

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 75-5058 Intake
with AS-1001 Scoop"

Reference: S&B Filters P.O. No. P2166 Line Item 1

Dear U(D'Hkngtu:

This report presents results of water spray removal testing conducted on a 75-5058 Intake with AS-1001 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 612 scfm, as specified. 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 scoop testing, with two major exceptions; notably, that the fender vent remained open during the current testing, and the water spray was aimed horizontally under the scoop, as illustrated in the S&B schematic shown in Figure 1. The general test arrangement is shown in Figure 2.

Test results are given in Tables 1 and 2 and Figures 3 and 4. Table 1 gives quantitative results in term of water spray collection and penetration. Table 2 gives pre and post-test airflow resistance at rated flow. Figure 3 shows pre-test airflow resistance as a function of flow rate, and



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

Figure 4 shows general photographs taken during testing. While SAE J2554 is primarily intended 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 remained on the inner walls of the scoop.

Table 1. Water Spray Penetration and Collection: S&B 75-5058 Intake with AS-1001 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.); Water Spray Presented Laterally under Scoop; Unit Airflow: 612 scfm.

Test	Configuration	Test Airflow Rate, scfm*	Water Penetrating Unit, % (a)	Water Penetrating Scoop Section, % (b)	Water Retained by Upper Unit/ and by Filter and Outlet Tube, % (c)	Water Retained by Filter/ Outlet Tube, % (c)	Water Collected on Scoop walls, % (d)
1	Fender vent open	612	0.0	0.60	0.70/0.60	0.42/0.18	0.36

Tests conducted: Jan 2012

*cfm At 20°C and 101.3 kPa

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

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

$$c. \text{ Water retained} = \left[\frac{\text{wt.of water collected in upperunit/and by thefilter and outlet tube}}{\text{total wt.of water provided to scoop}} \right] \times 100$$

$$d. \text{ Water retained} = \left[\frac{\text{wt.of water collected on scoop walls}}{\text{total wt.of water provided to scoop}} \right] \times 100$$

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. The total amount of water collected includes water collected in the downstream catch basins. 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. It is most likely that a better simulation would include ram air below the inlet in addition to the spray stream. This is doable, but would add some complexity to the test setup and testing protocol. A few velocity measurements were made to estimate the flow rate into the mouth of the scoop. These measurements indicate that approximately 43% of the total flow exiting the unit (and therefore entering the engine) is derived from the scoop entrance, while the rest of the flow must derive from the opened vent.

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	612	75-5058 intake with AS-1001 scoop	7.59	7.59

Tests conducted: Jan 2012

*Corrected to 20°C and 101.3 kPa

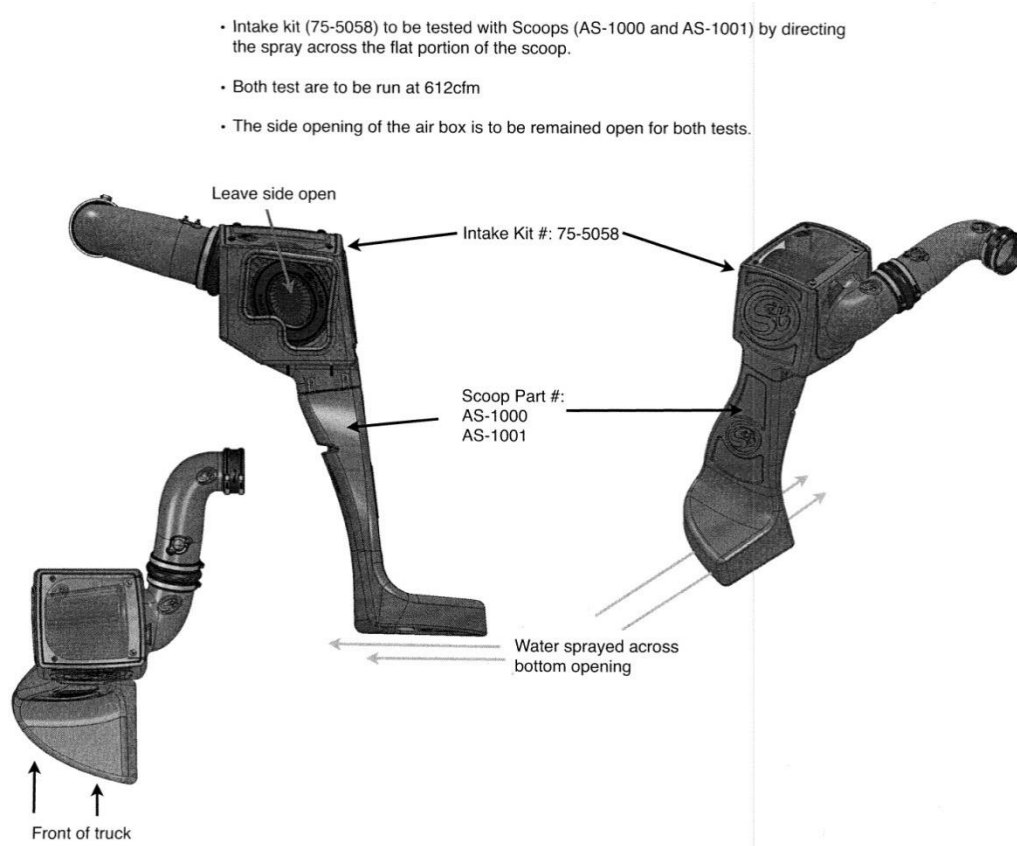


Figure 1. S&B Schematic for Water Testing of 75-5058 Intake with AS-1001 Scoop



Figure 2. General Test Arrangement for 75-5058 Intake with AS-1001 Scoop (top row: airflow testing; other rows: water spray testing)



Figure 2. General Test Arrangement for 75-5058 Intake with AS-1001 Scoop (top row: airflow testing; other rows: water spray testing) (Continued)

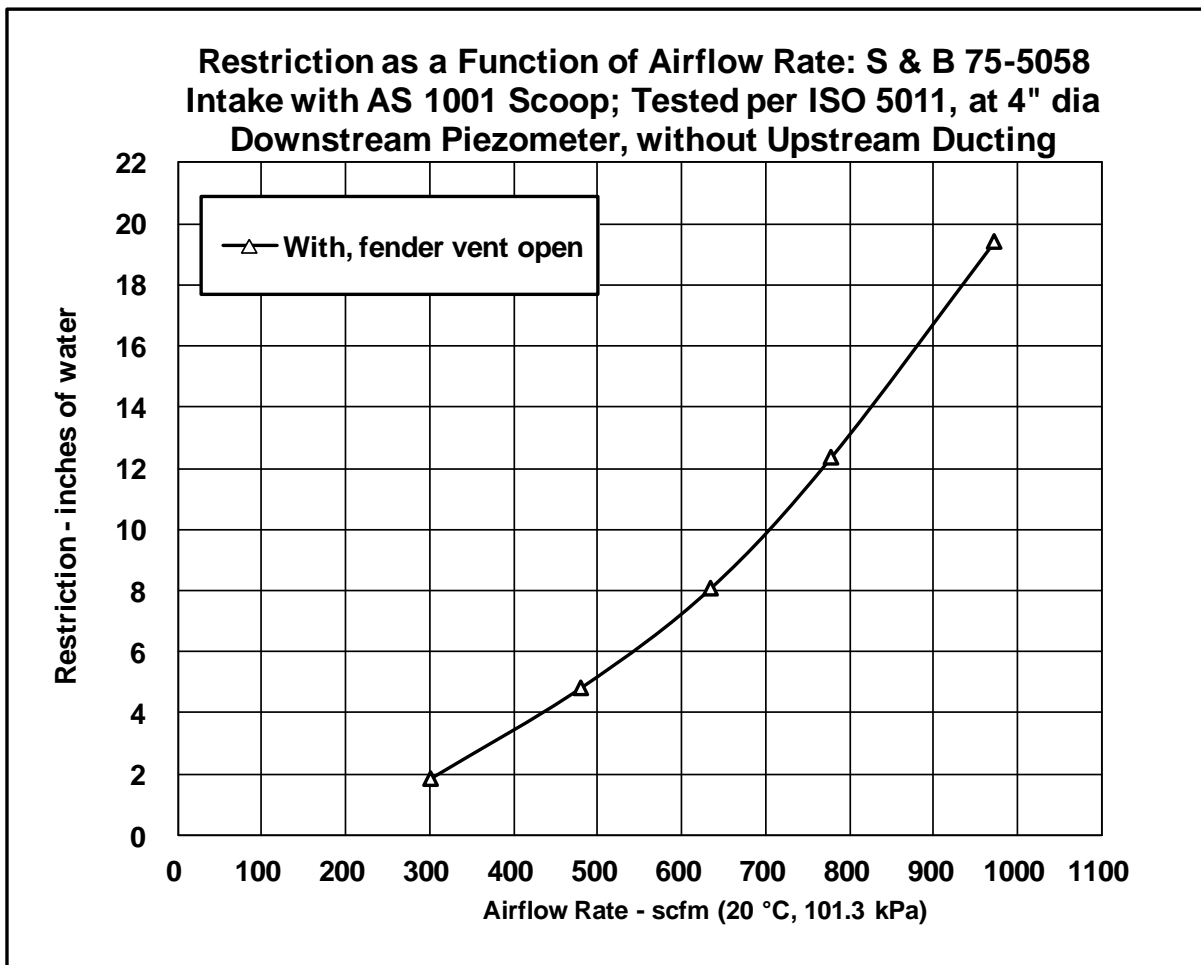


Figure 3



Figure 4. Some General Photographs during and after Testing of 75-5058 Intake with AS-1001 Scoop



Figure 4. Some General Photographs during and after Testing of 75-5058 Intake with AS-1001 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:

A handwritten signature in black ink that reads "Martin B. Treuhaft".

Martin B. Treuhaft, Manager
Filtration & Fine Particle Technology

Approved by:

A handwritten signature in black ink that reads "Gary Bessee".

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