



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
Washington, DC 20460

OFFICE OF  
AIR AND RADIATION

AUG - 8 2016

Gregory D. Hoenert  
Emissions Certification Manager  
Caterpillar Inc.  
P.O. Box 600  
Mossville, IL 61552-0600

Dear Mr. Hoenert:

The U.S. Environmental Protection Agency (EPA) has reviewed your request for verification of the Caterpillar Locomotive Selective Catalytic Reduction (SCR) System by Caterpillar Inc. (Caterpillar). This technology was originally granted a conditional verification on December 19, 2012 and then an extension on April 8, 2015. Based on our evaluation of your application, test data and additional information provided, EPA hereby verifies that this technology reduces emissions of certain criteria pollutants by the percentages described in the tables below.

This verification of emission reductions is for the following locomotive engine used in line-haul locomotive duty cycles provided all of the operating criteria are met as described below:

Technology	Engine Model/Application <sup>1</sup>	Fuel, Max Sulfur (ppm)	Reductions (%)			
			PM	NO <sub>x</sub>	HC	CO
Caterpillar Locomotive Selective Catalytic Reduction (SCR) System	Caterpillar 3516, line-haul locomotive engines; either originally manufactured to meet Tier 2 standards for model years 2010–2011, remanufactured to meet Tier 1 standards for model years 2012–2013, or remanufactured to meet Tier 2 standards for model year 2016; turbocharged with power ratings 2650 ≤ Horsepower ≤ 3005 <u>when used in line-haul application/duty cycle only</u>	15	20	75	90	70

The following criteria must be met in order for appropriately retrofitted engines to achieve the aforementioned emission reductions:

<sup>1</sup> There are two locomotive emission standards (Part 92 & Part 1033.11), often unofficially referred to Tier 0, Tier 1, Tier 2 (for originally manufactured), and Tier 0+, Tier 1+, and Tier 2+ (for remanufactured) which are applicable based on when the locomotive is first manufactured. The “+” sign is used by industry to highlight the “newer” standards (Part 1033) for Tier 0, Tier 1, and Tier 2; however, EPA references these as remanufactured locomotive engines. Note, EPA emission standards do not officially use the “+” to distinguish between the different locomotive standards.

1. The Caterpillar Locomotive SCR System is appropriately installed and operated in a line-haul locomotive application. Emission reductions are not verified for locomotives operated in switcher applications or switcher duty cycles.
2. The locomotive must be operated on ultra-low sulfur diesel fuel (ULSD) of 15 ppm or less.
3. The locomotive must always have a supply of Diesel Exhaust Fluid (DEF) that meets and displays certification of the American Petroleum Institute ISO Standard 22241-1 quality requirements that ensures the proper purity and concentration of 32.5% of urea. The engines and locomotives must be designed to track and log, in nonvolatile computer memory<sup>2</sup>, all incidents of engine operation with inadequate DEF injection or DEF quality.
4. The SCR system shall not be sold or operated in geographic areas where the DEF may freeze (-11°C), unless it is equipped with tank heaters and DEF line heaters to prevent freezing.
5. Caterpillar is required to provide the operator with clear and visible instructions for maintaining DEF for proper system operation.
6. Each installation will be equipped with a monitoring system that displays warning lights visible to the operator and audible alarms for low DEF tank level, high SCR inlet temperature and system abnormalities. The monitoring system will also store diagnostic error codes related to DEF tank level and system malfunctions.
7. The engine exhaust temperature must achieve at least 240°C for 40% of operation and not exceed 550°C. Caterpillar will review actual locomotive operating conditions and perform temperature data-logging prior to retrofitting a locomotive with the Caterpillar Locomotive SCR System to ensure compatibility.
8. The Caterpillar Locomotive SCR System may require replacement if SCR inlet temperature exceeds 550°C for an extended, continuous period of time. Operation with temperatures above 550°C may require inspection for damage by Caterpillar.
9. The Caterpillar Locomotive SCR catalyst should be replaced after 15,000 hours of operation or when the locomotive is rebuilt/remanufactured, whichever comes first.
10. Caterpillar is responsible for informing customers, in writing, that disposal of the Caterpillar Locomotive SCR System must be in accordance to all applicable federal, state, and local laws.

Information on the Caterpillar Locomotive SCR System, percent reduction, and applicable engines will be posted on the EPA's Verified Technology List website at: <https://www.epa.gov/verified-diesel-tech/verified-technologies-list-clean-diesel>. EPA reserves the right to review and/or revoke this verification if these operating criteria are not met or if information becomes available regarding the safety, design and/or operation of the technology.

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<sup>2</sup> Non-volatile storage is computer memory that can retain stored information even when not powered.

Thank you for participating in EPA's Technology Assessment Center Verification Program. If you have any questions or comments, please contact Britney J. McCoy, of my staff, at (202) 343-9218.

Sincerely,



Karl Simon, Director  
Transportation and Climate Division  
Office of Transportation and Air Quality