.

Jacobsen believes Tier 4 is about more than just emissions.

"It's about using innovative solutions to make equipment more environmentally friendly while still meeting customer performance, productivity and quality expectations," Luken says. "Additionally, manufacturers, dealers and superintendents should take some time to review and invest in their service capabilities to support these engine advancements." ■

Walsh is a contributing editor for Golfdom.