

## Summary

While trace metal grade (1ppb) acids are suitable for use with ICP-OES, the lower detection limits of ICP-MS require the use of high purity grade (10 ppt) acids when preparing standards and diluting samples prior to analysis by ICP-MS. The Savillex DST-1000 Acid Purification System is a sub-boiling still manufactured from PFA that produces high purity acid from cheaper, lower grade acids. The cost savings resulting from producing high purity acid using the DST-1000 compared to buying commercial high purity acid are significant. Depending on acid usage in the lab, a DST-1000 can pay for itself in months or even weeks. This technical note gives some examples of return on investment (ROI) calculations.



Savillex DST-1000 Acid Purification System

## ROI Calculations

The DST-1000 produces 10 ppt grade acid for virtually the same price as the 1 ppb grade acid feedstock it uses. The only additional costs are electricity (which at 70W can be assumed to be negligible) and the feedstock acid typically discarded after each run (50-100 mL for each batch of 1000 mL distilled). To allow for the small acid wastage we will add 10% to the price of the 1 ppb feedstock acid. The ROI calculation is the difference between the price of 1 ppb grade and 10 ppt grade acid multiplied by the acid usage in the lab. Acid prices used are typical discounted US prices. The monthly cost savings are then applied to the purchase price of the DST-1000 to give a payback time. High purity acid costs vary significantly depending on the acid type: HF is the most expensive. Four ROI scenarios are given below for  $\text{HNO}_3$  in a lab using 2 L of high purity acid per month and a large lab using 6 L acid per month. Calculations for HF are also shown but in this case lower usage is assumed: 1 L per month for an average lab and 3 L per month for a large lab. In each case, payback time is calculated.

Example - Average Lab, Using $\text{HNO}_3$	
Price paid for commercial high purity (10 ppt) grade acid (per liter)	\$400
Liters of high purity acid used by the lab per month	2
Price paid for trace metal (1 ppb) grade acid (per liter)	\$50
Monthly acid savings	\$700
US purchase price of DST-1000	\$4,722
Months it will take DST-1000 to pay for itself	6.7
Net savings over first three years (including paying for DST-1000)	\$20,478

Example - Large Lab, Using $\text{HNO}_3$	
Price paid for commercial high purity (10 ppt) grade acid (per liter)	\$400
Liters of high purity acid used by the lab per month	6
Price paid for trace metal (1 ppb) grade acid (per liter)	\$50
Monthly acid savings	\$2,100
US purchase price of DST-1000	\$4,722
Months it will take DST-1000 to pay for itself	2.2
Net savings over first three years (including paying for DST-1000)	\$70,878

Example - Average Lab, Using HF <sub>3</sub>	
Price paid for commercial high purity (10 ppt) grade acid (per liter)	\$1,000
Liters of high purity acid used by the lab per month	1
Price paid for trace metal (1 ppb) grade acid (per liter)	\$140
Monthly acid savings	\$860
US purchase price of DST-1000	\$4,722
Months it will take DST-1000 to pay for itself	5.5
Net savings over first three years (including paying for DST-1000)	\$26,238

Example - Large Lab, Using HF	
Price paid for commercial high purity (10 ppt) grade acid (per liter)	\$1,000
Liters of high purity acid used by the lab per month	3
Price paid for trace metal (1 ppb) grade acid (per liter)	\$140
Monthly acid savings	\$2,580
US purchase price of DST-1000	\$4,722
Months it will take DST-1000 to pay for itself	1.8
Net savings over first three years (including paying for DST-1000)	\$88,158

As can be seen, payback time of the DST-1000 ranges from 6.7 months to less than two months. The amount of acid used and also the cost of the acid have a large impact on payback time. Also shown are the net savings generated by the DST-1000 over the first three years of ownership, including paying for the DST-1000. The savings generated are very significant, especially for high usage labs and higher cost acids such as HF.

### DST-1000 Acid Quality

Although the cost savings achieved using the DST-1000 have been demonstrated above, an important point to consider is the impact on ICP-MS data quality. From the instant a bottle of high purity acid is first opened its quality degrades, and some contamination occurs every time the bottle is opened. With the DST-1000, high purity grade acid is freshly produced on demand and is always of the same quality as commercial high purity acid the very first time the bottle was opened. In addition, having high purity acid for the price of trace metal grade means that, for the first time, high purity acid can be used for sample digestions or even cleaning, which will further reduce the analytical blank and improve ICP-MS data quality.