Minimal Sample to Sample carry over with the newly designed HIAC 8011+

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Sample to sample carry over is a significant contributor to inaccurate and unreliable particle count measurements in industrial fluids which can severely impact manufacturing operations, maintenance, and quality control costs. The new HIAC 8011+ has been specifically designed to dramatically minimize this contribution of contamination.

In this application note, we demonstrate this unique feature which will set an industry leading trend and best practice design for Particle Counting instruments used for Predictive Maintenance (PdM).

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Introduction

A reliable, reproducible and accurate particle count measurement is a critical requirement in any predictive maintenance (PdM) program. The primary function of an effective PdM is to perform value added maintenance and/or service when necessary rather than performing scheduled service that can either be too early or even worse, too late. A particle count sample that has been compromised by the residue of a previous sample is therefore an unreliable measurement and failure for obvious reasons.

Several factors can contribute to the severity of the “sample to sample carryover” phenomenon. These factors include but are not limited to previous sample contamination level, viscosity, fluid miscibility, and flow rate, however, the particle counter fluid delivery system is considered to play a highly significant role and frequently is the primary factor. The new HIAC 8011+ particle counting system design provides a distinct advantage on this issue due to its minimal dead volume (~1.8ml) and high pressure to facilitate delivery of the sample through the system. The flow path of the new HIAC 8011+ has been designed to minimize the amount of sample to sample carryover by introducing a new feature of small volume requirement of residual fluid to be purged before an accurate measurement of the new sample can begin.

Proper sample preparation is another significant factor which can help to minimize the carryover phenomenon. Excessive wait times between sample runs, using a blank or clean fluid between the sample runs, and a sample probe wipe down with a lint free cloth are helpful, but can be both time consuming and cost prohibitive.

In this application note, we describe a simple experimental protocol to validate the minimal sample to sample carryover when the new HIAC 8011+ is used to measure the particle count level.

Method

8011+ System Setup	
Recipe Name	Sample2Sample Carryover
Number of samples / run	3
Sample volume	10ml
Tare	5ml
Reporting method	Counts/ml
Channel sizes	4, 6, 10, 14
System sample pressure	70 ±2 PSI
Initial sample pressure	50 PSI

Materials:

Prepare clean Mil-H-5606 Hydraulic oil sample

1. Blow out 4 ea. new unused, 120ml sample bottles for 5 seconds with clean dry air.
2. Dispense 500ml of clean fluid evenly into the 4 clean bottles to the shoulder.

Prepare Contaminated 5606 Hydraulic oil sample

1. Blow out 2 ea. new unused, 120ml sample bottles for 5 seconds with clean dry air.
2. After proper agitation, dispense 250ml of the reference fluid evenly between the clean bottles to the shoulder.

Procedure

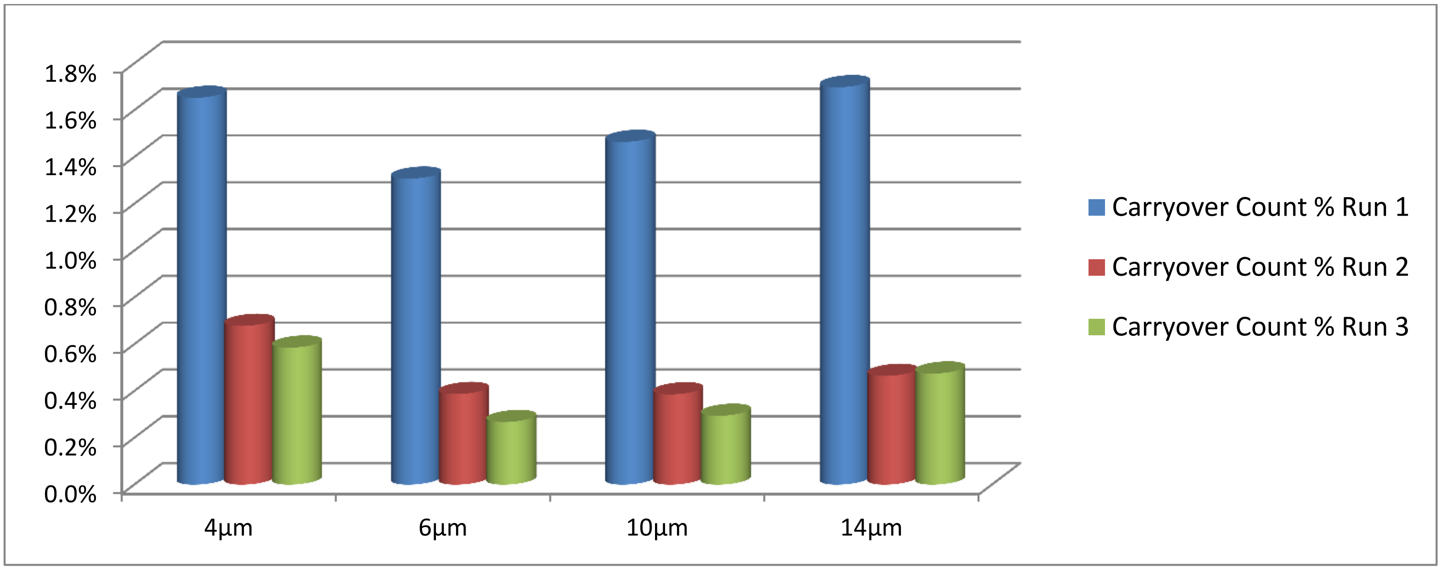
1. Turn on 8011+ system and insert a clean sample of the 5606 fluid into the sample chamber and lock it down. Start a sample measurement and set pressure to 70 ±2 PSI
2. Flush the system with ~30ml of the clean fluid to wet the entire flow path.
3. Setup a custom recipe for 3 Runs, 10ml Volume, 5ml Tare, and reports to Counts/ml
4. Shake a new clean fluid sample for 30 seconds, degas for 30 seconds, let stand for 60 seconds, and then install into the pressure chamber and run the recipe. Label this record as "Baseline run counts"
5. Remove the Clean fluid bottle from the chamber
6. Prepare the Reference sample by agitating for 1 minute, degas 30 seconds, and then install into the pressure chamber and press "start recipe".
7. Label this record as "Dirty run counts".
8. Remove the Dirty fluid from the chamber.
9. Shake another clean fluid sample for 30 seconds, degas for 30 seconds, let stand for 60 seconds, and then install into the pressure chamber and run the recipe. Label this record as "Carryover run counts Test 1"
10. Compare the counts between the Dirty and carryover runs and Compute the Carryover Count % difference between the Dirty runs to Carryover run counts Test 1.
11. Repeat all steps of the procedure for Test 2 except perform a tubing wipe down after step 8 for the 2nd round of testing.
12. Tables 1 and 2 and the graph on the subsequent pages reflect the results of the both Test regimes.

Carryover Count Results Test 1

Channel Size	Baseline run counts Test 1			Dirty run counts Test 1			Carryover run counts Test 1			Carryover Count %		
	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3	Run 1	Run 2	Run 3
4µm	49.8	45.0	42.9	7623.4	7696.3	7754.8	126.0	52.2	45.4	1.7%	0.7%	0.6%
6µm	9.3	8.4	8.4	2745.8	2764.2	2767.2	35.9	10.7	7.4	1.3%	0.4%	0.3%
10µm	2.2	2.6	2.7	641.8	648.1	646.3	9.4	2.5	1.9	1.5%	0.4%	0.3%
14µm	1.2	1.2	1.5	212.0	215.2	210.7	3.6	1.0	1.0	1.7%	0.5%	0.5%

Table 1

Carryover Count Percentage



Graph 1

Carryover Count Results Test 2 (includes tube wipe down)

Channel Size	Baseline run counts Test 2			Dirty run counts Test 2			Carryover run counts Test 2			Count % difference from Dirty to Carryover run Test 2		
	Run 1	**Run 2**	**Run 3**	**Run 1**	**Run 2**	**Run 3**	**Run 1**	**Run 2**	**Run 3**	**Run 1**	**Run 2**	**Run 3**
4µm	41.6	41.6	44.9	8118	8210.8	8096.6	120.5	47.2	46.8	1.5%	0.6%	0.6%
6µm	6.8	6.3	7.2	2825.8	2840.5	2767.9	34.7	9.8	9.9	1.2%	0.3%	0.4%
10µm	2.2	1.9	2.1	644.2	648.3	625.4	12	2.7	3.6	1.9%	0.4%	0.6%
14µm	0.8	0.8	0.4	214.4	206.3	198.3	4.6	1.3	1.3	2.1%	0.6%	0.7%

Table 2

Conclusion

Using the newly designed 8011+, this testing clearly demonstrated a minimal sample carryover result where only small volume of fluid was required to successfully purge the previous sample. Within the control parameters, (Mil –H-5606 fluid, ambient temperature, 1 minute wait period after dirty sample to approximate a typical test lab wait period between samples, etc.) this testing clearly showed as per **Table 1** and **Graph 1** that after a contaminated sample was run, the amount of carryover count residual remaining on the sample probe (both inside and outside) was ≤ 1.7% on the subsequent run immediately following the contaminated run. After running 20ml of clean fluid the residual count influence was ≤ 0.6 % on all channels. In **Table 2** the experiment involved wiping of the outside of the sample tube with a lint free wipe before the clean sample was run. The carryover counts for run 1 of Test 2 were very similar to the run 1 of Test 1 carryover counts illustrated in **Table 1.** For these control parameters the wipe down showed a negligible improvement. This testing clearly demonstrates the unique and industry leading capability of the new 8011+, and gives the user high confidence of particle measurement integrity.

About the author

Bill F. Bars is an Application Engineer / Scientist for Beckman Coulter Life Sciences in Grants Pass, Oregon, USA. He has created and developed many of the liquid systems production processes and procedural tools for the BEC Particle products. These products include but are not limited to the following HIAC branded products: 8011+, PODS, GlyCount, 9703+, ROC, and HRLD Sensors. He received his Electronics Engineering degree from DeVry Institute of Technology. He has worked for Beckman Coulter Life Sciences for 17 years in a multitude of engineering capacities ranging from Metrology to Service Training and Application Support. He is a member of the NFPA U.S. TAG to ISO/TC 131/SC 6 - Contamination control group. Email Bill F. Bars at: bbars@beckman.com

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