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# Environmental Technology Verification

## Baghouse Filtration Products

TTG Inc.
TG800 Filtration Media
(Tested August 2012)

Prepared by

RTI International

ETS Incorporated

Under a Cooperative Agreement with
U.S. Environmental Protection Agency

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# THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

# ETV Joint Verification Statement

| | | | |
|---|---|---|---|
| **TECHNOLOGY TYPE:** | **BAGHOUSE FILTRATION PRODUCTS** | | |
| **APPLICATION:** | **CONTROL OF $PM_{2.5}$ EMISSIONS BY BAGHOUSE FILTRATION PRODUCTS** | | |
| **TECHNOLOGY NAME:** | **TG800 Filtration Media** | | |
| **COMPANY:** | **TTG Inc.** | | |
| **ADDRESS:** | **7561 South Highway 13**<br>**Higginsville, MO 64037** | **PHONE:**<br>**FAX:** | **660-584-2448**<br>**660-584-3422** |
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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, 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 (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) is operated by RTI International[*] (RTI), in cooperation with EPA's National Risk Management Research Laboratory (NRMRL). The APCT Center evaluates the performance of baghouse filtration products (BFPs) used primarily to control $PM_{2.5}$ emissions (i.e., particles 2.5 μm and smaller in aerodynamic diameter). This verification statement summarizes the test results for TTG Inc.'s TG800 filtration media.

## VERIFICATION TEST DESCRIPTION

All tests were performed in accordance with the APCT Center *Generic Verification Protocol for Baghouse Filtration Products*, available at http://www.epa.gov/etv/pubs/05_vp_bfp.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 VDI document is available from Beuth Verlag GmbH, 10772 Berlin, Germany. The protocol also includes requirements for quality management and QA, procedures for product selection, auditing of the test laboratories, and the test reporting format.

Outlet particle concentrations from a test fabric were measured with an impactor equipped with appropriate substrates to filter and measure $PM_{2.5}$ within the dust flow. Outlet particle concentrations were determined by weighing the mass increase of dust collected in each impactor filter stage and dividing by the gas volumetric flow through the impactor.

Particle size was measured while injecting the test dust into the air upstream of the baghouse filter sample. The test dust was dispersed into the flow using a brush-type dust feeder. The particle size distributions in the air were determined both upstream and downstream of the test filter fabric to provide accurate results for penetration of $PM_{2.5}$ through the test filter. All tests were performed using a constant 18.4 ± 3.6 g/dscm (8.0 ± 1.6 gr/dscf) loading rate, a 120 ± 6.0 m/h (6.6 ± 0.3 fpm) filtration velocity [identical to gas-to-cloth ratio (G/C[**])], and aluminum oxide test dust with a measured mass mean aerodynamic diameter maximum of 1.5 μm (average of three impactor runs). All BFPs are tested in their initial (i.e., clean) condition.

Each of the three 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—six-hour filter fabric test period with impactor.

## VERIFIED TECHNOLOGY DESCRIPTION

Baghouses are air pollution control devices used to control particulate emissions from stationary sources and are among the technologies evaluated by the APCT Center. Baghouses and their accompanying filter media have long been one of the leading particulate control techniques for industrial sources. Increasing emphasis on higher removal efficiencies has helped the baghouse to be continually more competitive when compared to the other generic PM control devices to the point where the baghouse is now the control option of choice for most industrial applications. The development of new and improved filter media has further enhanced baghouse capability to control fine PM over an expanded range of industrial applications.

[*] RTI International is a trade name of Research Triangle Institute.

[**] 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.

TTG Inc. provided the following information about their filter media product. The TTG Inc. TG800 filtration media is a 16 ounces per square yard ($oz/yd^2$) scrim-supported polyphenylene sulfide (PPS) felt laminated with an ePTFE (expanded polytetrafluoroethylene) membrane. **Figure 1** is a photograph of the fabric. 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 (the upstream side of the fabric, which is exposed to the particle-laden air on which the filter cake builds up). Three of the swatches were selected at random for preparing three circular test specimens 150 mm (5.9 in.) in diameter.


**Figure 1. Photograph of TTG Inc.'s TG800 filtration media**

## VERIFICATION OF PERFORMANCE

Verification testing of the TTG Inc.'s TG800 filtration media was performed during the period of August 9 – 16, 2012, for standard test conditions at the test facility of ETS Incorporated, 1401 Municipal Road NW, Roanoke, VA 24012. Test conditions are listed in **Table 1**. The overall test results summarized in **Table 2** represent the averages of three individual tests.

The APCT Center quality manager has reviewed the test results and the 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.

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.

**Table 1. Test Conditions for Baghouse Filtration Products**
**Brand/Model: TTG Inc.'s TG800 Filtration Media**

| Test Parameter | Value |
|---|---|
| Dust concentration | 18.4 ± 3.6 g/dscm (8.0 ± 1.6 gr/dscf) |
| Filtration velocity (G/C) | 120 ± 6 m/h (6.6 ± 0.3 fpm) |
| Pressure loss before cleaning | 1,000 ± 12 Pa (4 ± 0.05 in. w.g.) |
| Tank pressure | 0.5 ± 0.03 MPa (75 ± 5 psi) |
| Valve opening time | 50 ± 5 ms |
| Air temperature | 25 ± 2 $^{o}$C (77 ± 4 $^{o}$F) |
| Relative humidity | 50 ± 10% |
| Total raw gas stream flow rate | 5.8 ± 0.3 $m^3$/h (3.4 ± 0.2 cfm) |
| Sample gas stream flow rate | 1.13 ± 0.06 $m^3$/h (0.67 ± 0.03 cfm) |
| Number of cleaning cycles | — |
| • During conditioning period | 10,000 cycles |
| • During recovery period | 30 cycles |
| Performance test duration | 6 h ± 1 s |

Beginning of table description. Table 1 is titled Test Conditions for Baghouse Filtration Products; the Brand/Model is listed as TTG Inc.'s TG800 Filtration Media. The table describes the test conditions that are specified in the QA/QC requirements for the test; all conditions were achieved for this test. The table lists the test parameters in one column and their values in the next column. The test parameters include such items as the dust concentration, filtration velocity, flow rates, air temperature and humidity, and the number of cleaning cycles during the test. End of table description.

**Table 2. Baghouse Filtration Product Three-Run Average Test Results for TTG Inc.'s TG800 Filtration Media**

| Verification Parameter | At Verification Test Conditions |
|---|---|
| Outlet particle concentration at standard conditions[a] | |
| $PM_{2.5}$, g/dscm | <0.0000167[c] |
| (gr/dscf) | (<0.0000073) |
| Total mass, g/dscm[b] | <0.0000167[c] |
| (gr/dscf) | (<0.0000073) |
| Average residual pressure drop (Δ P), cm w.g. (in. w.g.) | 2.76 (1.09) |
| Initial residual Δ P, cm w.g. (in. w.g.) | 2.74 (1.08) |
| Residual Δ P increase, cm w.g. (in. w.g.) | 0.06 (0.02) |
| Filtration cycle time, s | 218 |
| Mass gain of test sample filter, g (gr) | 0.10 (1.54) |
| Number of cleaning cycles | 98 |

[a] 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.

[b] Total mass includes the mass of PM2.5 and larger particles that passed through the fabric.

[c] The measured value was determined to be below the detection limit of 0.0000167 grams per cubic meter. The detection limit is for a six-hour test and based on VDI 3926.

Beginning of table description. Table 2 is titled Baghouse Filtration Product Three-Run Average Test Results for TTG Inc.'s TG800 Filtration Media. The table lists the verified test results for this product. The table lists the verification parameters in one column and their values at the verification test conditions in the next column. The verification parameters listed include the outlet particle concentration, the pressure drop characteristics, the filtration cycle time, the mass gain of the test sample, and number of cycles during the test. End of table description.

In accordance with the generic verification protocol, this verification statement is applicable to filter media manufactured between the signature date of the verification statement and three years thereafter.

*signed by Cynthia Sonich-Mullin* *3/7/2013*
Cynthia Sonich-Mullin Date
Director
National Risk Management Research Laboratory
Office of Research and Development
United States Environmental Protection Agency

*signed by Jason Hill* *11/1/2012*
Jason Hill Date
Director
Air Pollution Control Technology Center
RTI International