

U.S. EPA Tier 4 Requirements Bring Changes



When it comes to diesel engine emissions, generator sets used with container refrigeration systems have become progressively cleaner over the years, in part driven by increasingly strict regulations from the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (CARB).

In 2013, the U.S. diesel emissions standards, including those covering engines used in transport refrigeration units, change once again, and EPA's standard applicable to the PowerLINE™ platform's current engine class will be superseded by a more stringent one.

Most Carrier Transicold customers who operate generator sets in North America are aware that standards are changing and have questions about what it means for their present and future generator set purchases. Here, Carrier Transicold's business manager for generator sets, Charu Mahajan, provides answers to some of the most frequent questions from the field.

What are the EPA emissions changes for 2013?

The EPA's diesel emissions standards have followed a "tiered" path to progressively greater reductions, starting with the initial Tier 1 standards in the late 1990s. In 2004, EPA's Clean Air Nonroad Diesel Tier 4 standards were passed with a phase-in schedule spanning the period 2008-2015, depending on engine power.

For engines in the 19-37 kW (25-50 hp) bracket, which applies to today's TRU generator sets, the EPA provided a two-step approach, starting with an "interim" Tier 4 standard (Tier 4i) that became effective in 2008. The table below outlines Tier 4i and Tier 4 "final" thresholds for particulate matter and combined NOx and hydrocarbons. The stricter Tier 4 final standard becomes effective next year and reduces hydrocarbon and NOx emissions by 37 percent and particulate emissions by 90 percent over Tier 4i levels.

EPA Standards for Diesel Engines

| Engine Category | 2008 Standard | 2013 Standard |
|------------------------------------|--|--|
| 19 - 37 kW (25 - 50 horsepower) | Tier 4 interim PM: 0.3 g/kWh NOx + HC: 7.5 g/kWh | Tier 4 final PM: 0.03 g/kWh NOx + HC: 4.7 g/kWh Adds NTE requirement |
| 8 - 19 kW (11 - 25 horsepower) | Tier 4 PM: 0.4 g/kWh NOx + HC: 7.5 g/kWh For 2013 adds NTE requirement | |

Particulate Matter (PM), Nitrogen Oxides (NOx), Hydrocarbons (HC), Not to Exceed (NTE)

The EPA Tier 4 standard for engines in the range of 8-19kW (11 – 25 hp), became effective in 2008 and has ceilings similar to Tier 4i in the 19-37 kW bracket, as also shown in the table.

For 2013, EPA also adds a "Not To Exceed," or NTE test standard for Tier 4 engines in both horsepower ranges. Rather than setting maximum engine emissions over an average performance cycle, the NTE standard essentially requires that an engine does not exceed maximum emissions regardless of how it is operated, and includes factors such as altitude and ambient temperature.

What does this mean for my current gen set inventory?

As with previous EPA standard changes, older units – of any tier and any horsepower range – are "grandfathered," meaning that, the way the regulation is currently written, they will remain EPA-compliant for the life of the unit.

In California, however, CARB regulations require further emissions reduction seven years after the unit model year, if the generator sets are to remain in use there.

Do California regulations change too?

California regulations, which are set by CARB, remain in alignment with EPA with regard to purchase of new equipment. Therefore, generator sets purchased in 2013 that comply with applicable EPA standards will also be compliant in California.

CARB differs with EPA, however, when it comes to "in use" equipment, which is CARB's terminology for "used" units.

CARB's Airborne Toxic Control Measure for TRUs and TRU Generator Sets requires older units operating within California to be upgraded to meet lower particulate emission levels and will eventually need to comply with CARB's ULETRU standard, which reduces particulate emissions by 85 percent. This closely compares to the Tier 4 final standard for engines in the 19-37 kW bracket, and these engines need no further upgrade for CARB compliance. For Tier 4 engines in the 8-19 kW class, CARB requires upgrades to the ULETRU standard by the end of the unit's seventh year. Once the ULETRU level is achieved, engines are not subject to further reductions, based on existing California regulation.

How will Carrier PowerLINE units achieve compliance?

Carrier Transicold recently announced ecoFORWARD™ technologies for its North American diesel-powered trailer refrigeration units, providing a pathway for EPA Tier 4 and CARB compliance. EcoFORWARD technologies provide a compliance strategy for PowerLINE generator sets as well.

In developing ecoFORWARD technologies, Carrier's engineers took a holistic view of the generator set, customers' long-term needs and unit lifecycle operating costs. This balanced approach will bring numerous system improvements

for Generator Sets

while retaining much in common with the existing PowerLINE platform.

As with Carrier's trailer refrigeration technology, system enhancements will significantly improve efficiency and performance – so much so that engine horsepower requirements are reduced. As a result, the generator set engine will fall within the scope of EPA's Tier 4 emissions standard for nonroad engines rated 8-19 kW.



Generator sets with ecoFORWARD technologies will also be significantly more fuel efficient than today's standard PowerLINE units.

Fuel savings will help

to offset higher equipment costs, providing an anticipated one- to two-year payback. Additionally, users will benefit from lower greenhouse gas emissions and a reduced carbon footprint.

For maximum emissions reduction and compliance with CARB's ULETRU requirement, an optional new custom-designed engine emissions system (EES) will also be available.

More details on Carrier's next generation of generator sets for 2013 compliance will be announced later this year.

Will Carrier's current models be discontinued in 2013?

The EPA allows for a transition period, but eventually sales of today's Tier 4i models will be phased out in North America. EPA's Transition Program for Equipment Manufacturers temporarily allows the continued sale of a

limited number of units built with previous tier engines (in this case Tier 4i) within the U.S. However starting in 2013, these previous tier engines, often referred to as "flexibility engines," will count only as a maximum of model-year 2012 for the purposes of EPA and CARB. That means that while units built in 2013 with "flexibility engines" will come up for a California upgrade in 2020, units built in 2014 or later with "flexibility engines" would come up for California upgrade in 2019 (2012 plus 7 years), making them a less attractive option over time.

What about generator sets used outside of the U.S.?

Compliance strategies could vary depending on geographical location, so when thinking ahead to 2013 generator set customers should evaluate their acquisition requirements and balance their operational needs with applicable regulations.

Owners outside of North America are not affected by the new U.S. regulations. The U.S. standards, and particularly California's, are tougher than those in other parts of the world. In Europe, for instance, where "tiered" emissions standards also exist, units that comply with the current EPA Tier 4i standard are within the European final standard.

With that in mind, purchasers outside of North America may opt to consider Tier 4i units as long as they are available. However even though emissions regulations don't mandate the choice, Carrier generator sets with ecoFORWARD technologies may be preferred from the perspectives of fuel savings and long-term lifecycle costs.

No matter what continent your refrigeration units travel when they leave the container ship, Carrier Transicold will have a generator set solution to meet your needs.

