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**MONITORING OF FREE WATER AND PARTICULATE
CONTAMINATION OF F-24 FUEL**

**INTERIM REPORT
TFLRF No. 480**

by
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**U.S. Army TARDEC Fuels and Lubricants Research Facility
Southwest Research Institute® (SwRI®)
San Antonio, TX**

for
**Joel Schmitigal
U.S. Army TARDEC
Force Projection Technologies
Warren, Michigan**

Contract No. W56HZV-09-C-0100 (WD36)

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April 2016

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Approved by:



Gary B. Bessee, Director
U.S. Army TARDEC Fuels and Lubricants
Research Facility (SwRI®)

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14. ABSTRACT A study was conducted on the contaminant detection methods of fuel sensors which are capable of quantifying both free water (0-30ppm) and sediment (0-2.5 mg/L) independently. Additionally, a comparative analysis was conducted on multiple sensors with calibrated to two different particle count standards.						
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EXECUTIVE SUMMARY

The purpose of this work directive was to evaluate contaminate detection methods of fuel sensors. The scope included tests to evaluate a novel sensor's ability to differentiate between various contaminants, compare new and previous particle count calibration methods, impact of various coalescer/separator failure modes, the effectiveness of a co-solvent on reducing the impact of water on particle count results, and the effect of air bubbles on particle count results. Most of the testing profiles included multiple concentrations of A1, A2, A3, and/or red iron oxide test dusts, as well as free water concentrations from 0 to 15ppm. The Artium test sensor was able to accurately and efficiently detect and differentiate between water and dirt particles. It was also accurate in determining concentrations. The calibration study showed a general trend as found in industry, however, could merit further investigation. The failure mode analysis showed a high impact on results when a puncture or tear was introduced to one of the coalescer or separators, however a lower impact if there was only an installation malfunction. The co-solvent Resolver and isopropyl alcohol showed significant impact on particle counting results, reducing the impact of the water droplets, when an appropriate sample container was selected. The results showed that only samples taken in a metal can showed the presence of water and dirt. The samples taken in plastic and glass containers reduced the apparent levels of dirt or water in the container because of the surface chemistry of the bottle-sample interface. Finally, the entrained air study showed that the air bubbles did not significantly affect the particle count results. The method development for this study is still in infancy and could merit further investigation due to limited number of bubbles induced into the fuel stream.

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The authors would like to acknowledge the contribution of the TFLRF technical support staff and administrative and report-processing support.

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ACRONYMS AND ABBREVIATIONS

µm	Micrometer
ASTM	ASTM International
DOD	Department of Defense
EI	Energy Institute
GPM	Gallons per minute
ISO	International Organization for Standardization
L	Liters
L/m	Liters per minute
LPM	Liters per minute
Min	Minutes
mg/L	milligrams per liter
mL	milliliter
ppm	parts per million
RIO	red iron oxide
sec	Seconds
SwRI	Southwest Research Institute
TARDEC	Tank Automotive Research Development and Engineering Center

1.0 INTRODUCTION

The purpose of this work directive was to evaluate contaminant detection methods of various fuel sensors. The first study evaluated a new and advanced sensor which can differentiate and quantify both free water and sediment independently. Another study compared common particle counting instruments which were calibrated to different Standard reference materials, SRM 2806a vs SRM 2806b. Additionally, the impact of various failure modes on the coalescer and separators were tested and reported. Finally, Southwest Research Institute was tasked with developing a method to introduce air bubbles into the system as third contaminant, and determining whether or not common particle counting instruments were able to detect the air bubbles.

Additionally, as a continuation of a previous work directive, standard EI 1581 5th Edition tests were conducted using varying amounts of the +100 additive to determine whether or not there was a significant difference in filter performance with the M100 fuel.

2.0 SENSOR TESTING

2.1 NOVEL SENSOR TO DIFFERENTIATE CONTAMINANTS

A sensor provided by Artium was selected for the contaminant detection study.

2.1.1 Sensor Test Matrix

The Artium sensor was installed in line at the SwRI Aviation Filtration Test Rig. The system was operated at approximately 105.7 GPM. The Jet A fuel was clean and dry prior to any testing. Contaminants selected for evaluation were:

- A-3 Test Dust
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L, 2.5 mg/L
- A-2 Test Dust
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L, 2.5 mg/L
- A-1 Test Dust
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L, 2.5 mg/L

- 0.25 mg/L + 5ppm Water
- 1.0 mg/L + 10ppm Water
- Red Iron Oxide (RIO)
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L
- Water
 - 0ppm, 5ppm, 10ppm, 20ppm, 30 ppm, 40ppm

The testing procedure was as follows:

1. Established fuel flow rate. Without any contaminant injection, collect baseline measurements.
2. Begin injecting contaminant. At five (5) minute intervals, collect test measurements.
3. After twenty to thirty minutes, stop injecting contaminant
4. Establish baseline and then inject at next concentration.
5. Repeat this process until sensor has been challenged at all contaminant concentrations.

Data collected at each interval included: flow rate, fuel temperature, free water by aqua-glo (if applicable), gravimetric sample (if applicable), and particle counts by all instruments available.

2.1.2 Sensor Results

All data from the Artium instrument was sent directly to Joel Schmitigal (TARDEC) for analysis and is not included in this final report. Rig and particle count data is included in APPENDIX A.

Overall, the Artium sensor was able to meet flow and pressure requirements. The Artium sensor was able to differentiate between the various contaminants, determine particle size, and particle count. The Artium sensor data mirrored the data presented by the standard particle counting instruments.

2.2 PARTICLE COUNT CALIBRATION COMPARISON

2.2.1 ISO Calibration Results

After compiling all results, the particle counts were plotted and then a linear curve was fitted to show a correlation between the two different Standard reference material calibrated instruments.

Table 1 and Figure 1 to Figure 4 show these results.

Table 1. Particle Count Calibration Comparison – Linear Fit Curves to Show Correlation Between Different ISO Calibrated Instruments

	≥4μm		≥6μm		≥14μm		≥30μm	
	Scale	R ²	Scale	R ²	Scale	R ²	Scale	R ²
ACM20	1.18	0.9977	1.28	0.9966	1.49	0.9385	4.93	0.8831
SETA	1.12	0.9937	1.07	0.9920	0.96	0.9966	0.57	0.9918
Combined Data	1.14	0.9940	1.14	0.9817	1.00	0.9673	0.60	0.7039

Note: μm(c) plotted as a function of μm(b)

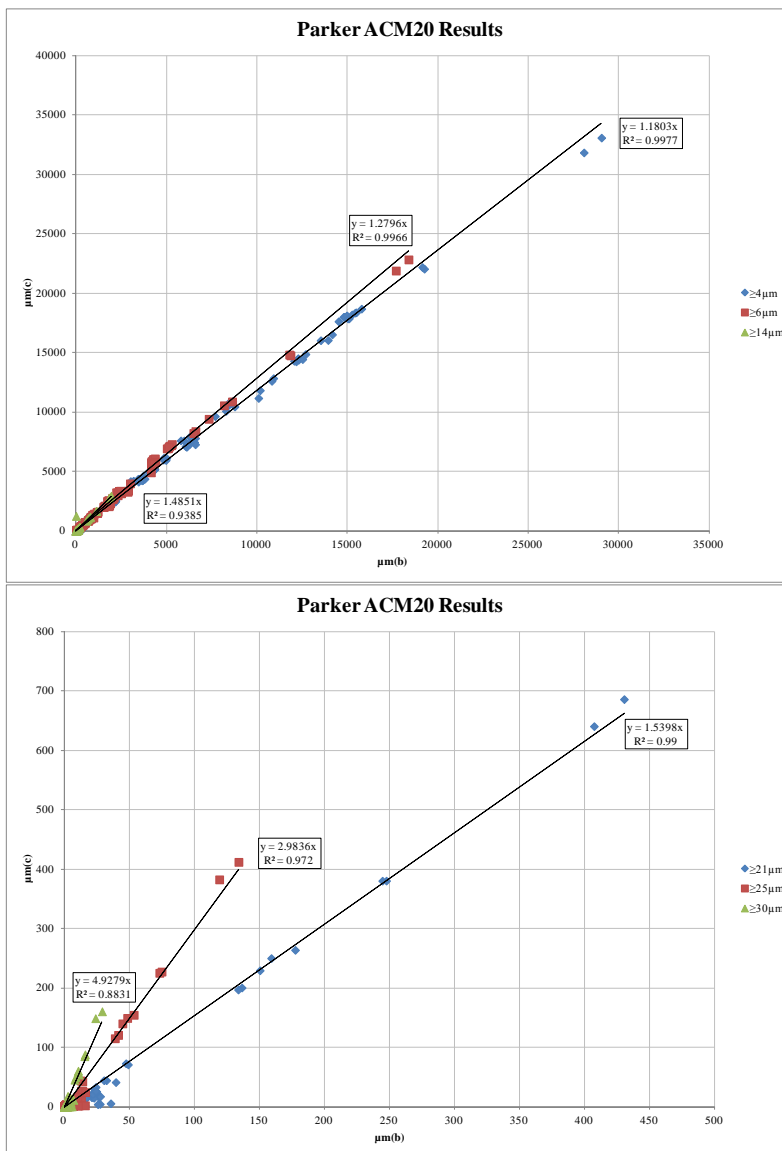


Figure 1. Particle Count Calibration Comparison – ACM20 Particle Counts Results

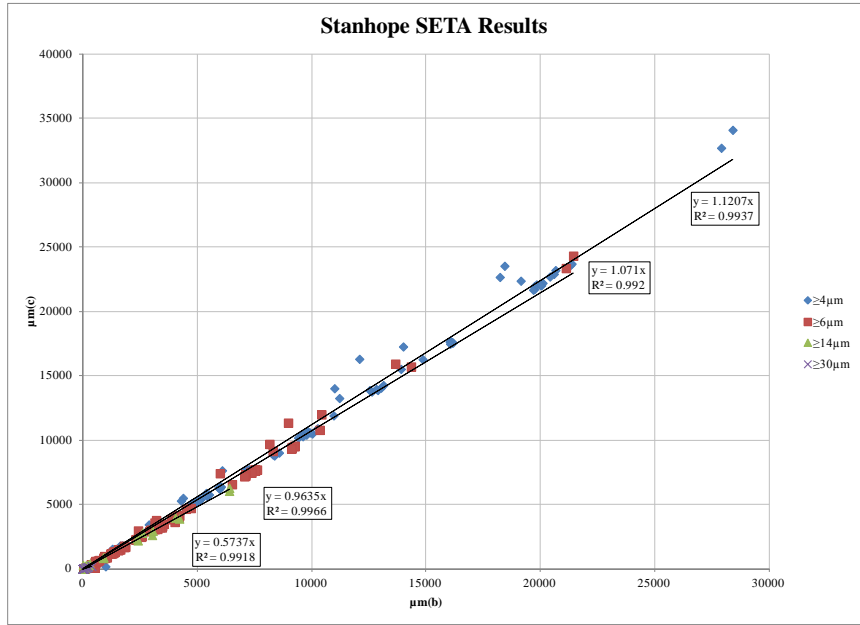


Figure 2. Particle Count Calibration Comparison – SETA Particle Counts Results

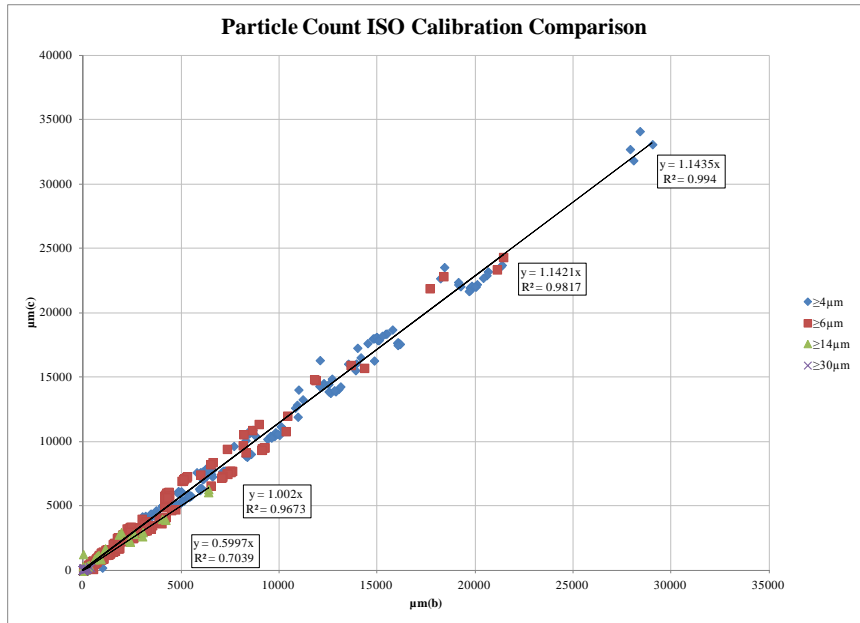


Figure 3. Particle Count Calibration Comparison – All Sensors Particle Counts Results

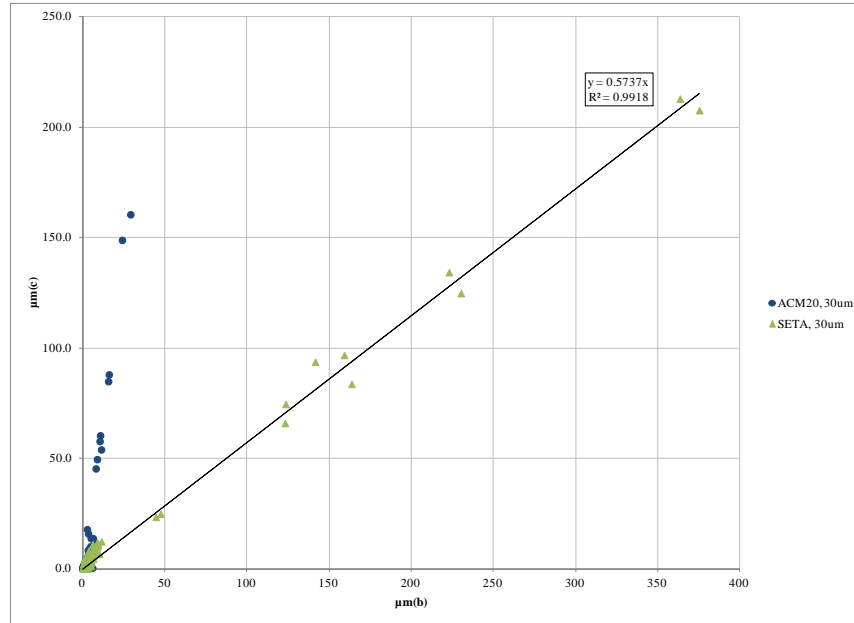


Figure 4. Particle Count Calibration Comparison – $\geq 30\mu\text{m}$ Particle Counts Results

Overall, the data for three of the four channels, trended closely. The ratio of raw counts between the two calibrations was found to be approximately 1-1.14 in this study. The largest channel, $\geq 30\mu\text{m}$, however would merit further investigation from this study.

All raw data can be found in APPENDIX B.

3.0 FAILURE MODE ANALYSIS

3.1 COALESCER FAILURE MODE ANALYSIS

For the coalescer failure mode analysis, the separator was installed properly, however the coalescer element was run with two testing profiles:

- Simulated end cap manufacturing defect
- Poorly seated end cap

The end cap manufacturing defect was simulated by puncturing a small hole at the base of the coalescer filter element. This allowed contaminated fuel past the coalescer to the properly installed

separator. The results of this failure mode showed a drastic failure of the filtration system with more than 40ppm of free water downstream of the filter.

The poorly seated end cap failure mode was simulated by improperly installing the coalescer element while correctly installing the separator. The coalescer was situated loosely in the test housing without the manufacturer's recommended torque. The results of this failure mode indicated that for a coalescer loosened by one rotation, the downstream free water remained significantly less than 15ppm of water (failure point constituted by EI 1581). A coalescer loosened by two rotations however, showed free water downstream around 12ppm. Though this is technically passing, the improper installation demonstrated the potential issues with contamination bypassing the coalescer.

3.2 SEPARATOR FAILURE MODE ANALYSIS

For the separator failure mode analysis, the coalescer element was installed properly, however the separator was run with two testing profiles:

- Simulated seam failure
- Poorly seated end cap

The seam failure was simulated by introducing a small slit in the seam. The original element was manufactured properly, and the slit was made right before installation into the test rig. This slit should allow contaminated fuel downstream of the filtration test housing. The results of this failure mode showed a drastic failure of the filtration system with more than 40ppm of free water downstream of the filter.

The poorly seated end cap failure mode was simulated by improperly installing the separator while correctly installing the coalescer element. The separator was situated loosely in the test housing without the manufacturer's recommended torque. Similar to the first failure mode, this failure mode resulted in a drastic failure of the filtration system with more than 40ppm of free water downstream of the filter.

All raw data can be found in APPENDIX C.

4.0 COSOLVENT ANALYSIS

The purpose of this analysis was to determine the effectiveness of co-solvent in eliminating the effects of free water contamination from fuel particle counts.

4.1 CO-SOLVENT TESTING PROFILE

The system was operated at approximately 105.7 GPM. The Jet A fuel was clean and dry prior to any testing. Contaminants selected for evaluation were:

- A-3 Test Dust
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L, 2.5 mg/L
 - With 0, 2, 5, 10, 15 ppm Water
- A-2 Test Dust
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L, 2.5 mg/L
 - With 0, 2, 5, 10, 15 ppm Water
- A-1 Test Dust
 - 0 mg/L, 0.25 mg/L, 0.50 mg/L, 1.0 mg/L, 2.0 mg/L, 2.5 mg/L
 - With 0, 2, 5, 10, 15, 30 ppm Water

The testing procedure was as follows:

1. Established fuel flow rate. Without any contaminant injection, collect baseline measurements.
2. Begin injecting contaminant[s]. At five (5) minute intervals, collect test measurements and samples.
3. After twenty to thirty minutes, stop injecting contaminant
4. Establish baseline and then inject at next concentration[s].
5. Repeat this process until sensor has been challenged at all contaminant concentrations.

Data collected at each interval included: flow rate, fuel temperature, free water by aqua-glo (if applicable), gravimetric sample (if applicable), and particle counts by all instruments available.

Each sample pulled was either treated with no additive, isopropyl alcohol (IPA) or Resolver. Each sample was tested using the Parker ACM 20 and/or the Stanhope SETA AvCount.

4.2 CO-SOLVENT TEST ANALYSIS RESULTS

While testing, there was one major problem encountered. The type of sampling bottle used significantly changed the results. Glass, metal and plastic sampling bottles were used for this sampling. When the glass sampling bottles were used, all of the water stuck to the glass. When the plastic sampling bottles were used, some of the contaminant stuck to the walls of the plastic. Finally, when metal cans were used to contain the samples, the walls of the container did not interact with the sample. However, when using metal cans an exact sample size could not be determined, therefore the error in concentration of the co-solvent in the sample was greatly increased.

Overall, the resolver and IPA both seem to decrease the raw particle counts when introduced to the sample, indicating they are eliminating the free water in the sample. For example, in Figure 6, 2.5 mg/L of A-3 test dust was continually injected into the system. Water was injected at different concentrations (0, 10, 15 and 30 ppm). The data plotting particle counts without the additive indicate an increase each time showing that water and dirt were both being injected. After the additive (IPA or Resolver) was mixed with the sample, the results returned to approximately the same result as the baseline (0ppm water injected). These results show that the additive was effective in eliminating the effects of free water on the particle count data.

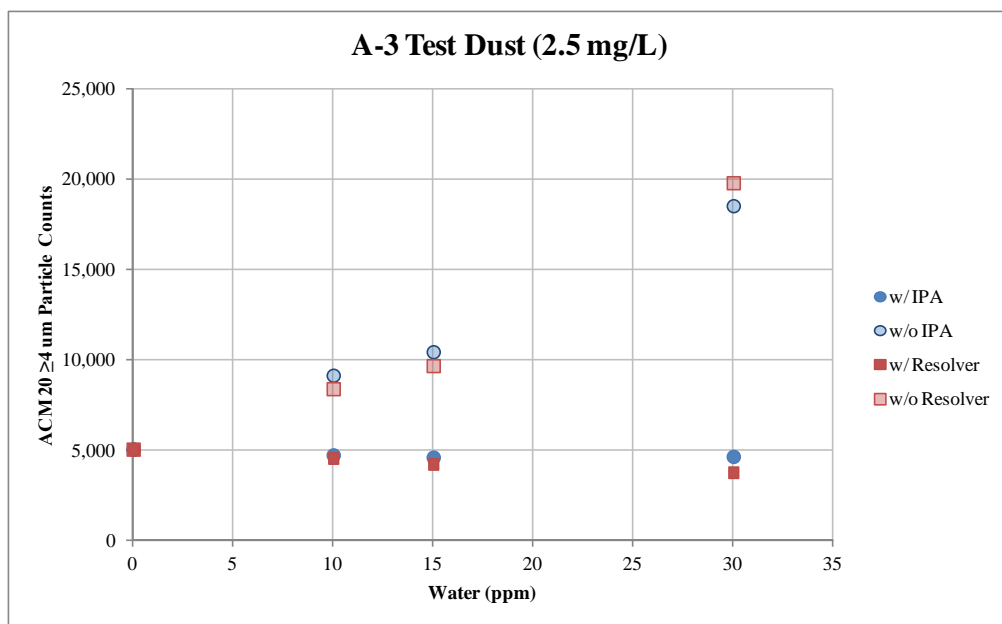


Figure 5. A-3 Test Dust at 2.5 mg/L Results – Plotting only $\geq 4\mu\text{m}$ Particle Count Channel

All data was supplied in a spreadsheet to the technical point-of-contact, Joel Schmitgal. The raw data presented in this report is a summary. For full spreadsheet, contact Keri Petersen (TFLRF).

The raw data can be found in APPENDIX D.

5.0 ENTRAINED AIR METHOD DEVELOPMENT

5.1 TEST SETUP

To inject air into the test rig, a Scientific Instrument Services 16cm long stainless steel fret (PN 783041) was installed upstream of the test housing, Figure 7. This test setup did not work because the injected air would collect at the top of the test housing. The fret was then reinstalled downstream of the test housing and filters. After establishing baseline, the air was injected without other contaminants to determine if the air bubbles could be detected by the particle count instruments. Next, air was injected with dirt and water to determine if the air had any effect on the particle count instruments with standard contaminants.

Fuel flow was established at 30 US-GPM. Air was injected at 0, 150 and 250 psi. A-2 Test Dust was injected at 0 mg/L and 0.25 mg/L. Water was injected at 5-15ppm (downstream free water measured by Aqua Glo).

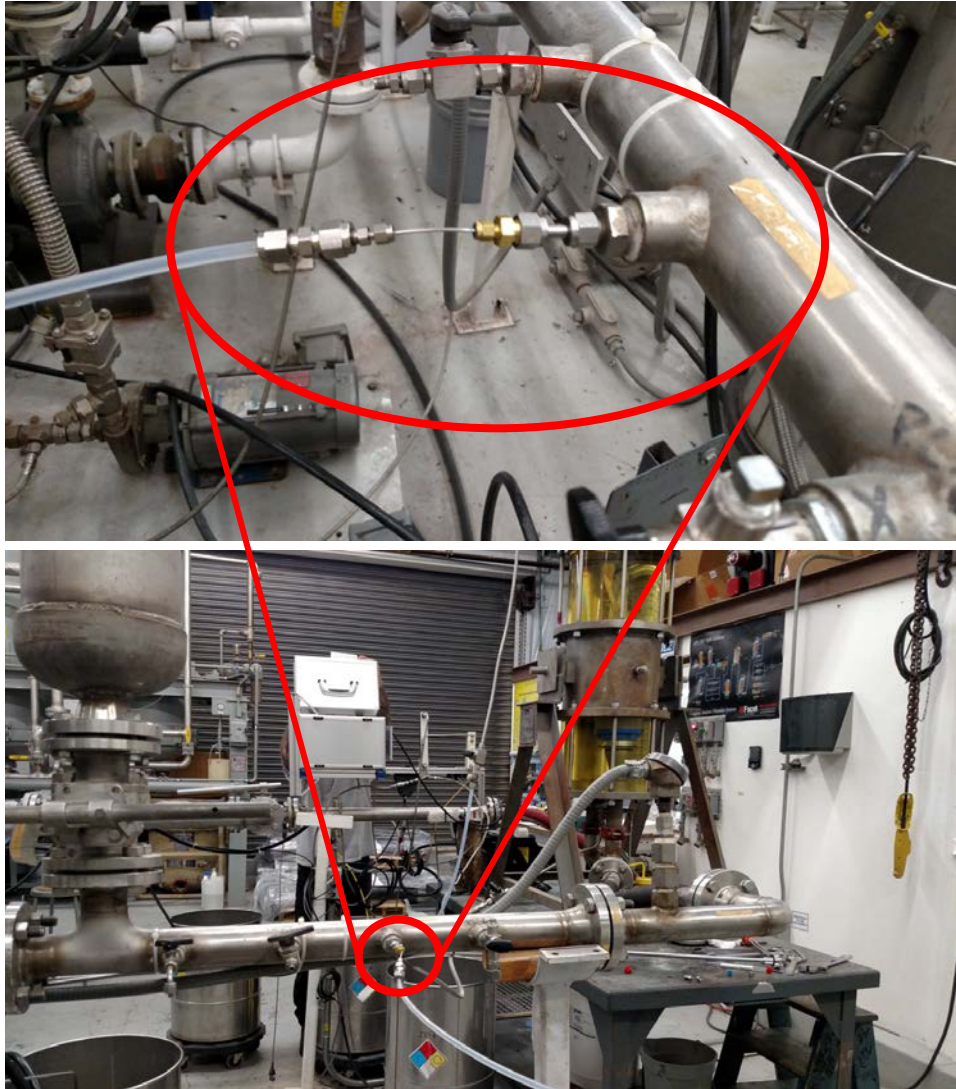


Figure 6. Air Injection System

5.2 ENTRAINED AIR TEST RESULTS

As mentioned previously, the air could not be injected upstream of the test housing and filters, because the air would collect at the top of the test housing. Figure 7 shows the air escaping the test filter and collecting at the top of the housing. There were some very small air bubbles that could have possibly escaped downstream, however they were not detected.



Figure 7. Upstream Air Injection Test Setup – Air Escaping Filter (left) and Air Collecting in Test Housing (Right)

When the air was injected downstream of the filters, there were slight changes in the raw particle counts however there was no change in the IOS 4406 codes with those particle counts. The Parker ACM 20 and Stanhope Seta AvCount were both used for the Entrained Air experiment, and both had the same results.

All raw data can be found in APPENDIX E.

6.0 M100 – ADDITIVE CONCENTRATION STUDY

All results from this study were included with the previous report written by Gary Bessee for Work Directive 15, Report No. 424, “*Alternative Fuels Compatibility with Army Equipment Testing – Effects of JP-8+100 on Military Filtration Equipment*”, including but not limited to EI1581 data, water droplet size distributions, additive concentration comparisons, etc.

It was concluded that the results of the addition of the +100 additive varied greatly between batches of additive. For additional results analysis, please reference final report for above mentioned work directive.

7.0 CONCLUSION

Overall the work directive was successful in testing a novel sensor to detect, count and differentiate between various fuel contaminants. The ISO calibration study noted similar industry trends, where the new calibration results in similar but slightly higher particle counts. The cosolvent project demonstrated that the isopropyl alcohol and Resolver both eliminated the effects of free water on particle counting. The Entrained Air method was unable to duplicate field conditions and therefore should be re-evaluated and performed with the Artium imaging system.

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APPENDIX A. Artium Sensor - Data

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Table A-1. Artium Sensor – A-3 Test Dust, Rig Data

Time min	Flow GPM	Fuel Temp °F	DP psi	Aqua Glo ppm	Gravimetrics mg/L
Baseline					
5	105.2	57	2.1	0.1	0.0150
10	104.8	57	2.1	--	--
15	104.9	57	2.1	--	--
20	104.8	57	2.0	0.1	0.0250
0.25 mg/L					
5	105.7	57	1.9	--	0.1000
10	106.2	58	2.0	--	--
15	105.9	58	2.1	--	--
20	105.7	58	2.3	0.1	0.0750
25	105.9	58	2.0	--	--
30	105.9	58	2.0	--	--
0.50 mg/L					
5	105.5	58	2.1	--	0.1800
10	105.5	58	2.1	--	--
15	105.5	58	2.1	--	--
20	105.8	58	2.0	--	--
25	105.5	58	2.1	0.2	0.1975
30	105.6	59	2.0	--	--
1.0 mg/L					
5	105.3	60	2.3	0.2	0.1550
10	105.4	60	2.1	--	--
15	105.3	59	2.1	--	--
20	105.2	60	2.0	--	0.3325
25	105.4	60	2.0	--	--
30	105.4	60	2.1	--	--
2.0 mg/L					
5	105.9	60	2.1	0.2	1.0925
10	106.1	60	2.2	--	--
15	106.0	61	2.2	--	--
20	105.5	60	2.1	--	1.0775
25	105.6	61	2.1	--	--
30	105.7	61	2.1	--	--
2.5 mg/L					
5	106.0	62	2.1	0.2	1.0750
10	105.8	63	2.1	--	--
15	105.8	63	2.1	--	--
20	105.8	63	2.1	--	1.4525
25	106.0	63	2.2	--	--
30	106.0	63	2.1	--	--

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Table A-2. Artium Sensor – A-2 Test Dust, Rig Data

Time min	Flow GPM	Fuel Temp °F	DP psi	Aqua Glo ppm	Gravimetrics mg/L
Baseline					
0	104.8	63	2.1	0.3	--
5	105.5	63	2.1	--	0.0100
10	105.5	63	2.2	0.4	--
15	105.5	63	2.0	--	0.0025
0.25 mg/L					
5	105.5	63	2.3	--	0.1575
10	105.6	63	2.0	0.3	--
15	105.5	63	2.1	--	--
20	105.3	63	2.2	--	0.1150
25	105.5	63	2.0	--	--
30	105.5	63	2.1	--	--
0.50 mg/L					
5	105.5	63	2.1	--	0.1075
10	105.5	64	2.1	0.4	--
15	105.5	64	2.1	--	0.3500
20	105.7	64	2.1	--	--
1.0 mg/L					
5	104.6	66	2.2	--	0.4700
10	105.5	66	2.1	0.3	--
15	105.7	66	2.1	--	0.3000
20	105.6	66	2.1	--	--
2.0 mg/L					
5	105.5	66	2.1	--	0.1075
10	105.6	67	2.3	0.2	--
15	105.5	67	2.1	--	1.1525
20	105.5	67	2.1	--	--
2.5 mg/L					
5	105.3	68	2.1	--	0.9375
10	105.9	68	2.3	0.3	--
15	105.5	68	1.9	--	0.8125
20	105.7	68	2.1	--	--

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Table A-3. Artium Sensor – A-1 Test Dust, Rig Data

Time min	Flow GPM	Fuel Temp °F	DP psi	Aqua Glo ppm	Gravimetrics mg/L
Baseline					
0	109.4	67	2.2	0.4	--
5	105.3	67	2.1	0.5	--
10	105.4	67	2.1	--	0.0950
0.25 mg/L					
5	105.4	73	2.1	--	0.1075
10	105.3	73	2.1	0.5	--
15	105.4	73	1.8	--	--
20	105.1	73	2.1	--	0.2400
25	105.4	73	2.1	--	--
0.50 mg/L					
5	106.0	72	2.1	--	0.2150
10	106.0	72	2.1	0.4	--
15	105.9	72	2.1	--	--
20	106.0	72	2.1	--	0.3025
25	105.4	72	2.1	--	--
1.0 mg/L					
5	104.8	67	2.0	--	0.3475
10	105.1	67	2.0	--	--
15	105.5	67	2.4	0.5	--
20	105.1	67	2.0	--	0.3525
25	106.2	67	2.1	--	--
30	105.5	67	2.3	--	--
2.0 mg/L					
5	105.7	67	2.1	--	0.7775
10	105.5	67	2.0	0.6	--
15	105.1	67	2.1	--	0.7800
20	105.3	68	2.1	--	--
2.5 mg/L					
5	105.5	70	2.1	--	1.1925
10	105.3	70	2.1	0.5	--
15	105.2	70	2.0	--	0.4000
20	105.6	71	2.1	--	--
1.0 mg/L + 10 ppm Water					
5	104.3	68	1.8	7.9	--
10	105.3	68	2.0	8.8	--
15	104.2	68	1.8	8.1	--
20	105.3	68	2.0	--	--
0.25 mg/L + 5 ppm Water					
5	105.6	73	2.1	4.0	--
10	105.6	73	2.1	4.0	--
15	105.5	73	2.1	3.8	--
20	105.7	74	2.1	2.3	--
25	105.4	74	2.1	2.7	--
30	105.2	74	2.1	3.3	--

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Table A-4. Artium Sensor – RIO, Rig Data

Time	Flow	Fuel Temp	DP	Aqua Glo	Gravimetrics
min	GPM	°F	psi	ppm	mg/L
Baseline					
0	103.9	75	2.0	0.4	0.0125
5	105.8	75	2.1	--	0.0000
0.25 mg/L					
5	105.4	75	2.0	--	0.1650
10	105.9	75	2.1	--	--
15	106.0	76	2.1	--	--
20	105.7	76	2.1	0.4	0.2775
25	105.3	76	2.1	--	--
0.50 mg/L					
5	105.5	76	2.1	--	0.4075
10	105.2	76	2.1	--	--
15	105.1	76	2.0	--	--
20	105.2	76	2.0	0.3	0.4525
25	105.5	76	2.0	--	--
1.0 mg/L					
5	106.4	71	2.3	--	0.9125
10	105.6	71	2.1	0.4	--
15	105.7	71	2.2	--	--
20	105.7	71	2.3	--	0.7350
25	106.0	71	2.2	--	--
30					
2.0 mg/L					
5	105.9	71	2.3	--	--
10	106.4	71	2.1	--	2.0750
15	106.3	71	2.3	0.0	--
20	105.2	71	2.3	--	--
25					
30					
2.5 mg/L					
5	105.2	72	2.3	--	1.8225

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Table A-5. Artium Sensor – Water, Rig Data

Time	Flow	Fuel Temp	DP	Aqua Glo
min	GPM	°F	psi	ppm
Baseline				
0	105.2	69	2.0	0.3
5 ppm				
5	105.1	69	2.1	2.2
10	105.3	69	2.2	2.3
15	105.2	70	2.0	2.3
20	105.2	70	2.1	2.9
25	104.7	70	2.0	1.4
30	105.9	70	2.1	2.7
10 ppm				
5	105.5	70	2.1	3.6
10	105.5	70	2.1	6.6
15	105.5	70	2.1	8.1
20	105.3	71	2.1	8.2
25	105.5	71	2.1	11.3
30	105.7	71	2.1	10.1
20 ppm				
5	105.2	71	2.0	17.7
10	105.3	71	2.2	19.6
15	105.5	71	2.1	19.8
20	106.0	71	2.1	18.9
30 ppm				
5	105.9	72	2.1	25.0
10	105.3	72	2.1	27.5
15	105.1	72	2.1	27.7
20	105.3	72	2.1	24.4
40 ppm				
5	105.4	72	2.1	34.7
10	105.5	72	2.1	34.9
15	105.7	72	2.1	37.2
20	105.2	72	2.0	37.6

Table A-6. Artium Sensor – A-3 Test Dust, IOS Particle Count Data

min	Time		Parker IOS (ISO 4406 codes)		
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 30µm	
Baseline					
5	13	11	9	>7	
10	13	11	10	>8	
15	13	11	9	>8	
20	14	13	11	>7	
0.25 mg/L					
5					
10					
15	16	14	11	>9	
20	16	14	11	>7	
25	16	14	11	>8	
30	16	14	11	>7	
0.50 mg/L					
5	17	15	12	>7	
10	17	15	12	>9	
15	17	15	12	>8	
20	17	15	12	>7	
25	17	15	12	>7	
30	17	15	12	>8	
1.0 mg/L					
5	18	16	13	9	
10	18	16	13	9	
15	18	16	13	>8	
20	18	16	13	>8	
25	18	16	13	>9	
30	18	16	13	>8	
2.0 mg/L					
5	19	17	14	10	
10	19	17	14	10	
15	19	17	14	9	
20	19	17	14	10	
25	19	17	14	10	
30	19	17	14	9	
2.5 mg/L					
5	19	17	14	10	
10	19	17	14	10	
15	19	17	14	10	
20	19	17	14	10	
25	19	17	14	10	
30	19	17	14	9	

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Table A-7. Artium Sensor – A-2 Test Dust, IOS Particle Count Data

Time min	IOS (ISO 4406 codes)			
	$\geq 4\mu\text{m}$	$\geq 6\mu\text{m}$	$\geq 14\mu\text{m}$	$\geq 30\mu\text{m}$
Baseline				
0	14	13	11	>8
5	13	12	10	>7
10	13	12	10	>7
15	13	12	10	>7
0.25 mg/L				
5	16	14	11	>8
10	16	14	11	>8
15	16	14	11	>8
20	16	14	11	>7
25	16	14	11	>7
30	16	14	11	>8
0.50 mg/L				
5	17	15	12	>8
10	17	15	12	>7
15	17	15	12	>7
20	17	15	12	>8
1.0 mg/L				
5	18	15	12	>8
10	18	15	12	>7
15	18	16	13	>8
20	18	15	12	>8
2.0 mg/L				
5	19	16	13	9
10	19	16	13	>9
15	19	17	13	10
20	19	17	13	10
2.5 mg/L				
5	19	17	14	10
10	19	17	14	10
15	19	17	14	10
20	19	17	14	10

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Table A-8. Artium Sensor – A-1 Test Dust, IOS Particle Count Data

Time min	IOS (ISO 4406 codes)			
	≥ 4μm	≥ 6μm	≥ 14μm	≥ 30μm
Baseline				
0	15	13	11	>8
5	15	13	11	>8
10	14	13	11	>8
0.25 mg/L				
5	18	15	11	>8
10	18	14	11	>8
15	18	15	11	>8
20	18	15	11	9
25	18	14	11	>8
0.50 mg/L				
5	18	14	12	9
10	18	15	10	>8
15	18	15	11	>7
20	18	15	11	>8
25	18	15	11	>8
1.0 mg/L				
5	19	16	12	>9
10	19	15	12	>9
15	19	15	12	9
20	19	15	11	>9
25	19	16	11	>9
30	19	16	11	>8
2.0 mg/L				
5	20	16	11	>8
10	20	16	12	>8
15	20	16	12	>9
20	20	17	12	9
2.5 mg/L				
5	20	17	12	>9
10	20	17	12	>8
15	20	17	12	>9
20	20	17	12	>9

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Table A-9. Artium Sensor – RIO, IOS Particle Count Data

Time min	IOS (ISO 4406 codes)			
	$\geq 4\mu\text{m}$	$\geq 6\mu\text{m}$	$\geq 14\mu\text{m}$	$\geq 30\mu\text{m}$
Baseline				
0	13	11	9	>8
5	13	12	9	>7
0@1.0mg/L	15	12	10	>7
0.25 mg/L				
5	14	12	9	>6
10	17	14	11	>8
15	17	14	11	>7
20	17	14	11	>7
25	17	14	11	>8
0.50 mg/L				
5	17	15	11	>5
10	17	15	11	>6
15	17	15	11	>7
20	17	14	11	>8
25	17	14	11	>7
1.0 mg/L				
5	20	15	11	>8
10	19	14	10	>6
15	19	14	11	>5
20	19	14	11	>7
25	19	14	11	>7
30				
2.0 mg/L				
5				
10	20	15	11	>7
15	20	15	11	>8
20	20	15	11	>7
25				
30				
2.5 mg/L				
5	21	17	11	>8

Table A-10. Artium Sensor – Water, IOS Particle Count Data

Time min	IOS (ISO 4406 codes)			
	≥ 4μm	≥ 6μm	≥ 14μm	≥ 30μm
Baseline				
0	14	13	10	>7
5 ppm				
5	19	18	15	11
10	19	18	15	11
15	19	18	16	11
20	20	18	16	11
25	20	18	16	11
30	20	18	16	11
10 ppm				
5	20	18	16	11
10	20	19	17	12
15	21	19	17	12
20	21	20	17	13
25	21	20	17	13
30	21	20	17	13
20 ppm				
5	22	20	18	14
10	22	20	18	14
15	22	20	18	14
20	22	21	18	13
30 ppm				
5	22	21	19	14
10	22	21	19	14
15	22	21	19	14
20	22	21	19	14
40 ppm				
5	--	22	19	15
10	--	22	19	15
15	--	22	19	15
20	--	22	19	15

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Table A-11. Artium Sensor – A-3 Test Dust, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
5	13	11	8	>6	>5	>4	63.9	19.9	1.9	0.4	0.2	0.1
10	13	12	8	>6	>6	>5	63.1	21.7	1.6	0.6	0.4	0.2
15	13	12	8	>6	>5	>4	66.9	20.2	1.6	0.5	0.3	0.1
20	13	12	9	7	>6	>5	68.9	25.5	3.1	1.1	0.5	0.3
0.25 mg/L												
5	17	15	11	9	8	>6	657.1	221.0	12.7	3.2	1.7	0.4
10	17	15	11	8	7	>6	646.1	215.4	10.7	2.1	0.9	0.4
15	16	15	11	9	8	7	630.9	211.9	12.3	2.9	1.5	0.9
20	17	15	11	8	7	>6	646.4	212.1	12.4	2.5	1.1	0.4
25	17	15	11	9	8	7	659.6	225.6	12.9	3.1	1.6	0.8
30	16	15	11	9	7	>3	605.6	203.6	10.4	2.6	1.1	0.1
0.50 mg/L												
5	17	16	12	9	8	>6	1107.1	372.0	20.5	4.4	2.1	0.5
10	17	16	12	9	8	>6	1121.0	372.9	21.4	3.9	1.6	0.4
15	17	16	11	9	8	7	1077.4	354.1	19.6	4.3	2.2	0.9
20	17	16	11	9	8	7	1090.5	365.6	19.3	4.9	1.9	0.9
25	17	16	11	9	8	7	1099.9	365.7	16.7	3.1	1.6	0.8
30	17	16	11	9	8	>6	1096.1	363.0	20.0	4.2	1.4	0.4
1.0 mg/L												
5	18	17	12	10	9	7	2098.0	743.3	34.7	7.3	3.5	1.2
10	18	17	12	10	9	7	2155.1	764.5	33.1	6.1	3.3	1.3
15	18	17	13	11	9	8	2251.4	816.1	44.9	10.4	4.2	1.8
20	18	17	13	10	9	>6	2242.5	801.1	42.3	8.9	2.8	0.6
25	18	17	13	11	10	8	2359.5	854.3	52.0	12.8	5.4	1.8
30	18	17	13	10	9	7	2125.4	749.7	42.0	7.8	3.0	1.0
2.0 mg/L												
5	19	18	14	12	11	9	4219.8	1501.0	97.6	21.7	10.3	4.2
10	19	18	14	11	10	9	4116.9	1430.1	85.7	17.6	8.6	3.1

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Table A-11. Artium Sensor – A-3 Test Dust, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
15	19	18	14	11	10	9	4142.6	1458.1	81.6	17.0	8.0	3.0
20	19	18	14	12	11	10	4644.9	1735.9	115.6	27.6	12.6	5.3
25	19	18	14	12	10	9	4019.4	1402.3	86.2	20.3	8.9	3.0
30	19	18	14	11	10	9	3976.0	1381.0	81.2	16.8	8.0	2.7
2.5 mg/L												
5	20	18	14	12	10	9	5090.3	1779.3	108.2	24.7	10.0	3.6
10	19	18	14	11	10	8	4767.2	1632.4	84.8	17.9	7.9	2.5
15	20	18	14	12	11	9	5047.4	1796.5	118.1	27.5	12.5	4.9
20	19	18	14	11	10	8	4695.9	1595.0	92.9	17.1	6.7	2.4
25	19	18	14	12	10	9	4765.8	1652.4	98.0	21.9	9.9	3.1
30	19	18	14	12	10	9	4716.5	1623.2	94.1	20.1	8.2	2.9

Table A-12. Artium Sensor – A-3 Test Dust, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
5	13	11	8	6	6	5	50.5	12.7	2.4	0.7	0.4	0.3
10	13	11	8	6	5	4	45.6	11.1	2.0	0.5	0.2	0.1
15	13	10	8	6	5	4	42.2	9.3	1.6	0.3	0.2	0.1
20												
0.25 mg/L												
5	17	15	11	9	7	6	776.4	301.5	16.2	3.0	1.2	0.5
10	17	15	11	8	7	5	757.2	286.0	13.3	2.4	0.9	0.3
15	17	15	11	9	7	6	738.0	280.3	15.1	2.9	0.8	0.4
20	17	15	11	8	6	5	740.9	286.6	15.1	2.4	0.6	0.4
25	17	15	11	8	7	5	735.4	280.1	13.8	2.3	1.1	0.3
30	17	15	11	8	6	5	721.5	270.5	11.4	1.8	0.6	0.2
0.50 mg/L												

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Table A-12. Artium Sensor – A-3 Test Dust, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
5	18	16	12	9	8	6	1332.6	513.5	26.1	4.4	1.3	0.4
10	18	16	12	9	7	5	1317.8	501.8	23.6	3.7	1.1	0.3
15	18	16	12	9	7	5	1319.3	491.0	21.5	3.2	1.1	0.3
20	18	16	12	9	8	6	1350.4	520.2	25.9	4.5	1.7	0.6
25	18	16	12	9	7	5	1328.3	504.3	21.0	3.3	1.0	0.4
30	18	16	12	9	7	6	1324.1	493.2	23.3	3.4	1.0	0.4
1.0 mg/L												
5	19	17	13	10	8	5	2546.9	1077.2	50.9	7.5	1.8	0.4
10	19	17	13	10	8	6	2588.3	1099.5	55.0	7.1	2.0	0.6
15	19	17	13	10	9	7	2640.9	1126.5	63.5	9.4	3.1	0.9
20	19	17	13	10	8	7	2636.5	1116.9	59.4	8.5	2.4	0.9
25	19	17	13	11	9	7	2657.1	1142.5	63.7	10.8	3.2	0.8
30	19	17	13	10	8	6	2576.6	1075.0	52.0	6.9	1.7	0.6
2.0 mg/L												
5	19	18	14	11	9	7	4990.1	1986.5	90.1	11.7	3.5	1.1
10	20	18	14	11	9	8	5065.1	2049.3	105.5	15.1	4.8	1.4
15	20	18	14	12	10	8	5168.7	2115.2	128.3	20.5	6.8	2.1
20	20	18	14	12	10	9	5266.0	2176.3	143.3	23.5	8.6	3.0
25	20	18	14	11	9	7	5046.3	1964.8	85.9	10.8	3.1	1.0
30	20	18	14	11	9	7	5008.1	1936.2	84.2	11.3	3.1	0.7
2.5 mg/L												
5	20	18	14	11	8	6	6340.9	2441.1	97.5	10.6	2.5	0.5
10	20	18	14	11	9	7	6185.3	2378.0	95.7	11.3	2.7	0.7
15	20	18	14	11	8	6	6121.1	2335.8	93.2	11.0	2.5	0.5
20	20	18	14	11	9	6	6123.4	2342.1	93.7	11.3	2.9	0.5
25	20	18	14	11	9	6	6127.2	2333.6	93.9	10.8	2.7	0.5
30	20	18	14	11	8	6	6087.0	2319.3	93.2	10.4	2.2	0.5

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Table A-13. Artium Sensor – A-2 Test Dust, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	14	12	9	8	7	>6	89.4	34.0	4.6	1.9	1.1	0.6
5	14	12	9	8	7	>6	83.0	32.6	4.2	1.4	0.9	0.5
10	13	12	8	7	>6	>5	61.6	23.6	2.3	0.9	0.4	0.3
15	13	12	8	7	>5	>4	78.0	29.0	2.4	0.9	0.3	0.1
0.25 mg/L												
5	17	15	10	9	7	>6	1051.6	259.6	9.9	2.6	1.0	0.5
10	17	15	11	10	9	8	1061.6	261.8	15.6	5.6	3.1	1.4
15	17	15	11	9	8	7	998.0	232.1	11.0	3.6	1.7	0.9
20	17	15	10	8	7	>6	986.2	225.9	8.5	2.5	0.9	0.4
25	17	15	10	8	7	>5	982.9	223.1	7.8	2.4	0.9	0.2
30	17	15	10	8	7	>5	973.9	218.3	6.7	1.4	0.7	0.2
0.50 mg/L												
5	18	16	11	9	8	7	1760.6	404.8	16.9	4.0	1.9	0.9
10	18	16	11	9	8	>5	1764.7	403.1	15.9	3.8	1.5	0.3
15	18	16	11	9	7	>6	1729.6	388.0	13.6	3.2	1.3	0.4
20	18	16	13	11	10	9	2090.6	556.2	46.4	17.0	8.9	4.6
1.0 mg/L												
5	19	17	12	10	9	8	3152.5	771.2	26.1	6.7	3.2	1.7
10	19	17	12	10	9	>6	2978.6	727.1	23.0	6.8	3.1	0.6
15	19	17	12	10	9	8	3080.9	769.6	31.7	8.1	3.9	1.5
20	19	17	12	10	9	7	2971.8	714.6	26.5	5.9	2.6	1.2
2.0 mg/L												
5	20	18	13	11	10	8	6095.7	1443.9	48.6	11.8	5.7	1.6
10	20	18	14	12	11	10	6385.9	1656.0	88.0	26.1	13.4	6.5
15	20	18	13	12	11	9	6214.6	1547.1	71.8	21.2	11.2	4.7
20	20	18	13	11	9	7	5932.4	1411.5	48.3	11.2	4.8	0.9
2.5 mg/L												
5	20	18	13	11	10	9	7746.1	1934.2	79.5	19.9	9.7	3.6
10	20	18	13	11	10	8	7397.8	1784.5	62.9	15.5	6.9	2.4
15	20	18	13	11	9	7	7207.1	1693.5	51.7	10.9	4.3	1.1
20	20	19	16	14	14	12	9298.9	2974.2	356.5	146.1	87.1	39.9

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Table A-14. Artium Sensor – A-2 Test Dust, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	13	11	8	7	5	4	64.5	11.4	1.7	0.7	0.3	0.1
5	13	10	7	4	4	0	65.6	9.8	1.2	0.1	0.1	0.0
10	13	11	8	6	5	4	69.3	10.3	1.5	0.4	0.2	0.1
15	13	11	8	6	5	4	80.0	16.3	1.5	0.4	0.3	0.1
0.25 mg/L												
5	18	16	11	9	8	6	1472.1	476.0	17.1	3.2	1.3	0.5
10	18	16	11	8	6	4	1412.0	438.2	10.3	1.5	0.5	0.1
15	18	16	10	8	6	5	1419.3	434.1	9.3	1.7	0.6	0.2
20	18	16	11	8	6	4	1408.2	436.0	10.4	1.5	0.4	0.1
25	18	16	10	7	6	5	1417.5	429.0	9.8	1.1	0.4	0.2
30	18	16	10	8	6	4	1423.7	430.7	9.1	1.6	0.5	0.1
0.50 mg/L												
5	19	17	11	8	6	4	2536.6	766.6	15.1	2.4	0.4	0.1
10	19	17	11	8	7	5	2542.0	773.6	16.8	2.4	0.8	0.3
15	19	17	11	9	6	5	2548.8	777.2	16.8	2.8	0.5	0.2
20	19	17	11	8	7	5	2564.6	776.0	17.1	2.5	1.0	0.3
1.0 mg/L												
5	19	18	12	9	7	4	4453.0	1452.0	26.4	3.0	0.8	0.1
10	19	18	12	9	7	5	4294.7	1393.4	27.6	2.7	0.8	0.3
15	19	18	12	9	7	5	4253.2	1381.6	26.6	3.0	0.7	0.3
20	19	18	12	9	7	5	4269.5	1376.2	25.3	2.6	0.7	0.2
2.0 mg/L												
5	20	19	13	10	7	5	9043.2	2792.3	52.6	5.9	1.2	0.3
10	20	19	13	10	7	5	9050.1	2771.4	51.5	5.8	1.1	0.2
15	20	19	13	10	7	5	9022.0	2771.6	50.4	5.5	1.2	0.2
20	20	19	13	10	7	5	8993.0	2766.1	51.6	5.1	1.3	0.2
2.5 mg/L												
5	21	19	13	10	7	4	11638.8	3491.3	67.2	6.0	1.2	1.0
10	21	19	13	10	8	5	11219.2	3376.6	67.1	7.4	1.6	0.3
15	21	19	13	10	8	5	11133.0	3349.8	64.0	6.7	1.7	0.3
20	21	19	13	10	8	6	11047.4	3303.4	62.1	6.6	1.7	0.5

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Table A-15. Artium Sensor – A-1 Test Dust, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	16	14	10	8	7	>6	334.5	113.9	7.2	2.2	1.1	0.6
5	15	13	9	8	7	>6	242.1	74.9	3.5	1.7	1.0	0.6
10	15	14	11	9	9	8	252.4	92.0	12.7	4.6	2.6	1.7
0.25 mg/L												
5	18	16	9	7	>6	>6	2243.6	603.8	4.6	1.3	0.6	0.5
10	18	16	9	8	7	>6	2195.9	598.6	3.9	1.6	1.0	0.6
15	18	16	9	7	>6	>5	2209.5	593.8	3.8	0.8	0.4	0.2
20	18	16	9	7	>6	>5	2192.5	592.5	3.4	0.9	0.6	0.3
25	18	16	9	7	>6	>6	2221.0	603.1	3.8	1.1	0.6	0.4
0.50 mg/L												
5	18	16	9	>6	>5	>4	1666.4	441.7	3.1	0.6	0.3	0.1
10	19	17	10	8	>6	>5	3279.4	891.3	5.1	1.4	0.5	0.3
15	19	17	12	10	9	8	3410.0	979.8	21.8	8.0	4.9	2.4
20	19	17	10	8	7	>6	3228.1	875.8	6.6	1.6	1.1	0.5
25	19	17	10	8	7	>5	3136.9	850.9	5.6	1.7	0.9	0.3
1.0 mg/L												
5	20	18	11	9	9	8	5991.9	1688.6	16.0	4.7	2.9	1.7
10	19	18	11	9	8	7	4894.5	1354.4	11.4	3.0	1.9	1.0
15	19	17	11	9	8	7	4060.9	1119.9	11.7	3.4	1.7	0.8
20	19	17	10	8	7	>5	3837.3	1074.7	9.1	2.0	1.0	0.3
25	19	18	10	8	>6	>5	4900.9	1377.0	9.9	2.4	0.6	0.3
30	20	18	11	9	8	7	5604.5	1577.9	10.5	2.9	1.4	0.8
2.0 mg/L												
5	21	19	11	9	8	>6	10237.6	2989.9	18.5	3.7	1.9	0.6

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Table A-15. Artium Sensor – A-1 Test Dust, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
10	21	19	12	10	9	7	10202.4	2930.6	22.4	6.0	2.9	1.1
15	21	19	11	9	8	>6	10022.6	2885.9	17.6	3.9	1.6	0.5
20	21	19	11	9	8	7	10061.1	2876.1	18.1	4.6	2.4	1.1
2.5 mg/L												
5	21	19	11	8	>6	>4	13125.7	3933.4	15.7	1.9	0.6	0.1
10	21	19	12	9	8	7	12221.6	3642.1	20.5	3.8	1.5	0.7
15	21	19	11	9	8	7	12019.3	3584.8	16.1	3.1	1.8	1.0
20	21	19	11	9	8	>6	12089.4	3589.9	16.8	2.6	1.6	0.6

Table A-16. Artium Sensor – A-1 Test Dust, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0												
5	15	14	10	8	7	7	265.7	137.1	8.1	2.2	1.2	0.6
10	15	13	9	7	6	4	175.9	79.0	4.1	0.9	0.4	0.1
0.25 mg/L												
5	19	17	10	6	0	0	2847.0	1221.6	7.9	0.4	0.0	0.0
10	19	17	10	6	4	0	2831.3	1220.4	9.5	0.7	0.2	0.1
15	19	17	10	7	5	4	2794.7	1194.8	7.0	0.7	0.2	0.1
20	19	17	10	6	5	5	2777.5	1187.5	7.7	0.1	0.3	0.2
25	19	17	10	6	4	4	2757.3	1174.3	7.2	0.6	0.1	0.1
0.50 mg/L												
5	18	17	10	7	6	5	2090.1	896.0	7.4	1.1	0.5	0.2

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Table A-16. Artium Sensor – A-1 Test Dust, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
10	19	18	11	6	4	4	4146.2	1767.6	10.9	0.6	0.1	0.1
15	19	18	11	6	5	4	4058.0	1742.6	11.6	0.5	0.2	0.1
20	19	18	11	7	5	0	4050.3	1738.6	10.6	0.8	0.3	0.1
25	19	18	11	6	4	0	4025.4	1728.4	10.6	0.4	0.1	0.0
1.0 mg/L												
5	20	19	12	8	6	5	6843.2	3123.9	24.5	1.6	0.5	0.2
10	20	19	12	8	6	5	5709.2	2558.3	22.7	1.9	0.4	0.2
15	19	18	11	8	7	7	4747.3	2107.7	18.7	2.3	1.2	0.7
20	19	18	11	8	6	5	4643.3	2060.4	18.8	1.6	0.4	0.2
25	20	19	12	8	5	4	6336.7	2835.8	22.2	1.5	0.3	0.1
30	20	19	12	8	6	5	6689.3	3003.7	23.7	1.6	0.4	0.2
2.0 mg/L												
5	21	20	13	8	6	6	12894.0	5767.2	43.7	2.2	0.6	0.4
10	21	20	13	9	7	5	12829.4	5740.4	44.0	2.7	0.7	0.3
15	21	20	13	8	6	4	12839.4	5729.0	43.4	2.3	0.6	0.1
20	21	20	13	9	7	6	12838.6	5721.8	46.5	2.6	0.8	0.3
2.5 mg/L												
5	21	20	13	8	6	5	16698.9	7436.8	52.2	2.0	0.5	0.2
10	21	20	13	8	6	4	15666.4	6979.2	47.9	1.9	0.5	0.2
15	21	20	13	8	6	4	15714.2	6997.9	49.5	2.0	0.4	0.1
20	21	20	13	8	6	4	15693.5	6998.1	49.1	2.1	0.4	0.2

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Table A-17. Artium Sensor – RIO, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	13	12	8	>6	>5	>3	42.0	21.2	1.6	0.4	0.2	0.1
5	13	12	9	7	>6	>5	63.3	32.8	2.9	1.0	0.5	0.2
0.25 mg/L												
5	15	12	9	>5	>3	>0	187.6	31.0	1.9	0.3	0.1	0.0
10	20	16	11	8	7	>4	6621.1	618.9	10.8	2.0	0.9	0.1
15	20	17	11	8	7	>6	6767.2	640.9	12.8	2.4	1.1	0.6
20	20	17	11	8	7	>5	6700.2	640.8	12.1	2.4	1.1	0.3
25	20	16	11	8	7	>5	6697.5	640.0	11.9	2.0	0.9	0.2
0.50 mg/L												
5	20	17	11	9	7	>3	9839.9	995.6	17.6	2.9	1.1	0.1
10	20	17	11	8	8	>6	9968.0	952.0	13.2	2.5	1.4	0.4
15	20	17	11	9	7	>5	9945.7	938.2	13.5	2.7	0.9	0.3
20	21	17	11	9	7	>5	10925.7	1037.1	15.4	2.6	1.1	0.3
25	21	17	12	10	9	8	10735.9	1076.1	28.4	8.6	5.0	2.2
1.0 mg/L												
5	22	20	11	8	7	>5	23827.6	5060.5	13.6	1.5	0.7	0.2
10	22	19	11	8	7	>6	20479.8	4042.9	13.2	2.4	1.0	0.4
15	22	19	11	8	>6	>5	20467.6	4045.2	11.5	2.0	0.5	0.2
20	22	19	11	8	7	>6	20515.9	4062.1	11.7	1.9	0.9	0.6
25	22	19	11	8	>6	>5	20572.4	4035.9	13.1	1.8	0.6	0.2
30												
2.0 mg/L												
5	22	20	12	9	7	>6	32931.1	8932.7	29.2	3.0	1.1	0.4
10	22	20	12	8	7	>6	33154.1	898.1	28.4	2.1	0.9	0.4
15	22	20	12	9	7	>4	32922.9	8933.7	30.4	2.6	1.3	0.1

Table A-17. Artium Sensor – RIO, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
20	22	20	12	8	>6	>5	33275.6	9160.4	29.6	2.0	0.6	0.2
25												
30												
2.5 mg/L												
5	22	21	15	10	8	>6	39043.4	15495.1	174.1	6.6	1.8	0.4

Table A-18. Artium Sensor – RIO, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	13	12	10	7	5	0	52.2	31.5	6.0	0.9	0.2	0.0
5	14	13	10	7	6	5	112.1	45.9	5.2	1.0	0.6	0.2
0@1.0mg/L	16	14	8	5	0	0	380.0	135.9	2.7	0.3	0.0	0.0
0.25 mg/L												
5	15	12	9	6	5	4	215.2	38.0	3.4	0.5	0.2	0.1
10	21	18	12	9	8	6	14191.6	1541.9	24.2	4.3	1.5	0.5
15	21	18	12	9	7	6	14211.8	1537.4	25.2	3.8	1.2	0.4
20	21	18	12	9	8	6	14152.4	1544.6	25.2	4.5	1.7	0.6
25	21	18	12	10	8	6	14042.1	1552.6	28.3	5.1	1.6	0.6
0.50 mg/L												
5	22	18	12	10	8	6	20121.4	2321.8	37.4	5.6	1.7	0.6
10	22	18	12	9	7	6	20503.4	2301.6	28.3	4.6	1.2	0.4
15	22	18	12	9	8	6	20807.8	2317.5	25.0	3.8	1.8	0.7
20	22	18	12	9	8	6	21827.1	2380.1	24.8	4.0	1.3	0.3

Table A-18. Artium Sensor – RIO, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
25	22	18	12	9	7	6	21527.8	2318.2	20.8	3.5	1.1	0.4
1.0 mg/L												
5	23	21	12	9	5	0	44974.9	10791.7	28.8	2.6	0.3	0.0
10	22	20	12	8	6	4	33625.5	8093.5	22.7	2.0	0.4	0.1
15	22	20	12	8	6	0	32677.2	7814.3	21.7	1.9	0.4	0.0
20	22	20	12	8	6	4	32995.6	8010.4	20.8	1.7	0.5	0.1
25	22	20	11	8	5	4	32878.6	7938.1	18.4	1.4	0.3	0.1
30												
2.0 mg/L												
5	23	21	12	9	6	5	58791.5	13804.7	37.0	3.0	0.5	0.2
10	23	21	12	9	7	4	58612.9	13786.5	34.6	3.0	0.8	0.2
15	23	21	12	9	6	4	59234.2	14091.0	35.7	2.7	0.6	0.1
20												
25												
30												
2.5 mg/L												
5	23	22	14	10	8	5	72490.2	23327.3	85.6	5.9	1.5	0.3

Table A-19. Artium Sensor – Water, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	14	12	10	8	8	7	81.0	37.6	6.4	1.9	1.4	0.8
5 ppm												
5	19	18	14	12	11	8	3576.1	1986.1	159.0	31.3	10.1	2.2

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Table A-19. Artium Sensor – Water, Parker ACM 20 Particle Count Data

Time min	ACM 20 (ISO 4406 codes)						ACM 20 (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
10	19	18	15	13	11	9	3680.4	2003.6	167.5	40.1	12.9	3.9
15	19	18	15	13	11	9	4025.4	2227.1	191.6	43.9	13.9	3.0
20	19	18	15	13	11	8	4281.1	2383.1	208.4	43.8	12.4	2.3
25	19	18	15	13	11	9	4107.0	2281.5	202.5	44.3	12.3	2.6
30	19	19	15	13	11	9	4526.8	2511.1	217.5	50.2	15.4	3.4
10 ppm												
5	20	19	15	13	12	9	5749.7	3222.8	299.1	65.1	20.6	3.9
10	20	19	16	14	12	10	8526.3	4836.2	473.4	110.2	33.6	6.1
15	20	20	16	14	12	10	9585.4	5490.1	555.4	130.2	39.6	5.4
20	21	20	16	14	13	10	10814.1	6260.5	640.0	144.5	44.9	6.4
25	21	20	17	15	13	10	11856.1	6849.4	730.4	171.3	53.7	9.8
30	21	20	17	15	13	11	12804.6	7461.9	816.2	185.4	58.1	10.9
20 ppm												
5	21	21	18	16	14	11	18462.3	11061.7	1411.4	329.4	106.9	18.5
10	21	21	18	16	14	11	18537.6	11107.8	1415.8	332.1	105.1	15.9
15	21	21	18	16	14	11	18411.8	11036.4	1417.9	327.9	109.1	16.3
20	21	21	18	16	14	11	18900.7	11321.4	1451.8	339.5	110.7	17.4
30 ppm												
5	22	21	18	16	15	12	25139.6	15661.3	2468.2	608.4	211.9	37.7
10	22	21	18	16	15	12	25426.1	15850.9	2458.0	619.9	207.5	34.9
15	22	21	19	16	15	13	25175.5	15689.9	2507.9	626.2	217.2	40.1
20	22	21	18	16	15	12	25413.9	15848.2	2473.1	612.3	203.6	35.7
40 ppm												
5	22	21	19	17	16	13	29188.0	18752.6	3440.3	897.7	326.7	59.3
10	22	21	19	17	16	13	30836.9	19972.9	3783.4	994.1	357.5	62.8
15	22	22	19	17	16	13	31111.9	20283.0	4043.0	1083.9	391.6	71.4
20	22	22	19	17	16	13	21638.9	20652.4	4056.0	1073.8	387.9	65.8

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Table A-20. Artium Sensor – Water, Stanhope SETA Particle Count Data

Time min	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm	≥ 4µm	≥ 6µm	≥ 14µm	≥ 21µm	≥ 25µm	≥ 30µm
Baseline												
0	13	11	8	6	5	4	54.0	18.2	1.7	0.5	0.2	0.1
5 ppm												
5	18	18	16	14	13	12	2087.6	1761.0	524.5	114.5	53.8	22.9
10	18	18	16	14	13	12	2051.3	1724.4	521.2	115.1	53.2	21.7
15	18	18	16	14	13	12	2205.2	1859.5	563.7	121.4	57.9	24.5
20	18	18	16	14	13	12	2229.5	1876.4	566.7	120.2	56.0	22.9
25	18	18	16	14	13	12	2042.5	1717.3	517.0	109.8	50.6	21.2
30	18	18	16	14	13	12	2390.5	2017.1	606.5	131.1	59.5	24.0
10 ppm												
5	19	19	17	15	13	12	3088.6	2610.7	785.5	172.2	79.1	32.3
10	19	19	17	15	14	13	4534.3	3848.7	1145.0	250.0	117.0	46.7
15	20	19	18	15	14	13	5226.0	4440.1	1346.9	292.1	135.6	54.5
20	20	20	18	16	14	13	6252.8	5312.4	1607.1	345.5	159.5	62.9
25	20	20	18	16	15	13	7143.8	6055.1	1833.6	400.3	182.3	76.0
30	20	20	18	16	15	13	7225.4	6141.3	1855.1	404.1	183.6	75.4
20 ppm												
5	21	20	19	17	15	14	11490.4	9714.8	2933.3	647.5	298.1	120.3
10	21	20	19	17	15	14	11511.2	9743.5	2954.0	656.5	298.4	121.3
15	21	20	19	17	15	14	11566.8	9781.7	2944.3	640.6	292.2	118.7
20	21	21	19	17	15	14	11826.4	10008.9	3017.3	663.0	298.9	121.6
30 ppm												
5	21	21	19	17	16	15	17842.0	15079.2	4595.3	1017.6	461.9	187.6
10	21	21	19	17	16	15	17881.6	15089.7	4569.6	1013.4	463.0	184.0
15	21	21	19	17	16	15	18574.4	15661.2	4747.3	1064.0	479.2	192.7
20	21	21	19	17	16	15	18281.7	15397.3	4652.0	1031.5	473.2	185.1

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Table A-20. Artium Sensor – Water, Stanhope SETA Particle Count Data

Time	Stanhope SETA (ISO 4406 codes)						Stanhope SETA (particle counts)					
min	≥ 4μm	≥ 6μm	≥ 14μm	≥ 21μm	≥ 25μm	≥ 30μm	≥ 4μm	≥ 6μm	≥ 14μm	≥ 21μm	≥ 25μm	≥ 30μm
40 ppm												
5	22	22	20	18	16	15	23894.2	20166.8	6186.7	1406.0	635.4	255.0
10	22	22	20	18	17	15	25539.7	21497.3	6547.9	1499.4	682.1	275.5
15	22	22	20	18	17	15	26683.8	22424.2	6816.4	1563.0	701.5	284.5
20	22	22	20	18	17	15	27709.7	23230.6	7069.8	1632.8	739.2	300.5

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APPENDIX B. Particle Count ISO Calibration - Data

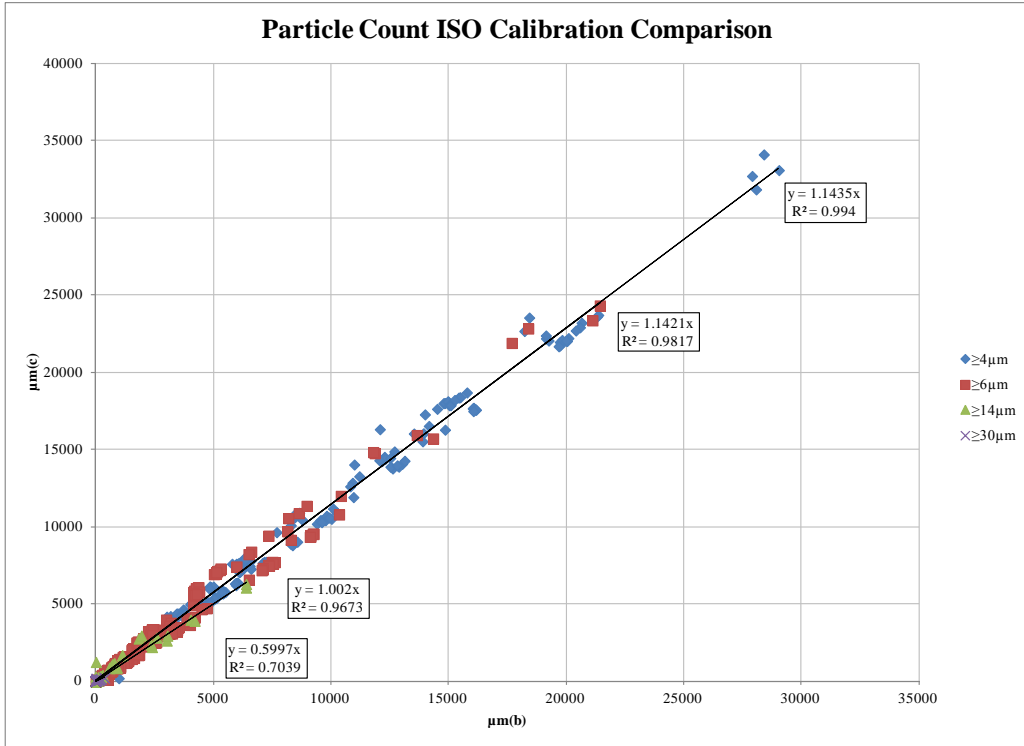


Figure B-1. Particle Count Calibration – All Data Comparison

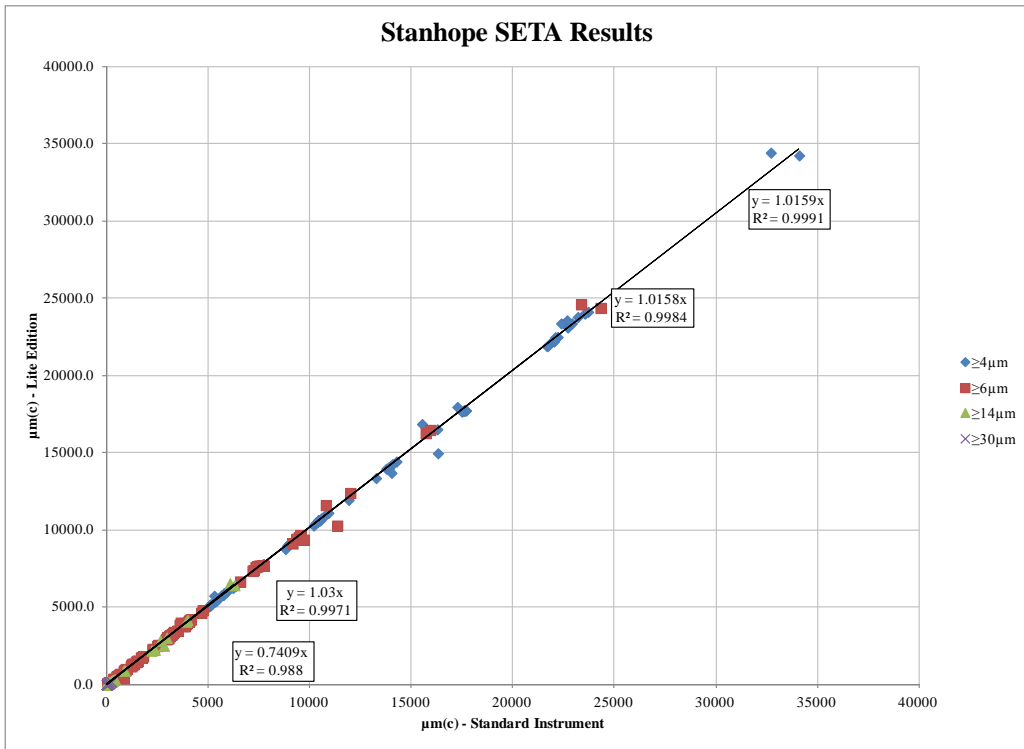


Figure B-2. Comparison of SETA AvCount Standard vs. AvCount Lite

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Table B-1. Particle Count Calibration Comparison – Parker ACM20 Results

Test Dust	Concentration mg/L	Time min	ACM 20 - old calibration						ACM 20 - new calibration					
			≥4μm(b)	≥6μm(b)	≥14μm(b)	≥21μm(b)	≥25μm(b)	≥30μm(b)	≥4μm(c)	≥6μm(c)	≥14μm(c)	≥21μm(c)	≥25μm(c)	≥30μm(c)
A1	2.50	0	95.3	50.6	4.9	0.6	0.4	0.1	75.2	37.3	1.9	0.3	0.1	0.0
A1	2.50	5	15783.3	5308.5	32.8	2.6	0.6	0.1	18685.1	7284.0	52.8	3.4	1.9	1.1
A1	2.50	10	15432.2	5167.1	32.5	2.6	0.6	0.5	18352.1	7121.2	47.7	3.2	1.8	0.7
A1	2.50	15	15091.1	5097.1	28.4	2.0	0.4	0.1	17861.6	6938.4	48.9	2.6	1.4	0.6
A1	2.50	20	15258.9	5129.3	30.6	2.9	0.7	0.1	18198.1	7037.6	44.9	3.4	2.2	0.6
A1	2.50	25	15493.6	5276.9	30.9	2.4	0.8	0.4	18373.2	7189.1	52.6	3.2	2.2	0.9
A1	2.50	30	15030.6	5029.6	28.3	2.6	0.8	0.1	17858.8	6921.7	47.4	3.1	1.4	0.8
A1	2.00	0	189.6	69.5	0.9	0.0	0.0	0.0	164.4	67.1	1.2	0.1	0.1	0.0
A1	2.00	5	12698.1	4401.9	18.1	0.6	0.2	0.1	14867.1	5791.5	34.3	0.9	0.4	0.1
A1	2.00	10	12275.0	4165.9	19.0	0.9	0.4	0.1	14516.8	5672.4	30.1	1.6	0.8	0.4
A1	2.00	15	12269.8	4157.6	17.6	1.0	0.3	0.0	14446.2	5563.1	33.6	2.1	0.9	0.4
A1	2.00	20	12304.6	4215.3	21.6	0.6	0.1	0.1	14384.9	5590.4	30.4	1.5	1.0	0.4
A1	2.00	25	12524.2	4300.3	20.8	1.6	0.6	0.2	14440.8	5629.5	34.8	1.8	0.9	0.4
A1	2.00	30	12174.9	4159.6	17.9	0.9	0.1	0.1	14246.6	5534.9	33.4	1.4	0.6	0.1
A1	1.00	0												
A1	1.00	5	6158.4	2020.9	7.7	0.4	0.3	0.1	7304.7	2760.4	13.9	0.7	0.3	0.1
A1	1.00	10	6278.0	2102.2	8.4	0.3	0.1	0.1	7291.1	2782.4	15.7	0.5	0.3	0.1
A1	1.00	15	6210.1	2042.3	7.7	0.4	0.2	0.0	7249.9	2751.6	14.0	0.6	0.4	0.1
A1	1.00	20	6064.1	1998.6	8.4	0.7	0.3	0.2	7108.3	2682.6	14.3	0.9	0.6	0.2
A1	1.00	25	6132.4	2029.5	7.6	0.4	0.1	0.1	7085.8	26.5	13.6	1.0	0.7	0.1
A1	1.00	30	6109.7	2038.9	9.3	0.4	0.1	0.0	7056.9	2644.4	13.3	0.6	0.3	0.1
A1	0.50	0	109.1	37.2	0.2	0.0	0.0	0.0	103.1	44.3	0.8	0.0	0.0	0.0
A1	0.50	5	3628.9	1154.6	3.8	0.4	0.1	0.0	4315.9	1562.8	5.9	0.2	0.1	0.1
A1	0.50	10	3650.0	1178.1	3.4	0.0	0.0	0.0	4232.1	1508.3	4.9	0.3	0.1	0.0
A1	0.50	15	3804.4	1214.6	6.4	1.1	0.3	0.0	4364.5	1597.6	6.6	0.5	0.3	0.1
A1	0.50	20	3704.6	1179.2	3.9	0.1	0.1	0.0	4297.0	1519.9	4.8	0.1	0.1	0.0
A1	0.50	25	3672.6	1152.7	4.0	0.2	0.0	0.0	4247.3	1506.1	4.0	0.1	0.0	0.0
A1	0.50	30	3670.0	1182.1	3.9	0.2	0.0	0.0	4246.3	1490.2	5.2	0.1	0.0	0.0
A1	0.25	0												

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Table B-1. Particle Count Calibration Comparison – Parker ACM20 Results

Test Dust	Concentration mg/L	Time min	ACM 20 - old calibration						ACM 20 - new calibration					
			≥4μm(b)	≥6μm(b)	≥14μm(b)	≥21μm(b)	≥25μm(b)	≥30μm(b)	≥4μm(c)	≥6μm(c)	≥14μm(c)	≥21μm(c)	≥25μm(c)	≥30μm(c)
A1	0.25	5	2178.9	683.1	1.9	0.0	0.0	0.0	2458.4	844.9	2.6	0.0	0.0	0.0
A1	0.25	10	2182.7	684.6	2.3	0.1	0.1	0.0	2518.1	879.9	3.5	0.1	0.0	0.0
A1	0.25	15	2197.7	686.5	2.1	0.1	0.0	0.0	2533.4	882.1	3.5	0.2	0.1	0.1
A1	0.25	20	2106.0	657.2	1.9	0.3	0.1	0.1	2456.9	858.4	3.7	0.4	0.3	0.1
A1	0.25	25	2135.0	672.9	2.1	0.1	0.0	0.0	2431.1	843.9	3.2	0.2	0.1	0.0
A1	0.25	30	2134.4	666.2	3.1	0.3	0.1	0.1	2466.6	857.4	3.8	0.1	0.1	0.0
A2	2.50	0	72.3	25.7	0.6	0.1	0.1	0.0	88.4	34.9	0.7	0.1	0.0	0.0
A2	2.50	5	8296.9	2317.6	84.7	22.7	8.4	3.1	10080.9	2977.1	75.2	14.9	8.6	3.2
A2	2.50	10	8513.6	2370.0	81.6	21.7	9.9	3.3	10707.0	3256.3	95.4	21.5	14.8	7.0
A2	2.50	15	8461.2	2374.3	87.9	22.8	10.4	4.3	10603.0	3207.4	97.6	23.1	14.5	7.4
A2	2.50	20	8776.6	2501.4	93.8	27.6	12.9	4.5	10446.9	3135.7	79.8	17.4	9.6	2.7
A2	2.50	25	8502.7	2390.0	89.1	24.7	10.0	3.6	10862.7	3340.1	108.4	25.6	16.1	8.8
A2	2.50	30	8655.2	2454.2	89.4	24.1	10.1	3.1	10895.6	3356.6	107.9	26.1	16.4	8.4
A2	2.00	0	346.0	119.7	0.7	0.1	0.1	0.0	115.6	43.5	0.5	0.0	0.0	0.0
A2	2.00	5	6596.8	1822.8	59.2	15.4	6.9	2.4	7263.9	2052.9	27.9	2.4	1.1	0.4
A2	2.00	10	6291.8	1761.8	55.4	14.5	6.6	1.8	7346.7	2113.6	27.4	3.3	1.1	0.1
A2	2.00	15	6548.2	1849.5	61.5	13.4	4.8	1.4	7450.7	2156.2	28.9	2.9	1.1	0.0
A2	2.00	20	6599.4	1892.8	62.9	15.8	6.2	2.3	7791.0	2299.1	33.5	2.5	1.1	0.3
A2	2.00	25	6446.6	1809.4	58.4	15.0	6.1	2.4	7668.5	2155.6	28.9	2.6	1.1	0.6
A2	2.00	30	6512.1	1842.5	60.7	13.6	4.9	2.0	7919.8	2180.1	28.2	2.8	1.3	0.5
A2	1.00	0												
A2	1.00	5	3176.8	867.8	23.8	5.1	1.7	0.7	4203.2	1156.6	17.1	2.1	1.1	0.4
A2	1.00	10	3098.6	836.6	26.1	5.1	2.1	0.6	3954.1	1022.9	12.2	1.0	0.4	0.1
A2	1.00	15	3146.0	859.6	28.4	7.1	2.3	0.7	4049.4	1107.6	15.3	1.6	0.7	0.4
A2	1.00	20	3019.4	811.6	24.6	5.2	1.9	0.9	4166.0	1080.6	11.9	1.4	0.4	0.1
A2	1.00	25	3013.9	813.4	24.0	6.0	2.7	1.1	3890.4	1047.2	15.1	1.6	0.7	0.4
A2	1.00	30	3455.3	973.6	32.4	7.8	3.6	1.1	4119.8	1101.0	14.4	1.6	0.9	0.1
A2	0.50	0	83.4	24.8	1.0	0.1	0.1	0.1	90.1	31.4	0.8	0.1	0.0	0.0
A2	0.50	5	1767.4	457.1	15.5	3.6	1.6	0.8	2277.7	653.8	18.6	4.5	2.9	1.1
A2	0.50	10	1812.7	471.0	16.6	4.0	2.1	1.0	2282.3	646.9	18.7	3.9	2.5	1.0

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Table B-1. Particle Count Calibration Comparison – Parker ACM20 Results

Test Dust	Concentration mg/L	Time min	ACM 20 - old calibration						ACM 20 - new calibration					
			≥4μm(b)	≥6μm(b)	≥14μm(b)	≥21μm(b)	≥25μm(b)	≥30μm(b)	≥4μm(c)	≥6μm(c)	≥14μm(c)	≥21μm(c)	≥25μm(c)	≥30μm(c)
A2	0.50	15	1752.0	451.7	15.6	3.3	1.2	0.5	2227.4	621.6	15.6	2.8	2.0	1.1
A2	0.50	20	1734.1	460.9	16.6	4.4	1.6	0.6	2244.4	643.2	20.0	4.2	2.4	1.3
A2	0.50	25	1783.5	474.4	17.6	5.6	3.0	1.2	2268.4	657.9	21.6	6.0	3.9	2.1
A2	0.50	30	1774.4	468.6	46.4	4.3	2.1	1.1	2235.2	625.4	17.9	3.6	2.1	1.0
A2	0.25	0												
A2	0.25	5	1046.5	267.9	7.9	1.8	0.5	0.1	1366.6	382.4	11.3	2.8	1.9	0.8
A2	0.25	10	1063.8	280.8	9.6	2.4	1.0	0.3	1364.3	392.6	10.8	2.6	1.6	0.8
A2	0.25	15	1010.1	271.0	9.0	2.4	1.4	0.5	1301.6	376.7	10.9	1.6	0.9	0.6
A2	0.25	20	986.5	258.8	9.0	1.9	0.7	0.4	1265.2	350.6	9.4	2.0	1.6	0.9
A2	0.25	25	1063.8	281.4	11.1	2.9	1.2	0.4	1365.4	390.4	13.6	3.2	1.9	1.4
A2	0.25	30	1040.9	270.3	7.1	1.6	0.9	0.4	1351.6	377.4	9.8	2.1	1.1	0.5
A3	2.50	0	64.0	25.9	3.3	1.6	0.7	0.5	142.7	73.1	8.1	3.6	2.4	1.5
A3	2.50	5	4850.3	1858.1	101.6	24.2	11.3	4.7	6125.2	2473.1	135.6	33.1	19.7	10.2
A3	2.50	10	4893.0	1876.5	104.1	24.3	10.0	4.4	6057.1	2398.7	110.0	21.6	13.1	5.6
A3	2.50	15	4911.9	1851.5	105.4	24.8	10.1	4.0	6080.4	2408.1	114.6	22.6	12.6	4.7
A3	2.50	20	5006.9	1893.1	110.8	26.2	11.5	4.6	6110.7	2418.9	100.8	16.6	8.9	2.4
A3	2.50	25	4973.6	1861.1	99.4	22.9	9.4	3.3	5939.4	2339.1	102.5	18.1	10.4	4.4
A3	2.50	30	4839.7	1782.7	92.4	21.0	8.3	3.9	5969.4	2351.9	99.2	15.8	8.9	2.8
A3	2.00	0	45.1	15.1	1.1	0.6	0.1	0.0	41.7	13.8	0.6	0.1	0.1	0.0
A3	2.00	5	4040.9	1566.1	87.3	22.4	10.6	5.0	5011.9	2045.8	104.4	23.6	13.7	6.3
A3	2.00	10	4065.4	1536.9	81.1	16.9	6.1	2.4	5012.5	1978.9	79.6	14.6	7.9	2.7
A3	2.00	15	4337.1	1675.9	98.6	23.2	10.1	4.1	5138.6	2088.1	101.6	22.9	13.4	6.9
A3	2.00	20	4164.7	1602.1	88.8	21.6	9.4	3.9	5173.9	2108.7	107.2	22.8	14.1	6.9
A3	2.00	25	4021.9	1526.1	78.3	16.4	6.6	2.4	4953.7	2009.3	90.6	14.6	8.3	3.2
A3	2.00	30	4332.8	1679.1	97.1	22.9	10.4	4.1	5291.3	226.7	120.9	29.9	17.4	9.2
A3	1.00	0												
A3	1.00	5	2167.7	823.8	41.3	8.9	3.5	0.7	2789.3	1166.4	52.9	9.9	5.4	2.3
A3	1.00	10	2092.4	808.5	40.6	10.4	4.2	2.1	2707.3	1129.0	58.1	12.8	7.6	3.4
A3	1.00	15	2004.6	784.2	43.5	10.4	4.0	1.9	2492.5	1045.3	52.6	12.1	8.3	4.8
A3	1.00	20	1918.2	726.0	36.4	8.1	3.1	1.2	2354.4	967.7	45.3	9.5	5.5	2.6

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Table B-1. Particle Count Calibration Comparison – Parker ACM20 Results

Test Dust	Concentration mg/L	Time min	ACM 20 - old calibration						ACM 20 - new calibration					
			≥4μm(b)	≥6μm(b)	≥14μm(b)	≥21μm(b)	≥25μm(b)	≥30μm(b)	≥4μm(c)	≥6μm(c)	≥14μm(c)	≥21μm(c)	≥25μm(c)	≥30μm(c)
A3	1.00	25	2098.1	808.6	48.9	12.7	5.4	2.4	2435.9	1017.5	54.3	12.4	8.5	4.4
A3	1.00	30	1904.1	719.7	36.3	8.1	3.1	1.1	2320.9	926.4	40.3	8.8	4.6	2.4
A3	0.50	0	37.8	13.9	0.8	0.3	0.1	0.1	39.4	15.0	0.2	0.1	0.1	0.1
A3	0.50	5	1103.1	415.7	24.1	4.7	2.3	0.8	1376.6	547.8	26.0	5.5	3.3	1.8
A3	0.50	10	1067.1	396.6	21.6	6.2	2.2	0.8	1319.4	532.6	25.2	4.6	3.1	1.6
A3	0.50	15	975.4	361.4	20.1	3.9	1.4	0.6	1268.9	509.1	25.6	6.7	4.1	1.9
A3	0.50	20	948.8	357.9	18.3	5.2	2.0	0.9	1185.6	474.7	25.1	5.3	3.9	1.9
A3	0.50	25	963.4	360.1	19.6	4.4	2.1	1.2	1200.6	478.1	26.3	5.6	3.2	1.7
A3	0.50	30	992.6	370.3	21.1	3.9	1.2	0.5	1214.6	489.7	27.0	6.8	4.2	1.7
A3	0.50	0												
A3	0.25	5	567.9	209.3	11.4	2.7	1.2	0.5	694.4	276.6	16.4	3.3	1.9	1.1
A3	0.25	10	567.1	219.5	10.0	2.0	0.8	0.3	706.2	285.6	14.4	3.6	2.6	1.5
A3	0.25	15	572.6	213.1	10.9	2.5	1.1	0.4	720.5	293.6	14.3	1.9	1.1	0.5
A3	0.25	20	593.2	225.1	12.5	2.7	1.1	0.5	673.6	275.4	14.0	3.1	2.0	0.9
A3	0.25	25	537.6	200.5	11.1	2.6	1.2	0.6	666.1	266.8	1237.0	2.2	1.4	0.6
A3	0.25	30	534.6	196.0	11.1	2.1	0.7	0.4	676.0	265.9	13.4	3.0	2.1	1.1
A1 _(90%) RIO _(10%)	2.00	0	129.6	64.7	2.6	0.3	0.1	0.1	163.4	85.1	4.2	0.9	0.7	0.2
A1 _(90%) RIO _(10%)	2.00	5	14841.2	4259.5	16.9	1.2	0.4	0.1	17999.1	6009.0	29.9	1.4	0.6	0.3
A1 _(90%) RIO _(10%)	2.00	10	14966.4	4369.9	17.9	0.7	0.1	0.0	18105.3	6069.1	31.2	2.2	1.0	0.6
A1 _(90%) RIO _(10%)	2.00	15	14982.9	4342.1	19.8	0.4	0.0	0.0	18099.2	6047.1	32.1	1.9	1.0	0.4
A1 _(90%) RIO _(10%)	2.00	20	14790.1	4331.5	20.6	0.9	0.2	0.1	17995.0	6016.4	32.9	1.8	0.8	0.2
A1 _(90%) RIO _(10%)	2.00	25	14516.6	4192.5	15.4	1.4	0.5	0.1	17625.5	5854.1	27.3	1.6	0.6	0.2
A1 _(90%) RIO _(10%)	2.00	30	14241.0	4157.2	18.1	1.4	0.3	0.1	1738.5	5763.1	26.5	1.1	0.4	0.2
A1 _(90%) RIO _(10%)	1.00	0												
A1 _(90%) RIO _(10%)	1.00	5	6533.7	1792.2	6.3	0.2	0.1	0.0	8136.6	2544.9	10.4	0.8	0.4	0.1

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Table B-1. Particle Count Calibration Comparison – Parker ACM20 Results

Test Dust	Concentration mg/L	Time min	ACM 20 - old calibration						ACM 20 - new calibration					
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥21µm(c)	≥25µm(c)	≥30µm(c)
Al _(90%) RIO _(10%)	1.00	10	6347.4	1754.4	6.0	0.6	0.2	0.1	7885.8	2461.8	12.3	0.7	0.5	0.1
Al _(90%) RIO _(10%)	1.00	15	6540.1	1816.5	6.6	0.3	0.1	0.0	8085.6	2530.6	10.4	0.6	0.4	0.1
Al _(90%) RIO _(10%)	1.00	20	6519.4	1809.9	7.9	0.4	0.0	0.0	8124.3	2538.4	12.3	0.4	0.3	0.1
Al _(90%) RIO _(10%)	1.00	25	6323.3	1740.9	7.7	0.3	0.1	0.0	7969.4	2486.0	11.3	0.6	0.3	0.2
Al _(90%) RIO _(10%)	1.00	30	6314.3	1739.9	7.0	0.4	0.0	0.0	7894.5	2475.4	11.9	0.8	0.4	0.0
Al _(90%) RIO _(10%)	0.50	0	101.7	33.7	0.7	0.2	0.1	0.0	104.1	40.0	1.4	0.2	0.1	0.1
Al _(90%) RIO _(10%)	0.50	5	3721.6	1012.6	3.3	0.4	0.1	0.0	4633.0	1430.1	6.2	0.5	0.3	0.2
Al _(90%) RIO _(10%)	0.50	10	3436.2	915.5	4.1	0.6	0.1	0.1	4367.6	1331.4	6.1	0.8	0.4	0.1
Al _(90%) RIO _(10%)	0.50	15	3445.1	940.6	2.8	0.1	0.0	0.0	4307.6	1307.6	6.1	0.4	0.2	0.1
Al _(90%) RIO _(10%)	0.50	20	3468.1	933.5	3.9	0.3	0.2	0.1	4341.9	1318.1	4.9	0.5	0.4	0.1
Al _(90%) RIO _(10%)	0.50	25	3477.1	945.4	4.3	0.2	0.0	0.0	4368.9	1336.3	5.8	0.6	0.4	0.3
Al _(90%) RIO _(10%)	0.50	30	3486.9	922.6	3.8	0.3	0.0	0.0	4349.9	1324.4	6.0	0.9	0.6	0.4
Al _(90%) RIO _(10%)	0.25	0												
Al _(90%) RIO _(10%)	0.25	5	1984.6	512.7	1.1	0.1	0.0	0.0	2471.6	734.9	3.2	0.1	0.1	0.0
Al _(90%) RIO _(10%)	0.25	10	1911.9	498.9	2.4	0.1	0.0	0.0	2368.7	700.6	3.4	0.3	0.1	0.0
Al _(90%) RIO _(10%)	0.25	15	1792.8	470.6	1.9	0.4	0.3	0.1	2252.4	673.8	2.6	0.4	0.1	0.1
Al _(90%) RIO _(10%)	0.25	20	1820.8	473.9	1.8	0.1	0.1	0.0	2253.1	663.9	2.4	0.1	0.1	0.1
Al _(90%) RIO _(10%)	0.25	25	1864.9	489.6	2.6	0.2	0.2	0.0	2240.3	665.6	3.4	0.4	0.3	0.2
Al _(90%) RIO _(10%)	0.25	30	1882.8	493.9	2.1	0.5	0.1	0.0	2338.6	685.7	2.4	0.3	0.1	0.0

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Table B-1. Particle Count Calibration Comparison – Parker ACM20 Results

Test Dust	Concentration mg/L	Time min	ACM 20 - old calibration						ACM 20 - new calibration					
			≥4μm(b)	≥6μm(b)	≥14μm(b)	≥21μm(b)	≥25μm(b)	≥30μm(b)	≥4μm(c)	≥6μm(c)	≥14μm(c)	≥21μm(c)	≥25μm(c)	≥30μm(c)
H ₂ O	0.0	0	31.7	11.5	0.5	0.1	0.0	0.0	37.2	12.8	0.7	0.1	0.1	0.0
H ₂ O	3.2	5	4236.1	2519.3	210.1	47.3	13.9	3.3	5156.0	3324.1	317.7	73.0	42.4	15.9
H ₂ O	3.0	10	4354.6	2582.9	209.1	49.0	12.6	2.6	5186.4	3305.8	305.4	71.0	44.0	17.9
H ₂ O	11.4	15	12060.9	7346.9	662.1	150.3	44.7	11.2	14296.1	9411.3	993.1	229.5	140.1	54.0
H ₂ O	9.7	20	10822.6	6500.6	580.2	133.6	38.9	7.9	12606.0	8215.9	836.6	197.1	115.1	45.4
H ₂ O	9.6	25	10918.6	6612.6	587.8	136.4	41.4	8.7	12835.7	8375.3	870.0	200.5	120.7	49.6
H ₂ O	12.8	30	13528.9	8188.3	716.9	159.0	48.4	10.3	16028.0	10548.4	1096.2	250.1	149.3	57.8
H ₂ O	13.5	35	14165.5	8636.8	794.2	177.4	53.4	10.6	16519.9	10871.0	1156.9	263.9	154.6	60.4
H ₂ O	21.7	40	19256.2	11865.4	1131.9	247.4	74.8	15.5	22047.8	14753.6	1659.3	380.5	227.4	84.9
H ₂ O	22.8	45	19146.6	11798.0	1126.1	244.4	73.1	15.9	22187.5	14824.1	1667.2	380.4	225.3	88.0
H ₂ O	33.9	50	28078.2	17688.7	1832.4	407.1	119.1	23.9	31835.0	21893.2	2753.7	640.6	382.6	148.9
H ₂ O	37.5	55	29046.1	18388.4	1944.4	430.2	133.9	29.0	33083.9	22829.9	2939.6	686.1	412.1	160.5

Note: Water concentrations are given by Aqua-Glo Results

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Table B-2. Particle Count Calibration Comparison – Stanhope SETA Results

Test Dust	Concentration mg/L	Time min	SETA AvCount - old calibration						SETA AvCount - new calibration			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A1	2.50	0	54.7	34.2	6.6	1.9	1.0	0.7	73.2	35.9	4.4	0
A1	2.50	5	20098.1	9253.7	118.6	12.7	4.3	1.9	22204.6	9541.8	133.3	0.7
A1	2.50	10	19735.6	9127.5	136.4	18.2	6.8	3.2	21952.5	9450.7	145.9	0.4
A1	2.50	15	19738.3	9132.6	130.3	15.6	5.9	2.7	21733	9358.4	139.5	1
A1	2.50	20	20036.5	9259.9	135.2	16.4	6.9	3.4	22017.4	9520.1	140.8	1.2
A1	2.50	25	19827.2	9229.9	149.1	23.6	10.1	4.9	22085.2	9533.1	139.9	1.2
A1	2.50	30	19685.6	9106.9	125.1	15.8	6.3	2.8	21675.4	9336	139.5	4
A1	2.00	0	982.1	512.8	33.2	10.3	5.1	2.7	182.4	82.2	6.8	1
A1	2.00	5	16032.2	7487.6	97.5	10.3	3.6	1.3	17654.2	7682	110.3	2.8
A1	2.00	10	16062.7	7520.7	106.5	14.7	5.8	2.8	17693	7714.1	106.9	1.3
A1	2.00	15	16135.7	7525.0	101.2	10.0	4.4	2.1	17583.1	7665.2	102.7	1.5
A1	2.00	20	16137.3	7529.2	99.5	10.3	4.4	1.8	17593.3	7670.8	104	1.2
A1	2.00	25	16168.3	7610.9	106.1	12.5	5.3	2.4	17563	7699.4	106.7	1.1
A1	2.00	30	16055.3	7525.5	105.5	12.3	5.1	2.4	17478.6	7609.4	108.1	3.2
A1	1.00	0										
A1	1.00	5	8439.8	4007.6	68.3	11.1	5.5	2.7	8983.1	3631.9	53.1	1.2
A1	1.00	10	8402.4	3974.1	64.8	10.1	4.0	1.9	8940.3	3932.9	54.4	1.3
A1	1.00	15	8332.2	3919.6	51.4	5.6	2.1	1.1	8966.4	3912.7	52.9	2.3
A1	1.00	20	8376.0	3925.0	49.3	5.0	2.0	0.6	8896.8	3898.8	53.4	2
A1	1.00	25	8296.6	3870.5	49.5	4.9	1.7	0.9	8874.7	3873	48.6	0.9
A1	1.00	30	8364.8	3927.2	66.5	12.8	5.8	3.2	8793	3840.6	59.7	2.6
A1	0.50	0	166.7	91.9	5.7	1.2	0.6	0.3	106.6	49.9	7.1	2.1
A1	0.50	5	5017.2	2310.9	28.2	3.4	1.3	0.6	5322.8	2246.6	27.1	0.9
A1	0.50	10	5107.7	2324.5	27.8	3.0	0.9	0.3	5370.1	2274.8	25.6	0.5
A1	0.50	15	5132.6	2345.5	34.6	5.9	2.5	1.3	5392.8	2299.6	50.1	5.1
A1	0.50	20	5088.1	2319.0	29.8	4.0	1.4	0.5	5372.9	2279.4	38.3	3.9
A1	0.50	25	5031.0	2305.0	37.9	6.4	2.5	1.2	5360.3	2274.8	37.3	3
A1	0.50	30	5047.3	2300.0	30.2	4.5	2.2	1.2	5324	2252.3	34.6	2.8
A1	0.25	0										
A1	0.25	5	3021.5	1360.4	20.8	4.0	1.4	0.8	3112.5	1296.1	18.5	1.4

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Table B-2. Particle Count Calibration Comparison – Stanhope SETA Results

Test Dust	Concentration mg/L	Time min	SETA AvCount - old calibration						SETA AvCount - new calibration			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A1	0.25	10	2976.9	1334.3	16.6	2.0	0.7	0.3	3163.1	1314.1	17.2	0.5
A1	0.25	15	3032.8	1371.4	17.5	2.6	1.2	0.7	3146.5	1308.1	13.8	0.1
A1	0.25	20	3046.6	1378.5	16.2	1.9	0.6	0.2	3136.2	1302.1	14	0.3
A1	0.25	25	2969.3	1330.5	15.6	1.7	0.5	0.3	3132.9	1299	15.5	0.7
A1	0.25	30	2930.7	1316.0	17.4	2.2	0.8	0.3	3045.6	1251.5	13.8	0.1
A2	2.50	0	159.1	80.2	7.5	2.4	1.4	1.0	124.6	51.7	7.7	0.2
A2	2.50	5	12623.5	4025.6	153.0	37.0	16.8	6.4	13762.6	4036.9	203.4	7.1
A2	2.50	10	13029.8	4192.2	154.6	37.3	15.7	6.0	14065.8	4101.7	200.9	11
A2	2.50	15	12532.4	4072.4	163.5	44.3	19.4	8.8	13875.3	4059.1	205.7	11.8
A2	2.50	20	12884.9	4180.7	158.3	41.9	18.5	8.0	13881.4	4030.1	203.1	10.6
A2	2.50	25	12818.8	4161.7	169.6	46.2	20.5	8.5	13964.7	4046.6	199.3	7.2
A2	2.50	30	13132.8	4214.2	158.1	40.7	18.0	7.5	14262.2	4133.7	203.4	8.5
A2	2.00	0	106.3	52.2	2.3	0.4	0.2	0.0	93.2	33.5	1.3	0.4
A2	2.00	5	9405.5	3.37.1	98.9	21.2	7.9	2.7	10182.2	2974.2	124.2	1.6
A2	2.00	10	9582.1	3134.4	107.3	22.7	9.0	4.0	10354.6	3075.1	134.5	3.2
A2	2.00	15	9671.5	3172.3	104.5	24.6	10.0	3.5	10434.3	3108.3	138.3	6
A2	2.00	20	9555.2	3131.5	106.4	24.7	9.6	3.8	10386.1	3083.7	136.1	4.2
A2	2.00	25	9669.4	3166.6	114.6	28.1	11.5	5.1	10422.2	3096.3	142.1	6.4
A2	2.00	30	9768.0	3244.3	124.6	29.8	13.0	5.7	10413.9	3088.9	142.4	5
A2	1.00	0										
A2	1.00	5	4824.6	1610.0	65.8	17.0	8.2	3.7	5080.5	1519.2	65.9	3.3
A2	1.00	10	4746.7	1545.9	56.7	12.4	5.1	1.8	5097.9	1512.8	71.3	4.6
A2	1.00	15	4894.7	1631.1	65.9	17.4	7.6	3.9	5102.3	1496.9	62.7	2.3
A2	1.00	20	4788.5	1545.8	53.0	12.3	5.5	2.8	5055	1464.6	68.2	4.4
A2	1.00	25	4771.6	1531.6	53.1	11.4	4.4	1.6	5084.1	1464.5	66.3	4.1
A2	1.00	30	4804.0	1536.5	62.1	16.7	8.1	4.0	5007.2	1430.6	63.1	3.2
A2	0.50	0	155.6	81.9	9.7	3.4	1.9	1.2	104.9	41.7	5.8	1.1
A2	0.50	5	2826.1	914.2	34.9	8.7	3.8	1.7	2986	842.8	39.4	2.4
A2	0.50	10	2890.0	961.5	41.7	13.6	6.4	3.0	2985.5	841.3	38	0.8
A2	0.50	15	2878.3	923.4	35.8	8.1	3.3	1.2	3009.4	858.8	39.3	1.7
A2	0.50	20	2834.9	905.5	33.1	9.0	4.3	1.9	2978.5	849.9	38	2.5

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Table B-2. Particle Count Calibration Comparison – Stanhope SETA Results

Test Dust	Concentration mg/L	Time min	SETA AvCount - old calibration						SETA AvCount - new calibration			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A2	0.50	25	2795.4	911.2	36.7	9.6	4.5	2.2	2934.8	831.8	40.1	0.8
A2	0.50	30	2761.3	890.9	35.8	10.1	4.9	2.4	2927.9	828.2	42.3	2.5
A2	0.25	0										
A2	0.25	5	1693.5	555.6	24.1	6.8	3.5	1.8	1760.7	487.6	22.6	1.4
A2	0.25	10	1714.2	553.2	24.5	6.5	2.9	1.1	1795.9	506.2	24.3	1.5
A2	0.25	15	1615.4	518.4	16.4	4.9	1.8	0.6	1791.7	492.9	22.5	0.9
A2	0.25	20	1662.8	527.9	19.5	4.9	2.3	1.0	1739.8	487.1	20.9	0.9
A2	0.25	25	1638.0	516.9	18.8	5.2	2.2	1.1	1732	488.2	22.2	0.8
A2	0.25	30	1704.8	558.6	22.9	6.4	3.1	1.5	1771.9	499.7	23.7	1.3
A3	2.50	0	75.4	38.2	6.5	2.9	1.9	1.0	43.9	13.7	1.8	0.6
A3	2.50	5	7098.0	2905.3	189.1	40.0	15.3	4.9	7524.3	2903.2	238.1	4
A3	2.50	10	6080.4	2408.1	114.6	22.6	12.6	4.7	7642.5	2964	247.9	6.9
A3	2.50	15	7163.2	2942.9	197.8	43.0	16.1	5.5	7718.5	3012.1	257.9	8.1
A3	2.50	20	7243.9	2991.8	210.5	49.1	21.8	9.3	7718.5	3026.9	267.8	11.3
A3	2.50	25	7095.4	2947.0	213.0	53.0	22.7	10.1	7644.8	2950.5	249.6	6.8
A3	2.50	30	7280.7	3019.4	208.8	49.5	20.6	8.5	7701.4	2978.1	254.1	11.3
A3	2.00	0	241.6	150.9	28.7	12.0	7.1	3.6	103	59.6	27.7	8.2
A3	2.00	5	5965.6	2542.3	175.8	40.5	16.2	6.0	6205.5	2473.5	199.3	5.9
A3	2.00	10	5955.3	2534.2	164.6	34.9	13.5	5.4	6315.5	2521.7	207.6	5.4
A3	2.00	15	6030.0	2567.6	180.4	42.0	17.6	7.1	6381.6	2559.2	218.3	7.8
A3	2.00	20	5964.2	2519.1	164.3	36.4	14.3	6.0	6343.9	2532.4	212.3	8.1
A3	2.00	25	6005.9	2575.1	182.6	40.6	16.3	6.4	6336.7	2529.4	200.2	4.5
A3	2.00	30	5924.6	2520.2	163.6	35.5	14.1	5.5	6310.3	2515	203.7	5.5
A3	1.00	0										
A3	1.00	5	3165.4	1383.1	100.4	22.8	9.9	4.3	3294.4	1333.5	115.3	6.9
A3	1.00	10	2933.6	1321.7	104.1	27.2	11.6	5.1	3040.7	1225.9	100.5	2.8
A3	1.00	15	2911.2	1256.3	87.5	20.6	9.4	3.7	2985.1	1201.1	92.1	1.5
A3	1.00	20	2849.9	1234.0	83.8	18.9	7.9	2.7	2959	1195.5	93	2.7
A3	1.00	25	2942.1	1280.5	95.6	23.6	10.3	4.3	3012.9	1194.3	92.9	2.3
A3	1.00	30	2831.8	1204.9	84.1	19.3	8.6	3.5	2964.4	1174.8	87.3	2.6
A3	0.50	0	103.8	64.6	15.2	6.9	3.3	1.6	40.4	14.3	1.1	0.2

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Table B-2. Particle Count Calibration Comparison – Stanhope SETA Results

Test Dust	Concentration mg/L	Time min	SETA AvCount - old calibration						SETA AvCount - new calibration			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A3	0.50	5	1667.0	709.2	54.2	13.6	6.0	2.2	1719.5	670.3	56.5	0.6
A3	0.50	10	1567.0	671.5	51.0	12.5	5.5	2.4	1621.7	635	51.1	1.4
A3	0.50	15	1279.5	544.3	45.5	13.6	6.6	3.0	1545.7	597.2	49.6	1.1
A3	0.50	20	1485.9	645.5	48.6	11.9	4.9	2.4	1518.7	587.7	48.4	1.8
A3	0.50	25	1461.4	619.8	46.0	11.6	5.1	2.0	1512	588.8	46	0.6
A3	0.50	30	1485.4	628.8	49.4	12.8	5.4	2.2	1524	591.4	48.5	0.9
A3	0.50	0										
A3	0.25	5	913.2	399.7	35.5	10.2	4.6	2.0	881.5	339.7	28.1	0.4
A3	0.25	10	858.7	371.3	30.4	9.2	3.7	1.6	867	328.5	24.9	0.7
A3	0.25	15	817.5	347.8	25.7	6.7	2.9	1.2	861.3	332.5	25.5	0.4
A3	0.25	20	864.5	365.0	25.9	6.1	2.5	1.0	882.7	332.8	25.7	0.3
A3	0.25	25	876.0	372.4	27.8	6.1	2.4	1.1	877.8	340	25.9	1
A3	0.25	30	826.2	350.2	27.5	7.5	3.7	1.6	851.4	325.7	26.8	0.5
A1 _(90%) RIO _(10%)	2.00	0	164.3	117.1	42.7	10.7	5.0	2.9	136.4	70.3	9.1	0.2
A1 _(90%) RIO _(10%)	2.00	5	21310.6	7331.0	83.0	7.3	2.5	1.3	23596.2	7517.5	96	0.1
A1 _(90%) RIO _(10%)	2.00	10	21368.0	7370.0	94.5	8.6	2.7	1.1	23703.7	7465.9	95.9	0.1
A1 _(90%) RIO _(10%)	2.00	15	18431.0	5987.7	74.0	7.3	2.7	1.1	23535	7417.2	96.9	0.1
A1 _(90%) RIO _(10%)	2.00	20	20659.5	7107.8	85.8	7.6	2.0	0.7	23198.1	7321.8	95.8	0.2
A1 _(90%) RIO _(10%)	2.00	25	20589.5	7102.5	84.1	8.4	2.6	1.0	22905.6	7224.6	93.2	0.1
A1 _(90%) RIO _(10%)	2.00	30	20411.9	7057.5	92.8	9.9	3.8	1.8	22698.2	7174.6	87.3	0.1
A1 _(90%) RIO _(10%)	1.00	0										
A1 _(90%) RIO _(10%)	1.00	5	10253.0	3462.9	50.3	6.4	2.7	1.3	10907.6	3304.1	38.9	0
A1 _(90%) RIO _(10%)	1.00	10	10022.7	3448.1	62.7	11.1	5.4	2.7	10503.7	3204.2	42.9	0.2
A1 _(90%) RIO _(10%)	1.00	15	9560.7	3220.5	44.9	6.0	2.9	1.3	10419.2	3171.9	38.5	0
A1 _(90%) RIO _(10%)	1.00	20	9814.5	3299.0	40.2	4.8	1.5	0.7	10700.3	3254.8	37.3	0
A1 _(90%) RIO _(10%)	1.00	25	9921.4	3373.4	49.7	7.9	3.6	2.0	10583.7	3215.8	37.8	0.1
A1 _(90%) RIO _(10%)	1.00	30	9607.6	3243.5	41.9	6.5	2.8	1.4	10285.6	3102.8	36.6	0.1
A1 _(90%) RIO _(10%)	0.50	0	123.9	53.8	3.7	1.1	0.5	0.2	104.4	30	1.4	0.2
A1 _(90%) RIO _(10%)	0.50	5	5382.4	1801.4	20.5	2.2	0.8	0.4	5884.9	1783.1	20.8	0.1
A1 _(90%) RIO _(10%)	0.50	10	5510.2	1847.3	27.3	3.0	1.2	0.6	5764.7	1709.3	17.1	0.1
A1 _(90%) RIO _(10%)	0.50	15	5455.3	1840.3	30.4	4.1	1.8	1.0	5728.1	1706.3	18.5	0.1

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Table B-2. Particle Count Calibration Comparison – Stanhope SETA Results

Test Dust	Concentration mg/L	Time min	SETA AvCount - old calibration						SETA AvCount - new calibration			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
Al _(90%) RIO _(10%)	0.50	20	5391.6	1795.4	24.4	3.0	1.1	0.6	5735.5	1697.1	18.7	0.1
Al _(90%) RIO _(10%)	0.50	25	5401.8	1813.9	34.9	8.0	4.5	2.9	5661.5	1674.9	20.4	0
Al _(90%) RIO _(10%)	0.50	30	5370.9	1796.6	25.1	3.4	1.5	0.7	5768.2	1734.8	20.7	0.2
Al _(90%) RIO _(10%)	0.25	0										
Al _(90%) RIO _(10%)	0.25	5	3149.3	1045.5	23.1	2.0	2.8	1.6	3280.2	937.5	10.8	0.1
Al _(90%) RIO _(10%)	0.25	10	3082.8	996.2	13.8	2.0	0.7	0.3	3231	929.9	10.4	0.4
Al _(90%) RIO _(10%)	0.25	15	2992.5	978.8	15.5	1.9	0.7	0.3	3119.4	899.3	11.3	0.1
Al _(90%) RIO _(10%)	0.25	20	2926.6	953.5	12.7	2.0	1.0	0.5	3091.6	899.6	11.6	0
Al _(90%) RIO _(10%)	0.25	25	3093.1	1037.2	20.4	3.9	2.1	1.2	3014.3	872.6	9.2	0.2
Al _(90%) RIO _(10%)	0.25	30	2876.6	937.8	14.2	1.8	0.7	0.4	3437.6	978.8	12.4	0.2
H ₂ O	0.0	0	46.1	23.8	3.7	1.4	0.5	0.3	40.5	14.2	2.1	0.4
H ₂ O	3.2	5	4372.4	3199.3	897.9	194.3	88.3	44.4	5500.2	3774.1	881.4	23.5
H ₂ O	3.0	10	4283.7	3129.1	875.7	196.5	91.5	47.4	5285	3580.7	839.7	24.9
H ₂ O	11.4	15	12082.5	8969.1	2592.6	603.1	285.7	141.5	16305.2	11343	2806.1	93.7
H ₂ O	9.7	20	11207.0	8297.2	2394.7	541.5	254.0	123.1	13257.9	9142	2202.8	66
H ₂ O	9.6	25	10992.5	8153.0	2351.6	531.9	248.0	123.5	14017.7	9692.1	2357.2	74.6
H ₂ O	12.8	30	13899.4	10346.4	3020.8	700.9	334.1	163.6	15522.3	10786.6	2622.6	83.7
H ₂ O	13.5	35	13997.6	10424.9	3044.8	692.5	325.0	159.1	17264.3	11988.7	2942.4	96.8
H ₂ O	21.7	40	18225.9	13655.2	4037.3	949.8	448.9	222.9	22665.8	15926.6	3968.6	134.3
H ₂ O	22.8	45	19141.0	14344.3	4208.7	999.2	467.5	230.2	22374.9	15705.7	3900.1	124.8
H ₂ O	33.9	50	27907.0	21118.5	6391.1	1588.1	749.1	375.3	32704.1	23358.3	6052.5	207.7
H ₂ O	37.5	55	28406.0	21436.6	6396.0	1571.4	743.8	363.5	34099.9	24317.1	6286.1	212.9

Note: Water concentrations are given by Aqua-Glo Results

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Table B-3. Particle Count Calibration Comparison – Stanhope SETA Standard vs. Lite Sensor Edition

Test Dust	Concentration mg/L	Time min	SETA AvCount - new calibration				SETA AvCount Lite - new calibration			
			≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A1	2.50	0	73.2	35.9	4.4	0	71.2	39.3	5.6	0.0
A1	2.50	5	22204.6	9541.8	133.3	0.7	22485.4	9611.3	112.6	0.4
A1	2.50	10	21952.5	9450.7	145.9	0.4	22235.3	9528.2	112.2	0.6
A1	2.50	15	21733	9358.4	139.5	1	21931.5	9415.3	117.5	0.8
A1	2.50	20	22017.4	9520.1	140.8	1.2	22187.9	9508.9	112.6	0.6
A1	2.50	25	22085.2	9533.1	139.9	1.2	22469.1	9662.1	117.2	1.4
A1	2.50	30	21675.4	9336	139.5	4	21888.8	9394.1	109.4	0.9
A1	2.00	0	182.4	82.2	6.8	1	231.7	120.2	18.7	1.0
A1	2.00	5	17654.2	7682	110.3	2.8	17729.9	7686.1	92.9	0.7
A1	2.00	10	17693	7714.1	106.9	1.3	17724.8	7680.8	95.0	0.9
A1	2.00	15	17583.1	7665.2	102.7	1.5	17693.1	7697.7	89.1	0.3
A1	2.00	20	17593.3	7670.8	104	1.2	17744.2	7711.4	96.0	2.2
A1	2.00	25	17563	7699.4	106.7	1.1	17706.9	7695.2	102.8	2.8
A1	2.00	30	17478.6	7609.4	108.1	3.2	17652.2	7667.1	95.2	1.2
A1	1.00	0								
A1	1.00	5	8983.1	3631.9	53.1	1.2	9111.3	3988.0	67.5	2.2
A1	1.00	10	8940.3	3932.9	54.4	1.3	9065.3	3980.8	60.9	1.8
A1	1.00	15	8966.4	3912.7	52.9	2.3	9043.9	3938.6	51.8	1.1
A1	1.00	20	8896.8	3898.8	53.4	2	8980.8	3911.6	57.6	1.4
A1	1.00	25	8874.7	3873	48.6	0.9	8939.0	3870.0	57.1	1.7
A1	1.00	30	8793	3840.6	59.7	2.6	8756.7	3759.2	48.6	0.6
A1	0.50	0	106.6	49.9	7.1	2.1	132.6	68.8	10.0	0.3
A1	0.50	5	5322.8	2246.6	27.1	0.9	5355.9	2255.5	28.4	0.3
A1	0.50	10	5370.1	2274.8	25.6	0.5	5426.3	2228.6	25.3	0.5
A1	0.50	15	5392.8	2299.6	50.1	5.1	5425.8	2279.6	28.5	0.4
A1	0.50	20	5372.9	2279.4	38.3	3.9	5440.9	2286.2	34.6	0.3
A1	0.50	25	5360.3	2274.8	37.3	3	5380.3	2246.2	25.3	0.5
A1	0.50	30	5324	2252.3	34.6	2.8	5373.6	2252.7	33.7	0.5
A1	0.25	0								
A1	0.25	5	3112.5	1296.1	18.5	1.4	3147.9	1304.4	19.5	0.4
A1	0.25	10	3163.1	1314.1	17.2	0.5	3204.4	1314.4	16.1	0.2

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Table B-3. Particle Count Calibration Comparison – Stanhope SETA Standard vs. Lite Sensor Edition

Test Dust	Concentration mg/L	Time	SETA AvCount - new calibration				SETA AvCount Lite - new calibration			
		min	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A1	0.25	15	3146.5	1308.1	13.8	0.1	3214.1	1324.5	15.1	0.2
A1	0.25	20	3136.2	1302.1	14	0.3	3172.1	1314.8	15.5	0.3
A1	0.25	25	3132.9	1299	15.5	0.7	3154.5	1306.4	17.4	0.1
A1	0.25	30	3045.6	1251.5	13.8	0.1	3109.5	1284.5	18.3	0.4
A2	2.50	0	124.6	51.7	7.7	0.2	138.6	60.0	9.3	0.8
A2	2.50	5	13762.6	4036.9	203.4	7.1	13957	4071	178	2.8
A2	2.50	10	14065.8	4101.7	200.9	11	14252	4168	178	3.5
A2	2.50	15	13875.3	4059.1	205.7	11.8	14034	4108	180	3.3
A2	2.50	20	13881.4	4030.1	203.1	10.6	13958	4059	171	2.6
A2	2.50	25	13964.7	4046.6	199.3	7.2	14134	4117	178	3.2
A2	2.50	30	14262.2	4133.7	203.4	8.5	14419	4196	176	2.4
A2	2.00	0	93.2	33.5	1.3	0.4	106.8	47.1	3.9	0.2
A2	2.00	5	10182.2	2974.2	124.2	1.6	10272.5	3026.9	120.3	1.1
A2	2.00	10	10354.6	3075.1	134.5	3.2	10489.6	3120.1	126.0	2.3
A2	2.00	15	10434.3	3108.3	138.3	6	10595.4	3155.1	123.8	2.7
A2	2.00	20	10386.1	3083.7	136.1	4.2	10515.3	3111.8	122.7	1.3
A2	2.00	25	10422.2	3096.3	142.1	6.4	10605.4	3134.2	116.9	1.4
A2	2.00	30	10413.9	3088.9	142.4	5	10616.6	3118.2	119.9	0.9
A2	1.00	0								
A2	1.00	5	5080.5	1519.2	65.9	3.3	5126.8	1519.9	58.7	0.6
A2	1.00	10	5097.9	1512.8	71.3	4.6	5147.4	1511.8	54.6	0.3
A2	1.00	15	5102.3	1496.9	62.7	2.3	5174.2	1501.2	53.7	0.4
A2	1.00	20	5055	1464.6	68.2	4.4	5100.5	1469.2	53.0	0.4
A2	1.00	25	5084.1	1464.5	66.3	4.1	5073.9	1469.3	53.9	0.3
A2	1.00	30	5007.2	1430.6	63.1	3.2	5019.7	1428.9	52.8	0.8
A2	0.50	0	104.9	41.7	5.8	1.1	106.9	47.5	9.6	0.9
A2	0.50	5	2986	842.8	39.4	2.4	2997.0	864.0	46.0	2.3
A2	0.50	10	2985.5	841.3	38	0.8	3020.3	860.6	38.1	1.2
A2	0.50	15	3009.4	858.8	39.3	1.7	3020.5	867.3	39.1	1.6
A2	0.50	20	2978.5	849.9	38	2.5	2985.0	851.3	37.0	1.1
A2	0.50	25	2934.8	831.8	40.1	0.8	2994.3	834.5	33.4	0.9

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Table B-3. Particle Count Calibration Comparison – Stanhope SETA Standard vs. Lite Sensor Edition

Test Dust	Concentration mg/L	Time	SETA AvCount - new calibration				SETA AvCount Lite - new calibration			
		min	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A2	0.50	30	2927.9	828.2	42.3	2.5	2944.0	383.9	36.8	0.9
A2	0.25	0								
A2	0.25	5	1760.7	487.6	22.6	1.4	1774.9	506.3	19.5	0.8
A2	0.25	10	1795.9	506.2	24.3	1.5	1826.7	521.8	24.5	0.9
A2	0.25	15	1791.7	492.9	22.5	0.9	1780.4	505.5	20.0	0.5
A2	0.25	20	1739.8	487.1	20.9	0.9	1725.2	483.8	21.1	0.7
A2	0.25	25	1732	488.2	22.2	0.8	1727.1	483.0	21.9	0.6
A2	0.25	30	1771.9	499.7	23.7	1.3	1786.1	501.3	19.6	0.3
A3	2.50	0	43.9	13.7	1.8	0.6	52.0	20.0	2.6	0.2
A3	2.50	5	7524.3	2903.2	238.1	4	7562.7	2905.8	223.4	2.0
A3	2.50	10	7642.5	2964	247.9	6.9	7688.2	2957.5	218.7	1.8
A3	2.50	15	7718.5	3012.1	257.9	8.1	7780.7	2995.3	223.9	2.9
A3	2.50	20	7718.5	3026.9	267.8	11.3	7758.6	2962.2	214.7	1.8
A3	2.50	25	7644.8	2950.5	249.6	6.8	7732.5	2954.1	210.6	1.4
A3	2.50	30	7701.4	2978.1	254.1	11.3	7759.2	2982.0	213.7	2.0
A3	2.00	0	103	59.6	27.7	8.2	86	45	11.5	1.5
A3	2.00	5	6205.5	2473.5	199.3	5.9	6233	2474	180	1.8
A3	2.00	10	6315.5	2521.7	207.6	5.4	6406	2539	179	1.3
A3	2.00	15	6381.6	2559.2	218.3	7.8	6422	2540	179	1.4
A3	2.00	20	6343.9	2532.4	212.3	8.1	6384	2506	173	1.2
A3	2.00	25	6336.7	2529.4	200.2	4.5	6373	2511	176	0.8
A3	2.00	30	6310.3	2515	203.7	5.5	6345	2504	174	1.0
A3	1.00	0								
A3	1.00	5	3294.4	1333.5	115.3	6.9	3264	1307	86	0.7
A3	1.00	10	3040.7	1225.9	100.5	2.8	3077	1250	84	0.4
A3	1.00	15	2985.1	1201.1	92.1	1.5	2980	1182	76	0.6
A3	1.00	20	2959	1195.5	93	2.7	3001	1198	81	0.3
A3	1.00	25	3012.9	1194.3	92.9	2.3	3029	1206	79	0.2
A3	1.00	30	2964.4	1174.8	87.3	2.6	2937	1155	76	0.1
A3	0.50	0	40.4	14.3	1.1	0.2	35.2	13.7	1.6	0.2
A3	0.50	5	1719.5	670.3	56.5	0.6	1734.0	674.1	48.9	0.4

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Table B-3. Particle Count Calibration Comparison – Stanhope SETA Standard vs. Lite Sensor Edition

Test Dust	Concentration mg/L	Time min	SETA AvCount - new calibration				SETA AvCount Lite - new calibration			
			≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A3	0.50	10	1621.7	635	51.1	1.4	1641.4	638.6	47.1	0.3
A3	0.50	15	1545.7	597.2	49.6	1.1	1545.1	596.6	42.8	0.5
A3	0.50	20	1518.7	587.7	48.4	1.8	1519.4	583.9	41.5	0.1
A3	0.50	25	1512	588.8	46	0.6	1541.0	600.0	41.9	0.4
A3	0.50	30	1524	591.4	48.5	0.9	1540.7	590.5	42.4	0.4
A3	0.50	0								
A3	0.25	5	881.5	339.7	28.1	0.4	896.8	344.8	25.4	0.0
A3	0.25	10	867	328.5	24.9	0.7	881.4	333.2	23.9	0.1
A3	0.25	15	861.3	332.5	25.5	0.4	866.2	332.9	24.6	0.1
A3	0.25	20	882.7	332.8	25.7	0.3	882.9	341.6	23.7	0.3
A3	0.25	25	877.8	340	25.9	1	876.3	339.4	24.1	0.5
A3	0.25	30	851.4	325.7	26.8	0.5	842.0	323.0	22.0	0.3
A1 _(90%) RIO _(10%)	2.00	0	136.4	70.3	9.1	0.2	128.0	68.0	6.8	0.0
A1 _(90%) RIO _(10%)	2.00	5	23596.2	7517.5	96	0.1	24077.0	7681.0	76.2	0.0
A1 _(90%) RIO _(10%)	2.00	10	23703.7	7465.9	95.9	0.1	24116.0	7664.0	76.0	0.0
A1 _(90%) RIO _(10%)	2.00	15	23535	7417.2	96.9	0.1	23999.0	7626.0	77.9	0.1
A1 _(90%) RIO _(10%)	2.00	20	23198.1	7321.8	95.8	0.2	23780.0	7591.0	81.0	0.2
A1 _(90%) RIO _(10%)	2.00	25	22905.6	7224.6	93.2	0.1	23365.0	7386.0	70.5	0.0
A1 _(90%) RIO _(10%)	2.00	30	22698.2	7174.6	87.3	0.1	23099.0	7343.0	72.0	0.0
A1 _(90%) RIO _(10%)	1.00	0								
A1 _(90%) RIO _(10%)	1.00	5	10907.6	3304.1	38.9	0	11094.0	3386.0	33.4	0.0
A1 _(90%) RIO _(10%)	1.00	10	10503.7	3204.2	42.9	0.2	10602.0	3232.0	27.7	0.1
A1 _(90%) RIO _(10%)	1.00	15	10419.2	3171.9	38.5	0	10639.0	3219.0	32.6	0.1
A1 _(90%) RIO _(10%)	1.00	20	10700.3	3254.8	37.3	0	10882.0	3323.0	22.8	0.0
A1 _(90%) RIO _(10%)	1.00	25	10583.7	3215.8	37.8	0.1	10773.0	330.0	37.1	0.0
A1 _(90%) RIO _(10%)	1.00	30	10285.6	3102.8	36.6	0.1	10452.0	3164.0	26.8	0.1
A1 _(90%) RIO _(10%)	0.50	0	104.4	30	1.4	0.2	109.1	33.9	0.5	0.0
A1 _(90%) RIO _(10%)	0.50	5	5884.9	1783.1	20.8	0.1	5961.8	1800.5	164.0	0.1
A1 _(90%) RIO _(10%)	0.50	10	5764.7	1709.3	17.1	0.1	5900.9	1756.2	18.6	0.0
A1 _(90%) RIO _(10%)	0.50	15	5728.1	1706.3	18.5	0.1	5773.0	1712.0	15.4	0.0
A1 _(90%) RIO _(10%)	0.50	20	5735.5	1697.1	18.7	0.1	5797.2	1713.2	15.0	0.0

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Table B-3. Particle Count Calibration Comparison – Stanhope SETA Standard vs. Lite Sensor Edition

Test Dust	Concentration mg/L	Time	SETA AvCount - new calibration				SETA AvCount Lite - new calibration			
		min	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
A1 _(90%) RIO _(10%)	0.50	25	5661.5	1674.9	20.4	0	5775.9	1717.6	15.3	0.0
A1 _(90%) RIO _(10%)	0.50	30	5768.2	1734.8	20.7	0.2	5870.8	1745.8	18.5	0.0
A1 _(90%) RIO _(10%)	0.25	0								
A1 _(90%) RIO _(10%)	0.25	5	3280.2	937.5	10.8	0.1	3397.0	973.6	9.6	0.0
A1 _(90%) RIO _(10%)	0.25	10	3231	929.9	10.4	0.4	3292.0	959.0	9.7	0.0
A1 _(90%) RIO _(10%)	0.25	15	3119.4	899.3	11.3	0.1	3189.0	931.0	11.7	0.0
A1 _(90%) RIO _(10%)	0.25	20	3091.6	899.6	11.6	0	3090.0	874.0	7.4	0.0
A1 _(90%) RIO _(10%)	0.25	25	3014.3	872.6	9.2	0.2	3042.0	872.0	8.2	0.0
A1 _(90%) RIO _(10%)	0.25	30	3437.6	978.8	12.4	0.2	3439.0	986.0	8.6	0.0
H ₂ O	0.0	0	40.5	14.2	2.1	0.4	48.0	20.0	2.6	0.0
H ₂ O	3.2	5	5500.2	3774.1	881.4	23.5	5561.0	3760.0	879.0	19.5
H ₂ O	3.0	10	5285	3580.7	839.7	24.9	5729.0	3834.0	884.0	20.0
H ₂ O	11.4	15	16305.2	11343	2806.1	93.7	14956.0	10269.0	2492.0	55.3
H ₂ O	9.7	20	13257.9	9142	2202.8	66	13348.0	9116.0	2173.0	46.5
H ₂ O	9.6	25	14017.7	9692.1	2357.2	74.6	13688.0	9361.0	2236.0	51.3
H ₂ O	12.8	30	15522.3	10786.6	2622.6	83.7	16849.0	11599.0	2822.0	63.8
H ₂ O	13.5	35	17264.3	11988.7	2942.4	96.8	17953.0	12381.0	3013.0	72.5
H ₂ O	21.7	40	22665.8	15926.6	3968.6	134.3	23563.0	16466.0	4158.0	100.2
H ₂ O	22.8	45	22374.9	15705.7	3900.1	124.8	23364.0	16263.0	4054.0	93.1
H ₂ O	33.9	50	32704.1	23358.3	6052.5	207.7	34419.0	24601.0	6538.0	166.2
H ₂ O	37.5	55	34099.9	24317.1	6286.1	212.9	34242.0	24367.0	6408.0	157.0

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APPENDIX C. Failure Mode Analysis - Data

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WI #:	15-159
Date:	5/20/2015
Technician:	RVL

Tech Notes

SOT conductivity = 950; Fuel was JP-8 from WD36 EI 1581 Test 1.

Test

Description:

- Test 1: The coalescer was loosened by one rotation
- Test 2: The coalescer was loosened by two rotations
- Test 3: The separator was slit along the seam - 3in slit
- Test 4: The separator was loosened to simulate a bad seal
- Test 5: A 1/8 in hole was drilled in coalescer, with a good seal on the separator

Table C-1. Test Results of Failure Mode Analysis

Time [min]	Flow [GPM]	DP [dpsi]	Water Inj. [mL/min]	Free Water [ppm]	Fuel Temp. [°F]	Notes
TEST 1						
0	30.0	7.3	0.0	1.5	75	Malvern could not detect water for this test.
10	30.0	8.1	11.4	2.1	75	
5	30.4	11.2	3.4	1.4	78	
TEST 2						
0	29.9	7.1	0.0	1.9	78	Malvern data was collected
5	29.9	8.0	11.4	13.6	78	
15	29.9	8.4	11.4	12.8	78	
30	29.9	8.5	11.4	11.9	78	
5	29.8	14.2	3.4	W/O	78	Malvern could not detect water.
15	29.7	14.7	3.4	W/O	78	
30	29.9	15.3	3.4	W/O	79	
TEST 3						
0	30.3	5.3	0.0	5.6	81	Malvern detected water
15	30.3	13.3	3.4	42.3	81	
30	30.0	15.9	3.4	W/O	81	
40	29.7	19.9	3.4	W/O	81	
TEST 4						
0	30.3	25.9	0.0	3.2	86	Used elements and fuel from WD36 FM Test 2; Malvern data was collected for this test.
5	29.8	58.2	3.4	42.2	87	
15	30.0	68.7	3.4	W/O	87	
25	30.1	73.6	3.4	W/O	88	
35	30.0	74.5	3.4	W/O	88	
TEST 5						
0	30.0	28.1	0.0	2.8	89	Malvern data was collected.
5	30.1	58.8	3.4	W/O	89	
15	29.8	74.1	3.4	W/O	90	
25	30.3	75.9	3.4	W/O	89	

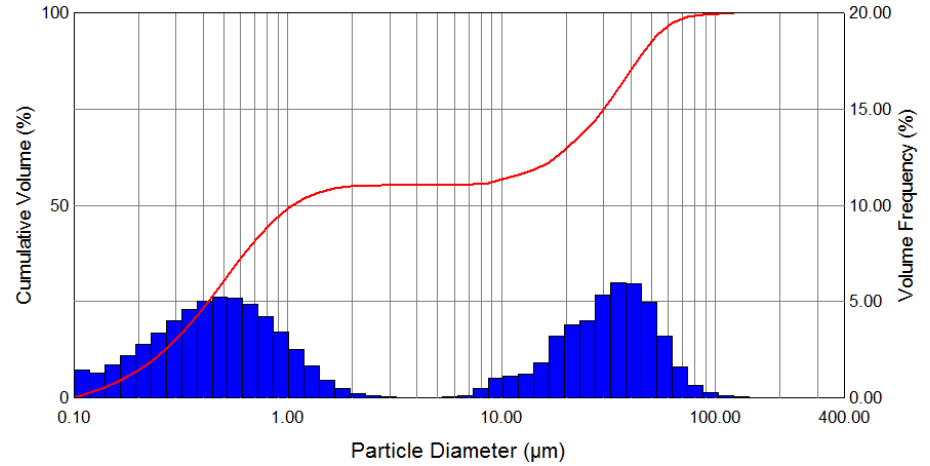
Note: "W/O" indicates a washout on the Aqua Glo D-2 reader.

Malvern Results

For each test, there are representative examples given of the data. If a full copy of the file is needed, it can be provided.

Table C-2. Malvern Results for Coalescer Failure Test 2

Title	Average	Min	Max
Transmission (%)	90.2	89.6	90.8
Dv(10) (um)	0.25	0.23	0.29
Dv(50) (um)	1.39	0.95	11.10
Dv(90) (um)	47.31	44.93	49.68



Title	Average	Min	Max
Transmission (%)	88.6	88.3	88.8
Dv(10) (um)	0.27	0.25	0.28
Dv(50) (um)	1.47	1.17	2.34
Dv(90) (um)	42.40	41.35	43.18

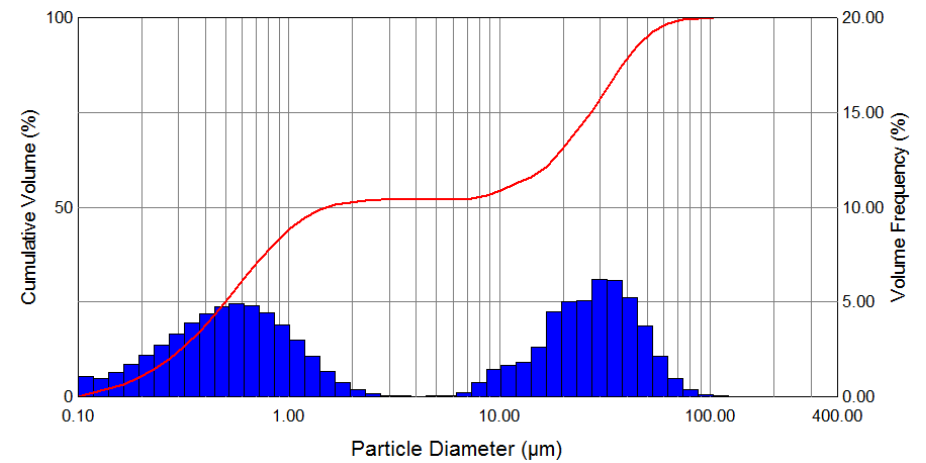
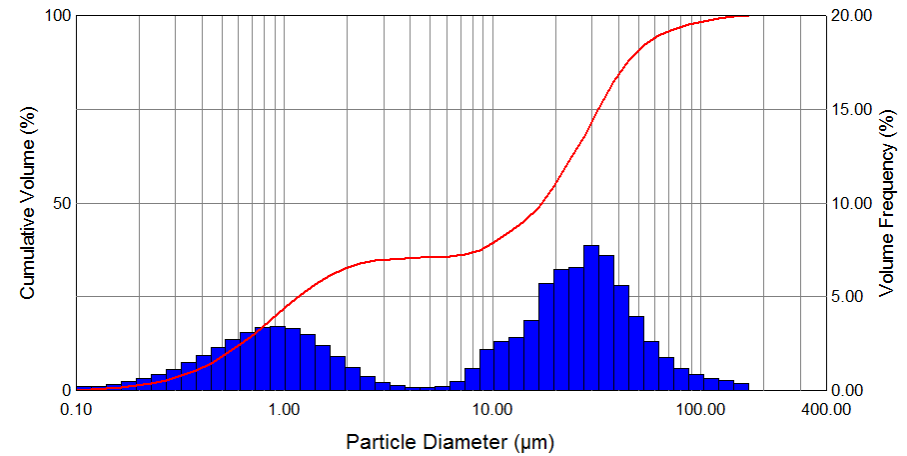


Table C-3. Malvern Results for Separator Failure (Test 3)

Title	Average	Min	Max
Transmission (%)	95.3	94.1	97.6
Dv(10) (um)	0.35	0.18	0.54
Dv(50) (um)	6.63	0.48	17.32
Dv(90) (um)	42.26	1.34	49.12



Title	Average	Min	Max
Transmission (%)	94.9	93.4	97.6
Dv(10) (um)	0.42	0.18	0.61
Dv(50) (um)	9.48	0.48	18.13
Dv(90) (um)	37.60	1.34	49.70

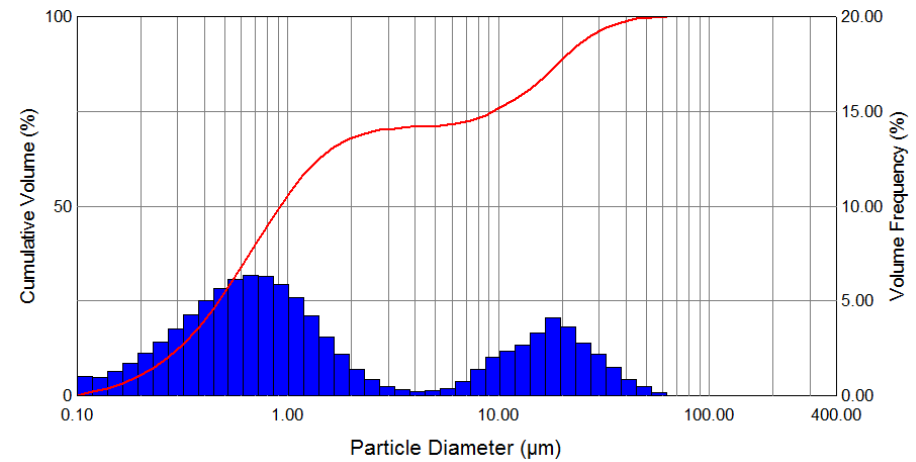
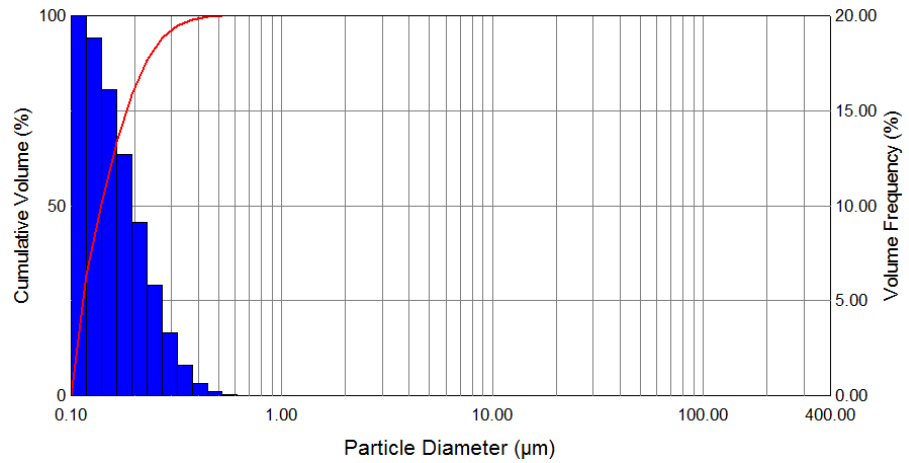


Table C-4. Malvern Results for Separator Failure (Test 4)

Title	Average	Min	Max
Transmission (%)	96.8	96.4	97.1
Dv(10) (um)	0.09	0.09	0.10
Dv(50) (um)	0.14	0.13	0.16
Dv(90) (um)	0.25	0.21	0.29



Title	Average	Min	Max
Transmission (%)	95.9	95.8	96.0
Dv(10) (um)	0.09	0.09	0.10
Dv(50) (um)	0.14	0.13	0.15
Dv(90) (um)	0.23	0.21	0.28

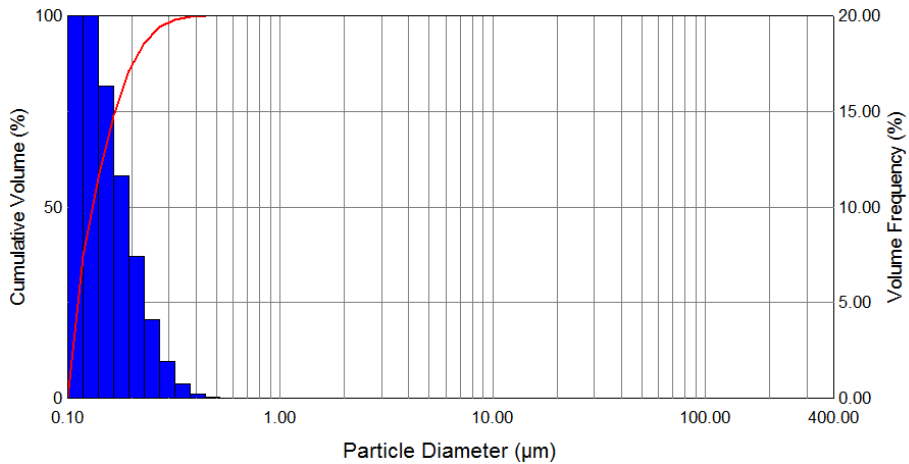
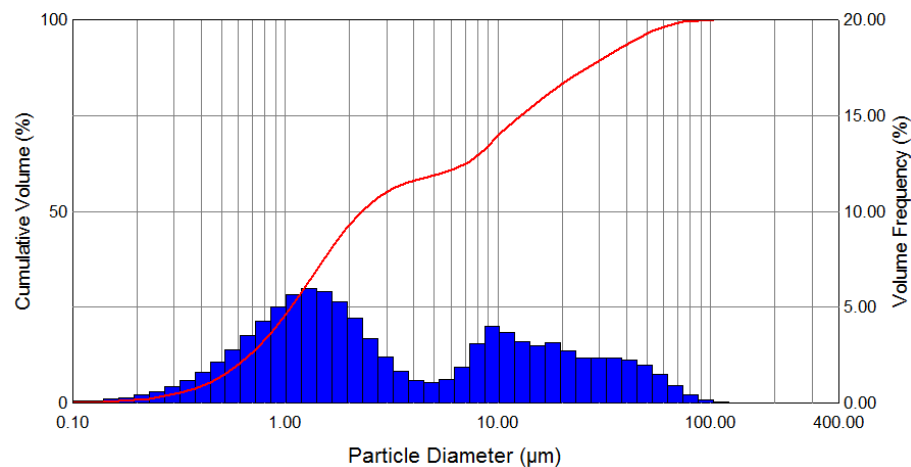
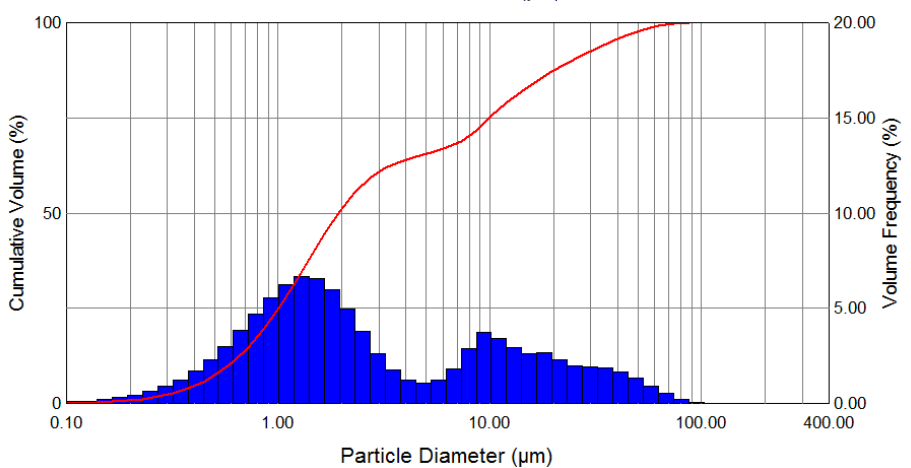


Table C-5. Malvern Results for Coalescer Failure (Test 5)

Title	Average	Min	Max
Transmission (%)	45.3	44.1	46.4
Dv(10) (um)	0.59	0.56	0.61
Dv(50) (um)	2.33	2.27	2.42
Dv(90) (um)	32.47	30.87	34.45



Title	Average	Min	Max
Transmission (%)	35.6	34.6	34.6
Dv(10) (um)	0.59	0.58	0.60
Dv(50) (um)	1.94	1.92	1.97
Dv(90) (um)	24.30	22.99	25.52



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Table C-6. Particle Count Results for Failure Mode Analysis (SETA Instrument)

Test Dust	Concentration mg/L	Time min	SETA AvCount – raw particle counts						SETA AvCount – ISO codes			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
TEST 1 – LOOSE COALESCER												
water	0.01%	0	211.6	125.0	33.9	6.0	0.9	0.2	15	14	12	5
water	0.01%	10	290.3	205.0	77.8	17.7	2.1	0.1	15	15	13	4
TEST 2 – LOOSE X2 ROTATIONS COALESCER												
water	0.01%	0	1444.8	789.0	120.6	32.2	5.3	0.9	18	17	14	7
water	0.01%	5	26147.7	14728.6	1872.4	395.8	86.5	19.0	22	21	18	11
water	0.01%	15	26897.9	15470.9	1976.3	409.5	83.5	21.5	22	21	18	12
water	0.01%	30	26775.9	15488.9	1996.0	409.2	84.0	20.7	22	21	18	12
water	3%	5	68152.9	64029.0	44000.4	31555.0	24780.1	19020.0	23	23	23	21
water	3%	15	67464.1	63938.3	45029.1	32757.4	25929.9	20067.1	23	23	23	22
water	3%	30	67429.1	64290.7	46964.3	35123.5	28260.8	22255.2	23	23	23	22
TEST 3 – SEPARATOR SLIT SEAM												
water	0.01%	0	1802.1	803.5	67.8	13.7	2.9	1.1	18	17	13	7
water	0.01%	5	1355.1	642.7	118.3	30.7	16.1	8.2	18	17	14	10
water	0.01%	15	1489.2	645.4	149.6	35.7	17.4	7.9	18	17	14	10
water	0.01%	30	1953.6	829.9	216.1	41.5	19.7	9.7	18	17	15	10
water	0.01%	40	2230.7	896.5	203.5	40.8	20.5	10.8	18	17	15	11
TEST 4 – LOOSE SEPARATOR												
water		0	6390.0	1094.3	22.3	5.6	3.0	2.0	20	17	12	8
water	3%	5	66891.2	27908.4	3060.7	586.5	278.4	145.6	23	22	19	14
water	3%	15	61049.1	25951.1	3793.6	834.4	410.3	217.5	23	22	19	15
water	3%	25	27452.2	35728.3	6582.5	1473.1	693.2	353.3	23	22	20	16
water	3%	35	68185.0	39639.3	8415.7	1960.6	916.8	457.3	23	22	20	16
TEST 5 – HOLE IN COALESCER												
water		0	6768.3	1015.2	180.8	64.6	15.6	5.5	20	17	15	10
water	3%	5	69391.7	68591.0	59436.3	51237.0	45512.4	39778.0	23	23	23	22
water	3%	15	44609.6	44416.3	41838.5	39221.6	37176.8	34904.6	23	23	23	22
water	3%	25	30609.5	30534.2	29446.6	28275.4	27329.8	26221.9	22	22	22	22

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Table C-7. Particle Count Results for Failure Mode Analysis (ACM 20 Instrument)

Test Dust	Concentration mg/L	Time min	ACM 20 – raw particle counts						ACM 20 – ISO codes			
			≥4µm(b)	≥6µm(b)	≥14µm(b)	≥21µm(b)	≥25µm(b)	≥30µm(b)	≥4µm(c)	≥6µm(c)	≥14µm(c)	≥30µm(c)
TEST 1 – LOOSE COALESCER												
water	0.01%	0	44.5	13.5	3.8	2.4	1.6	0.9	13	11	9	7
water	0.01%	10	67.4	24.9	3.3	1.5	1.1	0.6	13	12	9	>6
TEST 2 – LOOSE X2 ROTATIONS COALESCER												
water	0.01%	0	490.4	137.2	7.4	2.0	1.1	0.6	16	14	10	>6
water	0.01%	5	20787.6	9607.1	888.7	116.1	29.4	8.8	22	20	17	10
water	0.01%	15	20416.1	9494.5	899.1	127.3	33.6	8.4	22	20	17	10
water	0.01%	30	21374.5	10088.0	931.8	113.1	29.8	7.6	22	21	17	10
water	3%	5										
water	3%	15	40641.6	38676.6	29782.2	24001.9	20522.3	15690.1	22	22	22	21
water	3%	30	39249.3	37367.2	29140.7	23818.5	20561.8	15984.7	22	22	22	21
TEST 3 – SEPARATOR SLIT SEAM												
water	0.01%	0	144.6	47.0	4.1	0.9	0.4	0.2	14	13	9	>5
water	0.01%	5	3531.4	2279.1	1175.2	906.9	776.3	608.4	19	18	17	16
water	0.01%	15	882.4	352.4	62.6	41.4	32.4	24.2	17	16	13	12
water	0.01%	30	1217.1	506.0	135.5	98.6	79.6	60.0	17	16	14	13
water	0.01%	40	1199.0	422.5	73.7	46.0	35.7	28.7	17	16	13	12
TEST 4 – LOOSE SEPARATOR												
water		0	754.8	154.8	8.6	1.6	0.9	0.4	17	14	10	>6
water	3%	5	31713.9	12756.8	1123.4	308.9	162.7	74.3	22	21	17	13
water	3%	15	33298.9	13915.1	1287.6	321.8	163.1	70.3	22	21	19	13
water	3%	25	38153.7	19334.5	2519.5	671.7	347.7	173.9	22	21	19	15
water	3%	35	40636.4	21931.9	3085.5	753.8	345.1	136.3	23	22	19	14
TEST 5 – HOLE IN COALESCER												
water		1728.1	326.4	20.2	5.6	3.4	1.6	18	16	12	8	1728.1
water	3%											
water	3%											
water	3%											

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APPENDIX D. Cosolvent Analysis - Data

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts					
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
A-3	2.5 mg/L	0 ppm	none		5065.9	1745.5	65.1	13.9	6.3	1.8	7376.5	2158.1	250.6	59.6	24.7	9.6
		10 ppm	IPA	Before	9149.4	5050.0	245.0	43.9	13.6	3.4	10749.6	6530.5	1463.0	290.7	121.5	43.3
				After	4745.9	1655.5	64.3	17.8	9.5	5.5	7027.5	3023.0	241.9	56.0	21.7	8.0
			Resolver	Before	8407.1	4483.3	256.9	53.4	20.3	4.2	10078.2	5888.8	1302.8	302.8	135.1	55.6
				After	4575.1	1564.6	63.1	14.9	8.1	2.9	6807.5	2849.8	201.5	47.1	18.0	7.6
		15 ppm	IPA	Before	10450.2	6109.1	314.3	50.5	17.2	3.4	11977.9	7838.0	1879.3	367.7	152.8	55.6
				After	4621.3	1598.8	62.3	16.7	9.4	3.6	6959.3	2952.8	247.0	61.0	25.4	9.5
			Resolver	Before	9683.7	5452.6	203.1	31.3	9.8	3.4	11056.1	6960.3	1487.7	243.3	89.9	27.4
				After	4248.6	1390.3	55.3	16.1	8.1	2.4	6425.6	2533.3	161.2	35.3	13.8	5.6
		30 ppm	IPA	Before	18522.4	12324.7	681.7	98.0	26.9	2.5	20339.6	15690.7	4418.0	826.0	323.0	109.2
				After	4664.5	1616.4	64.4	16.6	9.7	5.1	7027.1	2962.9	265.7	63.5	23.7	7.7
			Resolver	Before	19792.4	13216.5	724.0	105.6	27.6	2.3	21490.7	16747.7	4643.7	881.9	346.2	117.3
				After	3788.7	1095.0	29.0	9.6	5.1	1.7	6117.8	2288.7	115.2	24.2	9.5	3.5
		A-3	2.0 mg/L	0 ppm	None		4280.1	1543.4	47.2	8.7	4.4	0.7	5817.9	2518.1	201.8	45.3
10 ppm	IPA			Before	8258.5	4779.7	281.4	52.5	16.2	2.4	8885.5	5583.9	1391.3	318.1	141.6	54.7
				After	3921.3	1406.1	46.3	10.2	5.4	2.0	5568.7	2456.6	194.5	42.7	15.1	4.7
	Resolver			Before	13938.9	8467.9	495.1	95.3	30.8	4.4	13222.6	9429.7	2549.1	568.4	261.7	105.5
				After												

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts							
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um		
		15 ppm	none	After	3827.3	1324.6	48.8	13.8	7.4	3.1	5568.7	2396.6	181.0	41.0	14.6	5.5		
				Before	7683.5	4373.1	285.4	59.4	18.6	2.6	8912.2	5656.2	1455.9	348.0	163.1	67.5		
			IPA	After	3758.4	1322.9	46.6	12.4	7.1	3.6	5464.3	2366.7	184.2	38.4	14.9	5.5		
				Before	8206.3	4811.6	266.8	49.9	16.4	3.1	9675.4	6417.7	1620.1	356.1	157.1	60.4		
			Resolver	After	3289.9	1053.1	29.0	5.6	2.3	0.6	5214.7	2178.4	180.2	45.7	18.8	6.9		
				Before	8206.3	4811.6	266.8	49.9	16.4	3.1	9675.4	6417.7	1620.1	356.1	157.1	60.4		
		30 ppm	IPA	Before	17233.6	11588.9	657.2	100.6	27.9	2.5	19059.3	15070.2	4366.9	842.6	340.3	119.3		
				After	3569.7	1235.9	40.1	9.7	4.8	2.0	5430.9	2337.5	207.9	48.3	18.2	6.5		
			Resolver	Before	20123.9	13742.6	819.4	130.0	36.2	2.9	21381.6	17156.8	4971.1	997.9	409.1	144.8		
				After	3388.3	1110.9	52.0	13.8	6.1	1.8	5261.6	2073.9	170.9	43.0	15.6	5.2		
			A-3	0.5 mg/L	0 ppm	none	832.4	264	7.4	1.4	0.6	0.2	1285.9	535.1	41	40.3	3.9	1.6
					10 ppm	IPA	Before	4432	3019.8	211	40.5	11.1	0.8	4530.8	3478.2	1114.5	267.1	124.8
After	894.1	292.5					11.1	2.9	1.6	0.4	1369.4	587.8	40.1	8.3	2.9	1		
Resolver	Before	7559.8				5154.6	250.9	43.1	12.6	1	7553.1	6138.6	1735.2	316.7	133	48.5		
	After	904.5				295.3	8.1	1.5	0.9	0.5	1450.4	668.1	69	19.1	9.1	4.1		
15 ppm	IPA	Before			5570.3	3897.6	260.1	50.8	14.7	1.6	5753.5	4584.7	1504.3	335.1	151.6	59.9		
		After			957.1	300.2	8.9	2.5	1.6	1	1428.4	606	38.9	8.8	3.2	1.3		
	Resolver	Before			6348.2	4478.9	282.9	50.6	12.6	1.2	6352.7	5182.2	1657.5	355.7	158.7	59.9		
		After			719.9	229.6	7.3	1.4	0.9	0.4	1142.9	460.3	32.9	7.1	2.5	0.6		

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts					
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
		30 ppm	IPA	Before	15711.6	11360.6	668.6	105.4	28.1	2.2	16547.5	14226	4424.9	836.4	334.2	116.1
				After	913.4	291.4	3.8	0.8	0.4	0.1	1420.8	637.5	36.5	7.2	2.8	1
			Resolver	Before	16297.3	11654.9	594	79.5	21.3	1.5	16667.3	14275.5	4186.1	716.8	271.2	84.6
				After	757.1	238.1	4.8	0.9	0.6	0.1	1262.8	528.7	46.6	9.8	3	0.9
A-3	0.25 mg/L	0 ppm	none		411.1	248.1	22.7	8.3	4.0	1.1	250.6	146.8	30.0	4.8	2.3	0.9
		10 ppm	IPA	Before	4430.1	3265.7	236.0	51.2	16.7	2.9	3599.0	3202.6	1155.7	279.9	136.7	57.3
				After	77.1	32.0	3.3	1.5	1.0	0.5	93.3	39.6	2.9	0.7	0.4	0.2
			Resolver	Before	10673.3	7230.4	415.0	78.1	25.6	3.2	9089.0	7812.5	2314.4	496.8	229.9	95.6
				After	106.6	40.8	2.6	1.5	1.1	0.9	135.5	63.7	3.3	0.8	0.4	0.2
		15 ppm	IPA	Before	6100.8	4376.0	185.0	26.3	6.6	0.6	5702.4	4992.5	1461.3	239.7	98.6	32.7
				After	62.6	20.9	2.1	0.9	0.8	0.2	85.8	31.0	2.0	0.7	0.3	0.2
			Resolver	Before	5583.9	4049.4	175.1	23.8	6.0	0.6	5985.5	5253.9	1543.0	250.3	98.0	32.0
				After	83.0	29.6	2.4	1.5	1.0	0.6	106.0	43.9	3.1	0.9	0.5	0.3
		30 ppm	IPA	Before	16719.7	12258.6	900.3	198.7	77.9	15.5	17292.9	15185.6	5002.1	1131.0	532.8	234.0
				After	142.5	51.4	2.7	1.7	1.5	1.0	193.0	86.4	5.2	1.6	0.9	0.4
			Resolver	Before	25470.9	17853.4	767.2	79.8	18.6	1.5	26237.4	22603.1	5816.8	847.3	281.9	77.7
After	91.9			28.4	1.7	0.6	0.4	0.3	130.6	37.6	3.9	1.7	1.1	0.8		
A-2	2.5 mg/L	0 ppm	none		7625.5	1985.3	8.1	2.0	1.0	0.3	10631.7	4852.4	62.0	5.7	1.9	0.9

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts					
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
		10 ppm	IPA	Before	6289.7	1646.9	38.9	7.1	3.1	0.8	9011.7	3921.5	194.6	46.5	17.0	7.5
				After	6723.6	1754.9	10.9	3.0	1.7	0.7	9468.2	4288.2	72.6	7.7	3.0	1.4
			Resolver	Before	6599.6	1828.6	72.3	15.6	6.5	1.7	9400.8	4086.0	236.6	79.1	33.2	13.6
				After	6912.5	1770.5	9.3	1.6	0.8	0.4	9854.1	4432.4	67.2	7.4	3.0	1.3
		15 ppm	IPA	Before	7312.4	2942.0	146.8	23.4	8.0	1.1	9704.1	5023.5	986.2	181.6	64.0	22.3
				After	7295.9	2112.4	12.5	2.2	0.8	0.4	10055.5	4843.7	107.2	9.8	2.9	0.9
			Resolver	Before	6465.3	2330.4	91.3	15.7	5.5	1.2	8753.2	4195.8	630.7	102.6	38.4	14.3
				After	5267.4	1196.5	8.9	1.6	0.6	0.3	7813.0	3167.9	59.3	10.0	3.9	1.7
		30 ppm	IPA	Before	16981.1	11147.5	1025.1	241.4	97.0	16.6	19834.8	14976.8	4658.3	1102.4	497.7	210.3
				After	7525.2	2211.0	15.4	2.4	1.3	0.4	10377.2	4988.2	132.6	13.7	4.0	1.5
			Resolver	Before	17462.7	11488.1	1032.6	251.9	100.4	18.2	19599.1	14758.9	4707.0	1092.5	495.8	213.1
				After	5953.4	1545.4	15.6	3.4	1.6	0.6	8632.9	3765.7	98.7	15.8	6.0	2.7
A-2	2.0 mg/L	0 ppm	none		5896.8	1377.7	27.6	5.6	2.6	0.7	9891.4	3068.4	124.2	30.9	12.6	5.2
		10 ppm	IPA	Before	5647.2	1606.2	93.6	23.7	10.9	2.3	9321.5	3037.7	341.4	110.4	46.7	22.2
				After	5556.1	1312.4	44.4	9.9	4.0	0.9	9294.0	2811.6	135.2	29.7	10.5	3.4
		10 ppm	Resolver	Before	5983.3	1826.1	84.3	18.2	7.8	1.6	9657.0	3413.2	367.2	95.3	40.2	16.9
				After	4476.4	828.0	9.7	2.4	1.1	0.3	8277.9	2273.2	54.0	9.8	3.0	1.0
		15 ppm	IPA	Before	7032.9	2910.5	165.8	33.6	12.9	2.7	10430.7	4543.3	902.2	209.6	76.6	31.1

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive	ACM 20 counts						SETA counts						
				≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	
A-2	1.0 mg/L	30 ppm	none	After	5281.8	1243.4	29.6	6.4	3.1	0.9	8985.7	2744.9	114.0	23.3	7.9	2.9
				Before	7424.1	3161.4	103.4	14.4	5.2	0.6	10588.0	4907.7	877.5	106.5	34.8	11.6
			Resolver	After	4209.7	800.6	15.2	4.4	2.4	0.6	7671.0	1984.6	43.3	11.3	5.0	2.4
				Before	13724.1	9154.7	439.4	71.9	23.9	4.3	17643.6	13539.1	3442.8	505.8	184.1	63.7
			IPA	After	2072.7	544.8	27.0	7.0	3.7	1.3	3487.6	1123.9	76.0	16.7	6.0	2.2
				Before	7509.9	5492.3	216.5	24.6	6.4	1.2	8648.5	7156.0	2319.2	261.0	79.9	19.1
		Resolver	After	685.6	160.8	7.9	2.3	1.6	0.8	1230.6	376.9	25.8	8.1	4.0	2.6	
			Before	4007.4	980.2	24.9	6.9	3.1	0.9	6351.8	2011.8	53.0	8.8	3.4	1.2	
		10 ppm	IPA	Before	7270.9	3618.5	264.9	63.6	20.6	2.8	8960.2	4703.5	1116.1	306.0	155.8	72.1
				After	3884.1	955.1	31.5	8.3	3.3	1.3	6262.8	2113.1	103.1	28.4	14.3	7.5
			Resolver	Before	5674.7	2422.9	169.6	39.2	15.5	2.2	7842.3	3809.1	750.4	213.1	112.4	55.1
				After	3447.4	807.5	22.6	6.4	3.0	0.9	5718.3	1850.5	70.4	19.1	8.0	3.7
IPA	Before		9900.7	5705.8	403.1	98.1	37.0	7.1	12344.2	7977.8	1975.5	504.1	253.6	119.2		
	After		3699.5	901.4	24.9	7.1	3.4	0.9	5961.1	1989.7	90.4	24.2	10.5	4.3		
Resolver	Before	10334.5	6099.3	381.5	69.7	20.4	2.7	13394.6	8863.0	2205.8	504.0	218.1	86.6			
	After	3288.4	765.9	21.9	4.9	1.9	0.8	5540.8	1770.4	76.2	21.7	9.4	3.9			
30 ppm	IPA	Before	18314.5	12290.4	959.1	196.7	64.8	7.4	21564.5	16635.8	4769.7	1152.6	547.0	239.6		
		After	3515.7	855.7	22.9	5.1	2.6	0.5	5618.8	1926.3	98.4	25.4	10.9	4.1		

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts					
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
			Resolver	Before	25803.7	16377.4	1221.7	251.4	90.2	11.9	31618.0	22746.0	5642.0	1371.9	656.5	283.7
				After	3304.6	775.0	16.2	2.9	1.1	0.1	5530.8	1847.0	89.4	23.1	9.3	3.5
A-2	0.5 mg/L	0 ppm	none		2153.8	512.7	11.7	2.4	1.1	0.1	3511.5	1181.9	47.9	12.7	6.0	3.2
		5 ppm	IPA	Before	2579.0	898.6	60.8	12.8	4.9	1.1	3979.2	1611.9	238.5	78.8	35.7	17.1
				After	2131.1	505.4	15.3	3.0	0.9	0.4	3513.9	1139.0	47.3	10.2	4.0	1.5
		5 ppm	Resolver	Before	2586.3	899.4	63.6	18.4	7.5	1.8	3881.6	1555.7	243.2	78.2	37.7	19.7
				After	2045.5	485.4	14.9	3.5	1.6	0.6	3426.5	1107.4	50.1	12.7	4.8	1.9
		10 ppm	IPA	Before	4083.9	2263.5	198.9	45.5	17.6	3.2	5306.7	3086.2	972.3	252.3	118.6	54.3
				After	1995.6	478.6	14.8	3.6	1.6	0.6	3312.8	1075.3	49.0	12.4	4.8	2.2
			Resolver	Before	5212.6	2972.1	222.9	52.1	20.8	3.3	6354.6	3999.3	1140.5	274.1	131.2	57.6
				After	1848.1	398.7	9.1	1.7	0.9	0.3	3198.8	974.8	41.0	9.1	3.8	1.2
		15 ppm	IPA	Before	4451.5	2612.2	250.9	59.9	22.3	3.4	5457.0	3057.3	1109.5	304.5	133.3	59.2
				After	2027.9	467.1	13.3	3.6	1.6	0.4	3431.5	1059.9	49.7	11.5	4.3	1.4
			Resolver	Before	8604.0	5485.1	365.7	81.1	31.3	6.1	10157.7	7502.5	2032.4	442.5	209.1	93.7
				After	1820.2	404.1	12.1	2.4	1.3	0.7	3118.0	951.0	43.1	11.8	5.9	2.7
		A-2	0.25 mg/L	0 ppm	none		1269.5	285.1	7.9	1.8	0.6	0.1	2204.0	685.6	26.8	7.1
10 ppm	IPA			Before	3397.9	1996.0	142.0	27.2	7.7	1.1	4115.4	2486.3	803.4	172.2	77.1	32.9
				After	1287.9	294.6	8.6	2.1	1.1	0.1	2251.1	681.1	31.9	7.3	2.9	0.9

Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts							
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um		
		15 ppm	Resolver	Before	2447.1	1319.3	107.5	24.4	8.0	1.1	3134.8	1661.0	504.1	119.8	57.7	24.7		
				After	1177.1	247.1	7.6	1.9	0.9	0.5	2206.6	642.7	46.7	17.2	8.8	4.6		
			IPA	Before	5700.9	3813.7	291.3	62.6	20.4	3.2	6385.3	4578.3	1602.5	347.7	158.2	66.3		
				After	1357.8	321.7	10.9	3.1	1.7	0.4	2267.1	686.4	28.3	4.0	1.2	0.3		
		Resolver	Before	7311.1	4766.1	385.9	93.8	35.4	6.1	9064.6	6709.9	1947.8	450.7	212.5	93.0			
			After	1078.6	224.6	6.4	1.6	0.9	0.5	1875.5	523.1	13.5	2.0	0.7	0.2			
		30 ppm	IPA	Before	16422.8	11720.1	834.8	182.6	69.2	12.6	17972.3	14862.5	4525.5	917.7	404.7	167.9		
				After	1248.1	288.1	6.9	1.6	0.6	0.2	2134.5	662.9	25.5	4.5	1.5	0.6		
			Resolver	Before	12907.6	9121.4	409.7	57.3	16.1	2.1	14125.6	11702.6	3267.3	478.7	167.3	52.7		
				After	1057.1	231.0	14.5	7.1	4.8	3.0	1866.0	520.0	19.2	5.7	3.2	1.9		
		A-1	2.5 mg/L	0 ppm	none		16698.1	4660.4	12.7	1.5	0.8	0.1	22123.2	10252.0	138.2	11.5	2.9	0.7
				10 ppm	IPA	Before	18789.3	6885.4	221.5	49.9	16.6	1.8	23379.0	12153.0	997.1	224.2	101.4	41.2
After	15677.0					4448.4	15.8	1.6	0.7	0.1	20750.0	9812.0	135.8	11.0	3.2	1.5		
Resolver	Before			18260.8	6320.2	187.4	40.1	12.9	1.6	23289.0	11718.1	824.3	190.3	87.9	35.7			
	After			16047.1	4494.3	13.8	2.2	1.1	0.6	21537.2	10130.9	114.3	6.9	2.3	1.0			
15 ppm	IPA			Before	18960.4	7214.0	203.1	37.1	10.3	0.8	23683.5	12459.4	1219.2	226.0	95.3	35.4		
				After	15893.0	4470.8	16.6	1.8	0.8	0.4	21195.1	9906.6	134.8	10.4	2.9	0.8		
	Resolver			Before	17786.8	6399.5	174.7	29.6	7.6	0.7	22429.7	11338.6	956.4	179.8	75.2	27.2		

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Table D-1. Cosolvent Test Results – Raw Data Counts

Test Dust	Dust Concentration	Water Concentration	Bottle Additive		ACM 20 counts						SETA counts					
					≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um
A-1	2.0 mg/L	30 ppm	none	After	15200.1	4117.4	10.6	1.0	0.6	0.1	20635.9	9446.7	106.1	8.5	2.3	0.8
				Before	26036.8	14240.7	850.6	154.6	52.3	8.6	29825.3	19742.0	4729.5	893.0	365.7	139.6
		30 ppm	IPA	After	16493.1	4872.2	22.1	4.1	2.1	1.0	21507.4	10235.3	174.3	15.6	4.9	1.8
				Before	25434.9	13736.0	660.6	94.4	23.8	1.9	29062.4	18995.4	4254.5	706.2	259.6	81.6
		30 ppm	Resolver	After	13612.1	3364.7	13.0	2.5	1.9	1.3	19224.3	8286.7	92.9	12.0	4.3	1.6
				Before	12541.5	3309.6	14.6	3.4	1.7	0.4	16707.9	8088.5	94.4	6.4	2.7	1.4
		10 ppm	IPA	Before	16353.0	6855.7	309.7	65.1	22.9	2.4	19115.4	10649.8	1354.0	295.7	134.2	53.6
				After	12096.6	3410.4	11.1	1.7	0.6	0.4	15982.4	7869.6	98.1	7.0	2.0	0.8
		10 ppm	Resolver	Before	13934.9	4945.1	197.1	46.6	16.9	2.4	17623.8	8993.5	778.8	181.3	87.9	38.3
				After	11636.6	3128.1	11.4	2.1	1.3	0.4	16284.1	7893.2	94.8	6.4	2.2	1.1
15 ppm	IPA	Before	14713.5	6009.6	288.2	64.1	22.8	3.0	18297.5	10089.5	1393.3	292.3	133.3	55.0		
		After	11800.2	3328.3	11.1	1.7	0.8	0.2	15833.4	7691.6	100.3	6.6	2.0	0.8		
15 ppm	Resolver	Before	14662.6	6062.9	272.2	60.7	20.1	3.1	17846.2	9789.5	1292.5	261.7	177.5	47.0		
		After	10668.3	2825.4	11.9	2.6	1.6	0.9	15059.0	7061.7	100.4	12.4	3.9	1.6		
30 ppm	IPA	Before	19289.3	10688.1	735.2	163.8	59.9	10.6	21831.1	14163.7	3574.7	727.7	318.7	126.5		
		After	11213.9	3127.2	13.6	2.3	1.6	0.9	15147.7	7327.4	126.1	11.0	3.4	1.3		
30 ppm	Resolver	Before	25180.4	15654.7	1249.8	282.0	103.3	14.4	28204.3	20322.5	5702.5	1223.5	548.2	225.5		
		After	10677.2	2923.5	23.0	5.5	3.9	2.4	14527.6	6760.4	126.6	16.1	5.6	2.5		

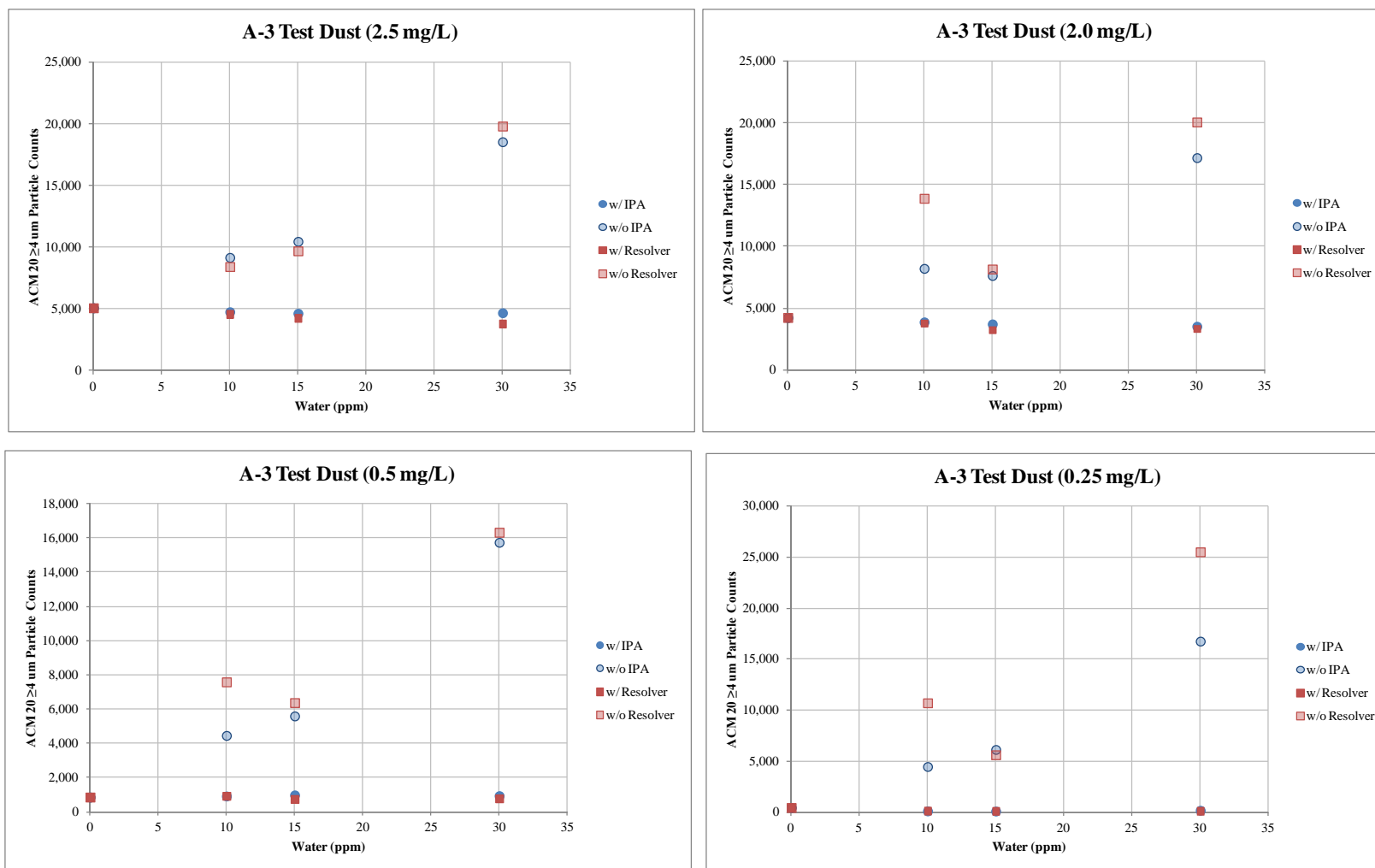


Figure D-1. A-3 Test Dust Cosolvent Results - $\geq 4 \mu\text{m}$ Particle Count Channel

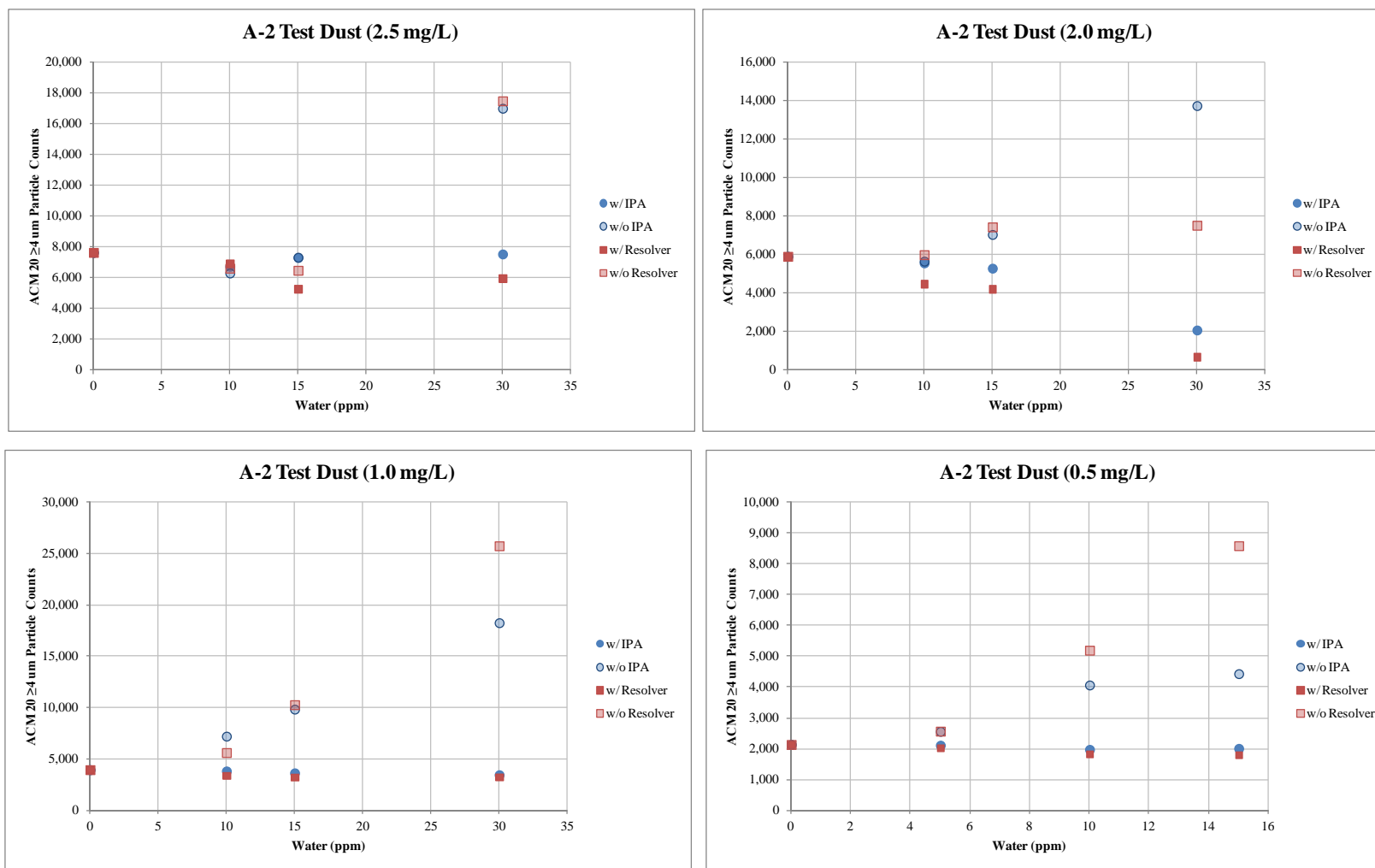


Figure D-2. A-2 Test Dust Cosolvent Results - $\geq 4\mu\text{m}$ Particle Count Channel

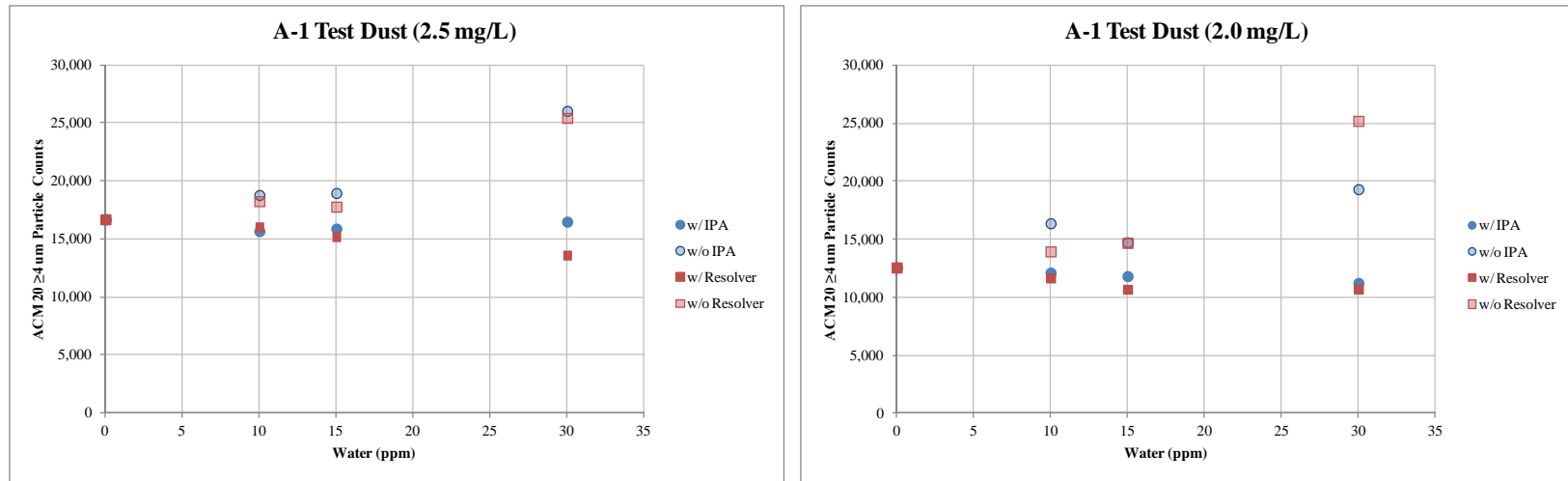


Figure D-3. A-1 Test Dust Cosolvent Results - $\geq 4\mu\text{m}$ Particle Count Channel

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APPENDIX E. Entrained Air Method Development - Data

Table E-1. Entrained Air Test Results – Raw Particle Counts

Flow Rate	Fuel Temp	Free Water	Dirt Conc.	Air Inj.	ACM 20 counts						SETA counts					
					GP M	°F	ppm	mg/L	psi	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um
30.3	54	0.0	0	0	3.1	0.6	0.0	0.0	0.0	0.0	5.9	1.6	0.1	0.0	0.0	0.0
30.3	55	0.0	0	40	6.8	1.8	0.1	0.0	0.0	0.0	15.6	8.5	1.8	0.5	0.4	0.4
30.3	55	0.0	0	80	3.1	0.9	0.1	0.1	0.1	0.1	7.9	3.1	0.7	0.1	0.1	0.0
29.4	55	0.0	0	120	4.9	1.5	0.1	0.1	0.0	0.0	8.1	2.7	0.4	0.1	0.0	0.0
31.1	55	0.0	0	200	88.5	31.7	6.1	3.2	0.6	0.3	92.7	35.5	12.9	5.1	3.4	2.0
28.9	55	0.0	0	150	338.9	236.9	64.0	27.4	12.6	3.7	157.5	94.0	45.9	20.5	12.5	8.3
32.9	55	0.0	0	300	20.1	7.3	0.9	0.1	0.0	0.0	26.7	7.5	1.8	0.7	0.5	0.3
31.4	55	0.0	0.25	0	121	307	5.7	7.3	0.9	0.4	1986	608	15.0	2.8	1.2	0.1
32.0	55	0.0	0.25	150	110	274	9.1	4.4	0.7	0.4	1817	553	15.0	2.8	1.1	0.3
33.2	55	0.0	0.25	250	944	231	2	4.4	0.9	0.4	1626	492	11.8	2.5	0.7	0.2
26.7	55	0.0	0.25	0	136	352	9.3	6.1	1.4	0.4	2490	798	25.2	5.4	2.3	1.1
31.1	55	17.1	0	0	618	459	0	202	137	95	459	419	267	159	126	102
31.6	55	24.0	0	150	573	466	6	223	159	114	479	414	257	153	119	94
31.0	55	14.7	0	250	548	415	2	189	133	96	441	364	217	128	100	81
23.3	55	15.2	0	0	492	384	8	167	117	80	412	340	196	11	83	65
30.8	55	9.3	0.25	0	178	633	9.1	144	98	71	2207	870	212	120	91	72
33.3	55	7.4	0.25	150	147	612	1.0	180	127	90	2031	799	189	106	81	65
29.2	55	14.7	0.25	250	135	579	7.7	167	114	84	1880	783	217	124	96	78
28.9	55	20.8	0.25	0	188	864	7.9	220	138	94	2251	958	255	135	102	79
31.0	55	0.1	0.25	0	103	254	1.1	5.5	1.0	0.6	1716	515	18.0	5.6	3.1	1.9
31.3	55	0.0	0	0	21.8	5.1	0.4	0.0	0.0	0.0	53.2	3	1	7.1	5.5	4.1

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Table E-2. Entrained Air Test Results – ISO 4406 Particle Count Codes

Flow Rate	Fuel Temp	Free Water	Dirt Conc.	Air Inj.	ACM 20 codes						SETA codes					
					GP M	°F	ppm	mg/L	psi	≥4 um	≥6 um	≥14 um	≥21 um	≥25 um	≥30 um	≥4 um
30.3	54	0.0	0	0	9	>6	>0	>0	>0	>0	10	8	4	0	0	0
30.3	55	0.0	0	40	10	8	>3	>0	>0	>0	11	10	8	6	6	5
30.3	55	0.0	0	80	9	7	>4	>4	>3	>3	10	9	6	0	0	0
29.4	55	0.0	0	120	9	8	>4	>4	>0	>0	10	9	6	4	0	0
31.1	55	0.0	0	200	14	12	10	9	>6	>5	14	12	11	10	9	8
28.9	55	0.0	0	150	16	15	13	12	11	9	14	14	13	12	11	10
32.9	55	0.0	0	300	12	10	7	>4	>0	>0	12	10	8	7	6	6
31.4	55	0.0	0.25	0	17	15	10	7	>6	>3	18	16	11	9	7	4
32.0	55	0.0	0.25	150	17	15	9	7	>6	>4	18	16	11	9	7	6
33.2	55	0.0	0.25	250	17	15	9	7	>6	>3	18	16	11	8	7	5
26.7	55	0.0	0.25	0	18	16	10	8	>6	>0	18	17	12	10	8	7
31.1	55	17.1	0	0	16	16	15	14	14	13	16	16	15	15	14	14
31.6	55	24.0	0	150	16	16	15	14	14	13	16	16	15	14	14	14
31.0	55	14.7	0	250	16	16	15	14	14	13	16	16	15	14	14	14
23.3	55	15.2	0	0	16	16	15	14	14	13	16	16	15	14	14	13
30.8	55	9.3	0.25	0	18	16	14	14	13	13	18	17	15	14	14	13
33.3	55	7.4	0.25	150	18	16	15	14	14	13	18	17	15	14	14	13
29.2	55	14.7	0.25	250	18	16	15	14	14	13	18	17	15	14	14	13
28.9	55	20.8	0.25	0	18	17	15	14	14	13	18	17	15	14	14	13
31.0	55	0.1	0.25	0	17	15	10	7	>6	>5	18	16	11	10	9	8
31.3	55	0.0	0	0	12	10	>0	>0	>0	>0	13	12	11	10	10	9