THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

Research Triangle Institute

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**BAGHOUSE FILTRATION PRODUCTS**
APPLICATION:	**CONTROL OF PM 2.5 PARTICLE EMISSIONS BY BAGHOUSE FILTRATION PRODUCTS**
TECHNOLOGY NAME:	**QG061**
COMPANY:	**BHA Group, Inc.**
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The U.S. Environmental Protection Agency (EPA) has 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 substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV 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.

ETV works in partnership with recognized standards and testing organizations; stakeholder groups which consist of buyers, vendor organizations, permitters, 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 protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Air Pollution Control Technology (APCT) program, one of 12 technology areas under the ETV program, is operated by the Research Triangle Institute (RTI), in cooperation with EPA's National Risk Management Research Laboratory. The APCT program has recently evaluated the performance of baghouse filtration products (BFPs) used primarily to control fine particulate matter (PM) emissions. This verification statement summarizes the test results for the BHA Group's filter fabric QG061.

VERIFICATION TEST DESCRIPTION

All tests were performed in accordance with the APCT draft "Generic Verification Protocol for Baghouse Filtration Products," available at the Website http://etv.rti.org/apct/pdf/baghouseprotocol.pdf . The protocol is based on and describes modifications to the equipment and procedures described in Verein Deutscher Ingenieure (VDI 3926, Part 2), "Testing of Filter Media for Cleanable Filters under Operational Conditions," December 1994. The document is available from Beuth Verlag GmbH, 10772 Berlin, Germany. The protocol also includes requirements for quality management, quality assurance, procedures for product selection, auditing of the test laboratories, and test reporting format.

Outlet particle concentrations from a test fabric are measured with an impactor equipped with appropriate substrates to filter and measure particles 2.5 µm and smaller in aerodynamic diameter (PM 2.5) within the dust flow. Outlet particle concentrations are determined by weighing the mass increase rate of dust collected in each impactor filter stage and dividing by the gas volumetric flow through the impactor.

Particle size is measured while injecting the test dust into the air upstream of the baghouse filter sample. The test dust is dispersed into the flow using a brush-type dust feeder. The particle size distributions in the air are determined both upstream and downstream of the test filter fabric to provide accurate results for penetration through the test filter of particles equal to or smaller than 2.5 µm in diameter. All tests are performed using a constant 18.4 ± 3.6 g/dscm (8.0 ± 1.6 gr/dscf) loading rate, a 180 ± 9.0 m/h (9.8 ± 0.5 fpm) filtration velocity (identical to gas-to-cloth ratio*), and aluminum oxide test dust with a measured mass mean aerodynamic diameter of 1.0 (average of three impactor runs) ± 0.5 µm. All baghouse filtration products are tested in their initial (i.e., clean) condition.

Each of three or more test runs consisted of the following segments:

- Conditioning period - 10,000 rapid pulse cleaning cycles.
- Recovery period - 30 normal pulse cleaning cycles.
- Performance test period - 6-hour filter fabric test period with impactor.

TECHNOLOGY DESCRIPTION

The BHA Group's QG061 filter fabric was a woven-glass-base fabric with an expanded, microporous PTFE membrane, thermally laminated to the filtration/dust cake surface. This product is traditionally used to capture fine particulate in hot gas filtration applications. A photograph of the fabric is shown in Figure 1. Sample material was received as nine 46 x 91 cm (18 x 36 in.) swatches marked with the manufacturer's model number, year and month of manufacture, and cake side. Three of the swatches were selected at random for preparing three test specimens 150 mm (5.9 in.) in diameter.

VERIFICATION OF PERFORMANCE

Verification testing of the BHA Group's QG061 filter fabric was performed during May 30 - June 5, 2000, at the test facility of ETS, Incorporated, 1401 Municipal Road, Roanoke, VA 24012. Test conditions are listed in Table 1. The overall test results are summarized in Table 2, and are the averages of four individual tests.

*Filtration velocity and gas-to-cloth ratio are used interchangeably and are defined as the gas flow rate divided by the surface area of the cloth.

RTI's APCT quality assurance officer has reviewed the test results and the quality control data and has concluded that the data quality objectives given in the generic verification protocol have been attained. This verification statement addresses five aspects of filter fabric performance: filter outlet PM 2.5 concentration,filter outlet total mass concentration, pressure drop, filtration cycle time, and mass gain on the filter fabric. Users may wish to consider other performance parameters such as temperature, service life, and cost when selecting a filter fabric for their application.
In accordance with the generic verification protocol, this Verification Statement is applicable to filter media manufactured between the publication date of the Verification Statement *(10/12/00)* and 3 years thereafter.

TABLE 1. TEST CONDITIONS FOR BAGHOUSE FILTRATION PRODUCT BRAND/MODEL: BHA GROUP FABRIC QG061

Test parameter	**Value**
Dust concentration	18.4 ± 3.6 g/dscm (8.0 ± 1.6 gr/dscf)
Filtration velocity (G/C)	180 ± 9 m/h (9.8 ± 0.5 fpm)
Pressure loss before cleaning	1,000 ± 12 Pa (4 ±0.05 in. w.g.)
Tank pressure	0.52 ± 0.03 MPa (75 ± 5 psi)
Valve opening time	50 ± 5 ms
Air temperature	25 ± 2 °C (78 ± 4 °F)
Relative humidity	50 ± 10 %
Raw gas stream flow rate	5.8 m^3/h (3.4 cfm)
Sample gas stream flow rate	1.13 m^3/h (0.67 cfm)
Number of filtration cycles	
• During conditioning period	10,000 cycles
• During recovery period	30 cycles
Performance test duration	6 h

TABLE 2. BAGHOUSE FILTRATION PRODUCT FOUR-RUN AVERAGE TEST RESULTS FOR BHA GROUP FABRIC QG061

Verification parameter	At verification test conditions	At manufacturer's requested test conditions*
Outlet particle concentration at standard conditions **		
PM 2.5, g/dscm (gr/dscf)	0.000002 (0.0000009)	NA
Total mass, g/dscm *** (gr/dscf)	0.000002 (0.0000009)	NA
Residual pressure drop, cm w.g. (in. w.g.)	6.20 (2.44)	NA
Residual pressure drop increase, cm w.g. (in. w.g.)	0.56 (0.22)	NA
Filtration cycle time, s	57	NA
Mass gain of test sample filter, g (gr)	0.10 (1.54)	NA
Number of cleaning cycles	377	NA

NA = Not applicable - values shown are for four tests

* As requested by manufacturer

** Standard conditions: 101.3 kPa (14.7 psia) and 20°C (68°F). One or more of the impactor substrate weight changes for these results were near the reproducibility of the balance.

*** Total mass includes the mass of PM 2.5 and larger particles that passed through the fabric.

Figure 1. Photograph of the BHA Group QG061 filter fabric

This verification statement addresses two aspects of baghouse filtration product performance: outlet particle concentration and pressure drop. Users of this technology may wish to consider other performance parameters when selecting a baghouse filtration product for their application.

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