

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 HIGHWAY USE BY DIESEL PARTICULATE FILTERS

TECHNOLOGY NAME: BA-B DIESEL PARTICULATE FILTER WITH PRE-CATALYST

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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 (RTI) in cooperation with EPA's National Risk Management Research Laboratory. The APCT Center has evaluated the performance of an emission control system consisting of a diesel particulate filter (DPF) with pre-catalyst.

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 Diesel Exhaust Catalysts, Particulate Filters, and Engine Modification Control Technologies for Highway and Nonroad Use Diesel Engines* and the *Test-Specific Addendum to ETV Mobile Source Test/QA Plan for Baumot for the BA-B 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 October 2011 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 also were made. A summary description of the ETV test is provided in **Table 1**.

Table 1. Summary of the Environmental Technology Verification Test

Test type	Highway Transient Federal Test Procedure
Engine family	XCEXH0359BAM
Engine make–model year	Cummins – 1999 ISB 215
Service class	Highway, medium heavy-duty diesel engine
Engine rated power	215 hp at 2700 rpm
Engine displacement	5.9 L, inline six cylinder
Technology	Baumot BA-B 1114
Technology description	Diesel particulate filter with pre-catalyst
Test cycle or mode description	One cold-start and multiple hot-start tests according to FTP test 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), soluble organic fraction of PM, exhaust backpressure, exhaust temperature, and fuel consumption

Note: CO₂ = carbon dioxide, FTP = Federal Test Procedure, hp = horsepower, NO = nitric oxide, NO₂ = nitrogen dioxide, ppm = parts per million, rpm = revolutions per minute.

Beginning of table description. Table 1 is titled Summary of the Environmental Technology Verification Test. The table lists the type of test conducted, the critical and ancillary measurements taken, the characteristics of the test engine, and the technology undergoing verification testing. End of table description.

VERIFIED TECHNOLOGY DESCRIPTION

The Baumot BA-B technology is a diesel engine retrofit device for light, medium, and heavy heavy-duty diesel on-highway engines for use with commercial ultra-low-sulfur diesel fuel (ULSD) conforming to 40 *Code of Federal Regulations* 86.1313-2007. The BA-B particulate filter is composed of a pre-catalyst on a metal basis and wall-flow monolith, both of which are coated with a precious metal oxidation catalyst. The 1114 unit is the BA-B variant specifically designed for use with engines with output of approximately 214-335 horsepower and displacement up to 11 liters.

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 Baumot BA-B system on highway 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 a sensor for exhaust gas backpressure.

VERIFICATION OF PERFORMANCE

The Baumot BA-B system achieved the reduction in tailpipe emissions shown in **Table 2** compared to baseline operation without the system installed on the test engine. In Table 2, “degreened” refers to a system with 25-124 hours of accumulated run time while “aged” refers to a system with over 1000 hours of accumulated run time. Additionally, the functional test results indicated proper operation of the monitoring and warning system for four of the five errors tested; the error code corresponding to a hose or pipe breakage or damage to the filter was not triggered successfully.

Table 2. Verified Emissions Reductions

System Type	Fuel	PM Mean Emissions Reduction (%)	NO _x Mean Emissions Reduction (%)	HC Mean Emissions Reduction (%)	CO Mean Emissions Reduction (%)	PM 95% Confidence Limits on the Emissions Reduction (%)	NO _x 95% Confidence Limits on the Emissions Reduction (%)	HC 95% Confidence Limits on the Emissions Reduction (%)	CO 95% Confidence Limits on the Emissions Reduction (%)
Degreened	ULSD	96	2.1	90	90	95 to 96	0.57 to 3.6	84 to 96	86 to 93
Aged	ULSD	97	2.7	94	93	97 to 97	1.4 to 4.0	88 to 99	89 to 97

Beginning of table description. Table 2 is titled Verified Emissions Reductions. The table describes the verified emissions reduction percentages for the degreened and aged systems for particulate matter, nitrogen oxides, hydrocarbons, and carbon monoxide. 95% confidence limits for these reductions are also listed. End of table description.

The APCT Center quality manager has reviewed the test results and quality control (QC) data and has concluded that the data quality objectives given in the generic verification protocol and 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 Baumot BA-B system for the stated application. Extrapolation outside that range should be done 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 Baumot BA-B system within the range of applicability of the statement.

signed by Cynthia Sonich-Mullin 5/30/2012
 Cynthia Sonich-Mullin Date
 Director
 National Risk Management Research Laboratory
 Office of Research and Development
 United States Environmental Protection Agency

signed by Jason Hill 4/30/2012
 Jason Hill Date
 Director
 Air Pollution Control Technology Center
 RTI International

NOTICE: ETV verifications are based on an evaluation of technology performance under specific, predetermined criteria and the appropriate quality assurance procedures. EPA and RTI make no express or implied warranties as to 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 federal, state, and local requirements. Mention of commercial product names does not imply endorsement.