

US EPA ARCHIVE DOCUMENT

THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM



ETV Joint Verification Statement

TECHNOLOGY TYPE: MOBILE DIESEL ENGINE AIR POLLUTION CONTROL

APPLICATION: CONTROL OF EMISSIONS FROM MOBILE DIESEL ENGINES IN NONROAD USE BY SELECTIVE CATALYTIC REDUCTION

TECHNOLOGY NAME: BLUEMAX 100 VERSION A UREA-BASED SELECTIVE CATALYTIC REDUCTION

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The U.S. Environmental Protection Agency (EPA) created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. The ETV Program seeks to achieve this goal by providing high-quality peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

The ETV Program works in partnership with recognized standards and testing organizations; stakeholder groups, which consist of buyers, vendor organizations, permittees, and other interested parties; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Air Pollution Control Technology Center (APCT Center), which is one of six centers under the ETV Program, is operated by RTI International¹ in cooperation with EPA's National Risk Management Research Laboratory. The APCT Center has evaluated the performance of an emissions control system consisting of a selective catalytic reduction (SCR) technology.

¹ RTI International is a trade name of Research Triangle Institute.

ENVIRONMENTAL TECHNOLOGY VERIFICATION TEST DESCRIPTION

All tests were performed in accordance with the *Test/QA Plan for the Verification Testing of Selective Catalytic Reduction Control Technologies for Highway, Nonroad, and Stationary Use Diesel Engines* and the *Test-Specific Addendum to ETV Mobile Source Test/QA Plan for Nett Technologies for the BlueMAX 100 Version A System*. These documents are written in accordance with the applicable generic verification protocol and include requirements for quality management and QA, procedures for product selection and auditing of the test laboratories, and the test reporting format.

The mobile diesel engine air pollution control technology was tested in August 2009 at Southwest Research Institute. The performance verified was the percentage of emissions reduction achieved by the technology for particulate matter (PM), nitrogen oxides (NO_x), hydrocarbons (HC), and carbon monoxide (CO) relative to the performance of the same baseline engine without the technology in place. Operating conditions were documented, and ancillary performance measurements were made. A summary of the ETV test is provided in **Table 1**.

Table 1. Summary of the Environmental Technology Verification Test

Test type	Non-road steady-state FTP and NRTC
Engine family	Box NR-7 Tier 1
Engine make, model year	Caterpillar 3406, 1989 (upgraded in 2006)
Service class	Non-road, heavy-duty diesel engine
Engine rated power	306 hp at 2100 rpm
Engine displacement	14.6 L, inline six cylinder
Technology	Nett Technologies, Inc.'s BlueMAX 100 version A
Technology description	Urea-based SCR
Test cycle or mode description	Three hot-start, eight-mode steady-state tests according to FTP test and the nonroad transient cycle for baseline engine, degreened, and aged systems
Test fuel description	Ultra-low-sulfur diesel fuel with 15 ppm sulfur maximum
Critical measurements	PM, NO _x , HC, and CO
Ancillary measurements	CO ₂ , NO, NO ₂ (by calculation), NH ₃ , soluble organic fraction of PM, exhaust backpressure, exhaust temperature, and fuel consumption

CO₂ = carbon dioxide, FTP = Federal Test Procedure, hp = horsepower, NO = nitric oxide, NO₂ = nitrogen dioxide, NH₃ = ammonia, NRTC = Nonroad Transient Cycle, ppm = parts per million, rpm = revolutions per minute.

VERIFIED TECHNOLOGY DESCRIPTION

Nett Technologies' BlueMAX 100 version A Urea-Based SCR System utilizes a zeolite catalyst coating on a cordierite honeycomb substrate for heavy-duty diesel nonroad engines for use with commercial ultra-low-sulfur diesel fuel (ULSD) conforming to 40 *Code of Federal Regulations* 89.330.

This verification statement describes the performance of the tested technology on the diesel engine and fuels identified in Table 1 and applies only to the use of the Nett Technologies' BlueMAX 100 version A Urea-Based SCR System on nonroad engines fueled by ULSD [15 parts per million (ppm) or less] fuel.

The monitoring and notification system that was functionally tested and used with this technology includes sensors for urea level, urea consumption, urea pressure, urea tank leakage, and a mechanism to interrupt engine restart in the event of an empty urea tank.

VERIFICATION OF PERFORMANCE

The Nett Technologies' BlueMAX 100 version A Urea-Based SCR System achieved the reduction in tailpipe emissions shown in **Table 2** compared to baseline operation without the system.

Table 2. Verified Emissions Reductions

Test Type	System Type	Fuel	Emissions Reduction (%)				95% Confidence Limits on the Emissions Reduction (%)			
			PM	NO _x	HC	CO	PM	NO _x	HC	CO
8-Mode	Degreened	ULSD	12	70	99	92	4.7 to 20	68 to 71	^b	91 to 94
	Aged	ULSD	-12	68	99	94	^a	64 to 71	^b	92 to 95
NRTC	Degreened	ULSD	26	66	100	87	^c	^c	^c	^c
	Aged	ULSD	30	65	100	89	^c	^c	^c	^c

^a The emissions reduction could not be distinguished from zero with 95% confidence.

^b The emissions reduction could not be distinguished from 100% with 95% confidence.

^c Confidence limits could not be determined for NRTC (Nonroad Transient Cycle) emissions reductions because replicate test runs were not performed.

The functional tests demonstrated the BlueMAX 100 system was operating properly; however, a malfunction in the urea dosing pump and the associated error indicator lamp occurred during emission testing. As a result, the urea pump was replaced before continuing with the emissions testing.

The APCT Center quality manager has reviewed the test results and quality control data and has concluded that the Data Quality Objectives given in the generic verification protocol and the Test/QA Plan have been attained. APCT Center QA staff have conducted technical assessments of the test laboratory procedures and of the data handling. These assessments confirm that the ETV tests were conducted in accordance with the EPA-approved Test/QA Plan.

This verification statement verifies the emissions characteristics of the Nett Technologies' BlueMAX 100 version A Urea-Based SCR System for the stated application. Extrapolation outside of that range should be performed with caution and an understanding of the scientific principles that control the performance of the technology. This verification focuses on emissions. Potential technology users may obtain other types of performance information from the manufacturer.

In accordance with the generic verification protocol, this verification statement is valid, commencing on the date below, indefinitely for application of the Nett Technologies' BlueMAX 100 version A Urea-Based SCR System within the range of applicability of the statement.

signed by Andrew Gillespie for
Sally Gutierrez
Director
National Risk Management Research Laboratory
Office of Research and Development
United States Environmental Protection Agency

6/16/2010
Date

signed by Jason Hill
Jason Hill
Director
Air Pollution Control Technology Center
RTI International

6/3/2010
Date

NOTICE: ETV verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate QA procedures. EPA and RTI make no express or implied warranties regarding the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable local, state, and federal requirements. Mention of commercial product names does not imply endorsement.