

SOUTHWEST RESEARCH INSTITUTE®

6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS, USA 78228-0510 • (210) 684-5111 • www.swri.org

ISO 9001 Certified
ISO 14001 Certified

January 20, 2012

S&B Filters
15461 Slover Ave
Fontana, CA, 92337

This report must be reproduced
in full, unless SwRI® approves
a summary or abridgement.

Subject: Letter Report, Test Results, Southwest Research Institute® (SwRI®)
Project No. 08.16927.06.002, "Water Spray Removal Testing of 75-5057 Intake
with AS-1002 Scoop"

Reference: S&B Filters P.O. No. P2166 Line Item 2

Dear S&B Filters:

This report presents results of water spray removal testing conducted on a 75-5057 Intake with AS-1002 Scoop configuration provided by S&B Filters for evaluation. Testing was conducted in accordance with SAE J2554, Engine Intake Air Water Separation Test Procedure, APR2003. Water spray removal testing was accomplished at 642 scfm. Proper droplet size and flow delivery were achieved by nozzle selection and pressure control. The spray nozzle was sized to provide a spray with a median volume diameter (MVD) of 1000 microns, based on nozzle performance specifications. The MVD is a value where 50% of the total volume (or mass) of liquid sprayed is made up of drops with diameters larger than the median value and 50% smaller than the median value. The MVD and the actual droplet size distribution (DSD) were not measured. For the specified airflow rate, SAE J2554 called for a water feed rate of 500 ml/min. This was accomplished, using the same general experimental arrangements and test protocols as used in the previous testing, as reported in our September 29, October 29, and December 21, 2009 test reports, with one major exception; notably, that the fender vent remained open during the current testing. The general test arrangement is shown in Figure 1. The inlet ducting, which served as a control volume for droplet injection was the same as that used during previous testing.

Test results are given in Tables 1 and 2 and Figures 2 and 3. Table 1 gives quantitative results in term of water penetration and removal. Table 2 gives pre and post-test airflow resistance at rated flow. Figure 2 shows pre-test airflow resistance as a function of flow rate, and Figure 3 shows general photographs taken during testing. While SAE J2554 is primarily intended



SAN ANTONIO, TEXAS • HOUSTON, TEXAS • ANN ARBOR, MI • WASHINGTON, DC

to measure separation efficiency, it is apparent in this case that the parameter of most importance is water penetration to the upper filter unit and beyond. In particular, the target for allowable penetration is zero, since the filter should remain dry during vehicle operation in all weather and road conditions. No water penetrated the unit and only a trace of water was retained by the filter. When the airflow was turned off, a very small amount of water wetted the scoop or drains back to the scoop area, where it was retained in the scoop's vertical depressions.

Table 1. Water Spray Penetration: S&B 75-5057 Intake with AS-1002 Scoop, with Fender Vent Open; 1000 µm Mean Volume Diameter (MVD) Spray (Single, Spray Systems Co. 1/8 G-1, 0.031" Dia., Full Jet Nozzle at 24 psi,); Unit Airflow: 642 scfm.

Test	Configuration	Test Airflow Rate, scfm	Water Penetrating Unit, % (a)	Water Penetrating Scoop Section, % (b)	Water Retained by Upper Unit/ and by Filter, % (c)	Scoop Ejection, % of total	Water Retained by Scoop when Airflow Turned Off, % (d)
1	Fender vent open	642	0.0	0.23	0.23/0.23	99.47	0.30

Tests conducted: Dec 2011

*cfm At 20°C and 101.3 kPa

$$a. \text{ Water penetration} = \left[\frac{\text{wt. of water collected downstream of unit}}{\text{total wt. of water collected}} \right] \times 100$$

$$b. \text{ Water penetration} = \left[\frac{\text{wt. of water collected downstream of scoop section}}{\text{total wt. of water collected}} \right] \times 100$$

$$c. \text{ Water retained} = \left[\frac{\text{wt. of water collected in upper unit/and by the filter}}{\text{total wt. of water collected}} \right] \times 100$$

$$d. \text{ Water retained} = \left[\frac{\text{wt. of water collected in scoop depressions}}{\text{total wt. of water collected}} \right] \times 100$$

It is important to understand the above terminology. Water penetrating the scoop section is the amount of water presented to the upper filtration section, as a percent of the total water collected during the test. Water retained by the upper unit is the amount of water retained in the filtration section (filter and filter housing area) as a percent of the total amount of water collected during the test run. The amount of water collected by the filter is also based on the total amount of water collected during the test run. It is also important to note that all testing was conducted under suction only, and that with the vent open, only a portion of the air enters the unit through the scoop inlet and the forward facing mid-scoop slot. A few velocity measurements were made to estimate the flow rate into the mouth of the scoop and the total flow provided from the scoop, including flow from the mid-point slot. These measurements indicate that approximately 20% of the total flow exiting the unit (and therefore entering the engine) is derived from the lower scoop entrance, while the total flow entering the unit through the entire scoop section is about 45% of the flow going to the engine.

Table 2. Pre-and Post-test Airflow Restriction Values*

Test	Test Airflow Rate, scfm	Configuration	Pre-test Restriction, "of water	Post-test Restriction, "of water
1	642	75-5057 intake with AS-1002 scoop	8.12	8.26

Tests conducted: Dec 2011

*Corrected to 20°C and 101.3 kPa

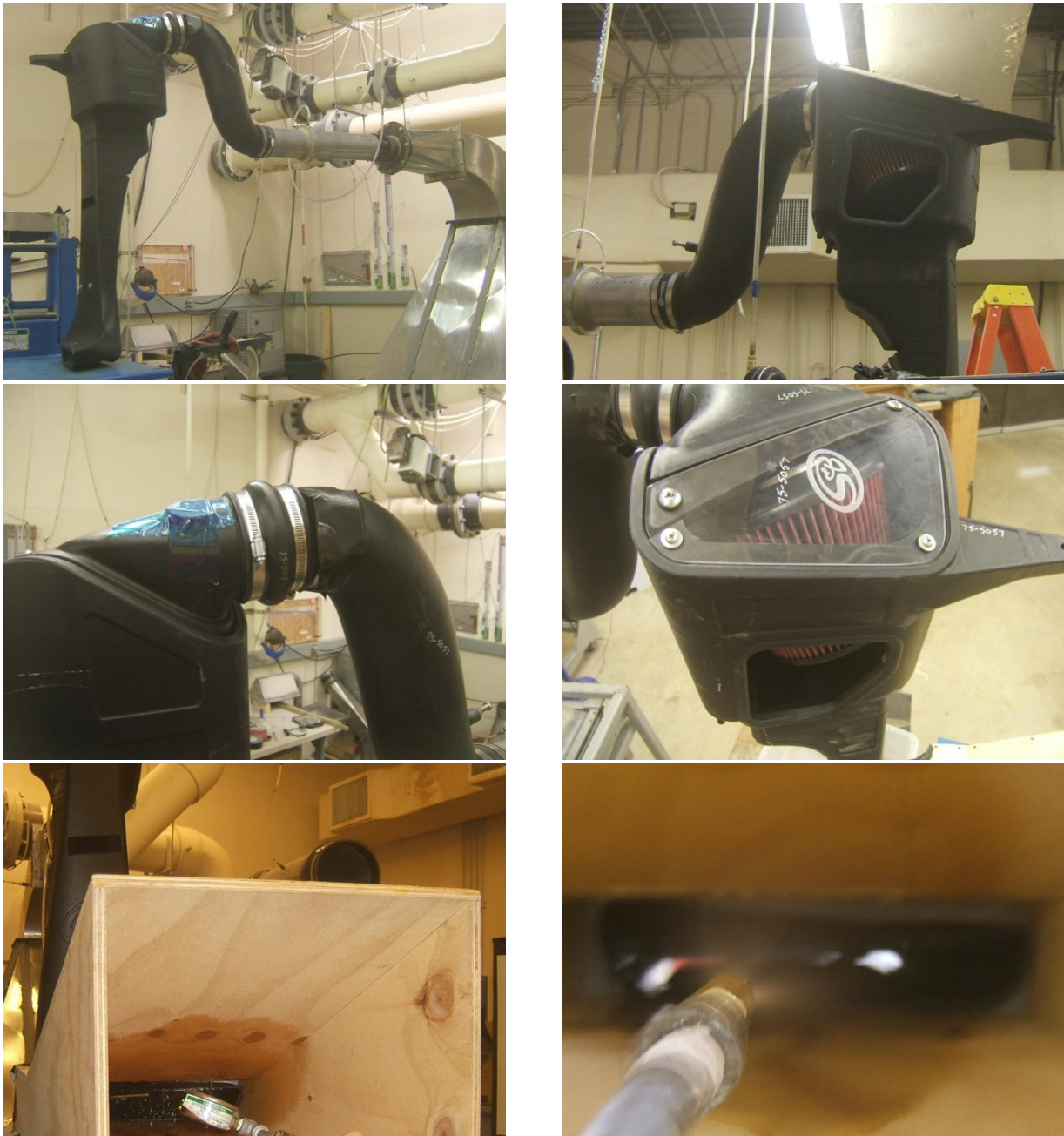


Figure 1. General Test Arrangement for 75-5057 Intake with AS-1002 Scoop (spray wand moved back and forth laterally across scoop inlet)

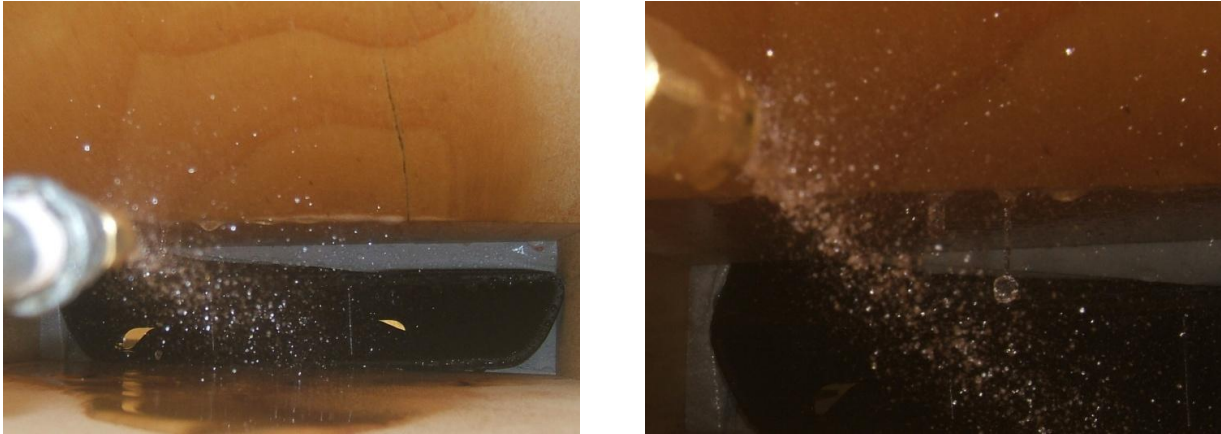


Figure 1. General Test Arrangement for 75-5057 Intake with AS-1002 Scoop (spray wand moved back and forth laterally across scoop inlet) (Continued)

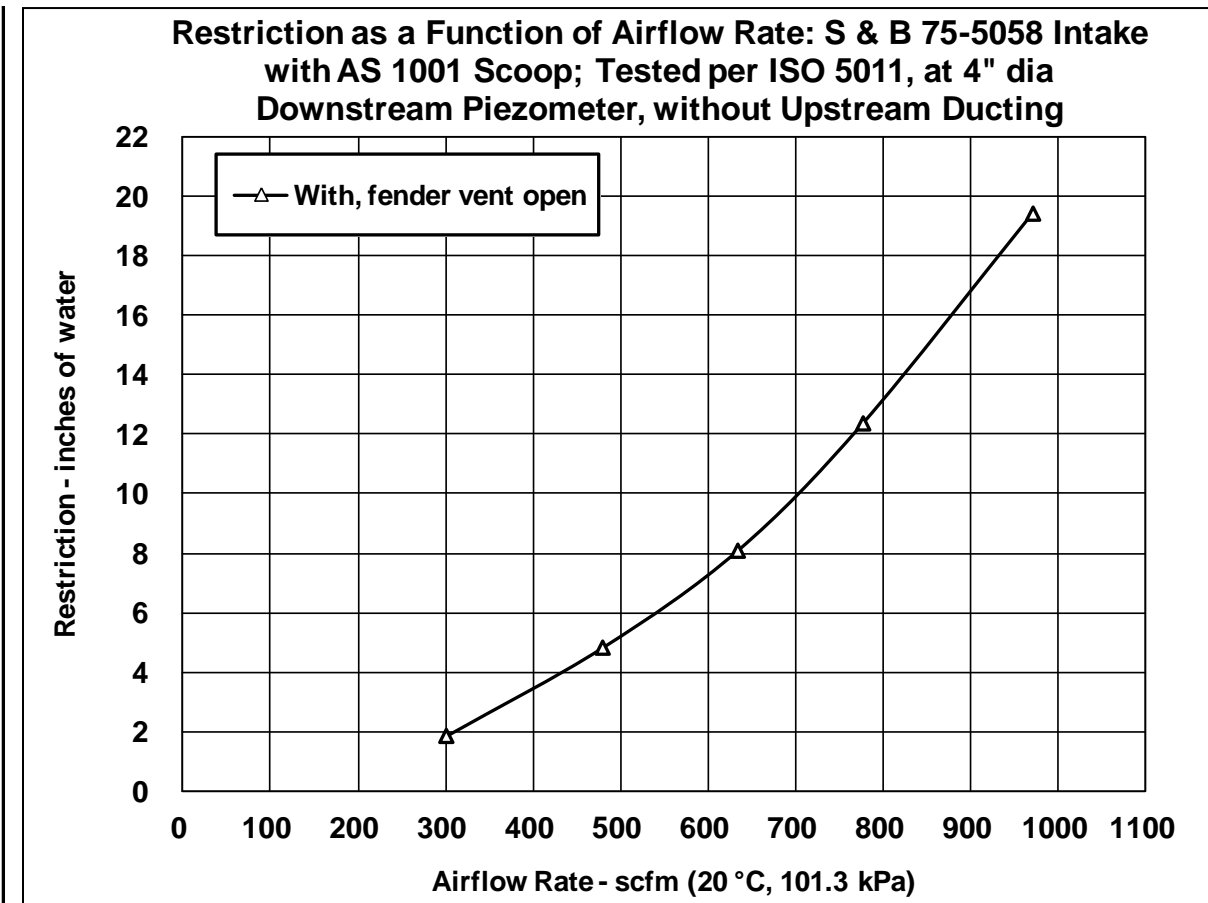


Figure 2



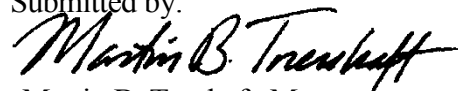
Figure 3. Some General Photographs during and after Testing of 75-5057 Intake with AS-1002 Scoop



Figure 3. Some General Photographs during and after Testing of 75-5057 Intake with AS-1002 Scoop (Continued)

If you have any questions concerning the test program or the results, please do not hesitate to contact me at (210) 522-2626 during normal business hours. For your convenience, our facsimile number is (210) 522-5720 and my e-mail address is mtreuhaft@swri.org.

Submitted by:



Martin B. Treuhaft, Manager
Filtration & Fine Particle Technology

Approved by:



FOR
Steven D. Marty, P.E., Director
Fuels & Lubricants Technology Department
Fuels & Lubricants Research Division