Technical Overview

Agilent
Trusted Answers

Smart Health Checks for ICP-MS

Your Agilent ICP-MS is a modern instrument which provides predefined method templates, auto-optimization routines, performance checks, and self-diagnostic sensors and monitors to streamline your method setup and routine operation. These built-in capabilities replicate the level of expertise of an experienced operator, helping you avoid unproductive time traps in ICP-MS analysis.

Performance report

The instrument performance report automatically completes a series of analytical tests including sensitivity, oxide ratio, doubly charged ratio, background, mass calibration and resolution, simply by using the multielement tuning standard.

The performance test can be set to run automatically after plasma ignition, giving a continuous record of system performance and any changes day to day. The test can also be scheduled to run after the final sample batch of an unattended run. By checking the report and performing any recommended maintenance or optimization before you start the next day's analysis, you can save valuable time.

What if my performance test fails?

Performance test results are conveniently recorded in the performance log, which then provides a comprehensive reference for the performance history of your ICP-MS (see Fig. 1).

The Performance test report PASS or FAIL criteria are based on sensible, default performance targets, which are fully configurable to any situation. Maintenance feedback is provided for any checks that do not meet the target performance, giving guidance for what maintenance task should be performed (see Fig. 2).

				Sensitivity					Background			Tune Parameters Ion Lenses		
	Created Date	Performance Check	Run at End	Channel 1 Count	Channel 2 Count	Channel 3 Count	Oxide Ratio	Doubly Charged Ratio	Channel 1 Count	Channel 2 Count	Channel 3 Count	Extract 1	Extract 2	Omega Bias
▶	16/09/20 10:07:44	Passed	No	9281.40	18664.24	12519.63	1.20 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	16/09/20 09:04:37	Failed	No	9312.15	18675.40	12496.33	2.21 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	09/09/20 14:24:33	Passed	Yes	9286.99	18664.76	12488.76	1.20 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	09/09/20 10:31:20	Passed	Yes	9280.51	18634.02	12493.78	1.21 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	09/09/20 09:58:02	Passed	No	9303.23	18606.10	12479.15	1.21 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	08/09/20 17:22:22	Passed	No	9291.25	18643.34	12519.42	1.22 %	0.90 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	07/09/20 10:56:17	Passed	Yes	9312.36	18649.24	12495.62	1.20 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	07/09/20 10:27:20	Passed	No	9300.89	18660.02	12504.68	1.22 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V
	25/08/20 13:24:02	Passed	No	9312.15	18675.40	12496.33	1.21 %	0.91 %	0.00	0.00	0.00	0.0 V	-190.0 V	-90 V

Figure 1. Startup and end of run performance PASS or FAIL checking standard.

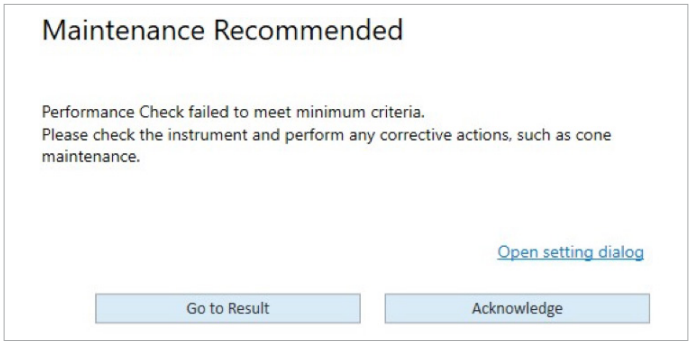

Figure 2. Guided maintenance gets you back to peak performance quicker.

How to prevent nebulizer blockage

The standard nebulizer fitted to Agilent ICP-MS systems is a micro-flow concentric nebulizer, typically operated at an uptake rate between 100 and 400 µL/min (see Fig. 3). These nebulizers have a machined, constant internal diameter capillary that is resistant to clogging. However, if a sample contains relatively large (micron size) suspended particles, these may clog the back of the nebulizer capillary. For such samples, an optional "high solids" nebulizer should be used.

To maintain a healthy nebulizer think "PREVENTION". Use only lint less wipes, autosampler enclosures and adjust the autosampler probe height off the bottom of the sample vial. Rinse at the end of sample analysis, never allow sample to dry in nebulizer and run 3-4 reagent blanks at end of a sample batch to rinse for at least 10 minutes before extinguishing the plasma.

Avoid aspiration of undissolved solids and particulates present in your sample by filtering/centrifuging/gravitational settling. Typically, an ICP-MS analysis requires around 1 to 2 mL of solution (less if discrete sampling is used), therefore syringe filters are a convenient choice for simple mechanical filtration. Agilent Captiva syringe filters provide an efficient solution. A PTFE membrane with 0.45µm pore size is appropriate for spectroscopy applications, e.g. Captiva Econofilters, 1000/pk (5190-5268)

Figure 3. Micro-flow nebulizer aerosol.

Cleaning the nebulizer

Never sonicate a glass concentric nebulizer or attempt to clean the capillary with wire, as this could easily damage the nebulizer tip. For normal cleaning soak in 5% nitric acid for approx. 10 mins.

To remove a nebulizer blockage use a dedicated nebulizer cleaning tool (see Fig. 4) to push cleaning solvent (e.g. methanol) through the tip; or reverse pump the nebulizer with the tip in solvent using the instrument peristaltic pump.

For salt deposits soak the nebulizer overnight in a beaker of 25% alkaline lab detergent, then rinse with pure water. For even more thorough cleaning you can soak the nebulizer overnight in conc. nitric acid. Use a pipette to ensure there are no air bubbles in capillary. Rinse thoroughly with pure water.

For more information see Nebulizer Tips and Guidelines for Usage

Figure 4. Nebulizer cleaning tool G3266-80020.

Figure 5. Easy-fit ICP-MS peristaltic pump tubing is optimized for the Agilent ICP-MS.

Don't neglect the pump tubing

Using peristaltic pump tubing for too long before replacement can lead to problems with precision and stability. Typical lifetime is 1-2 weeks (based on normal 5 day week, 8 hour working day). To extend lifetime unclamp tubing from the peristaltic pump after use, removing tension and compression on the rollers. Use the software function to enable post-run rotation of the pump at the end of unattended analysis. This will prevent the pump tubing becoming unevenly compressed. Don't over tighten the clamp when adjusting tension, you just need smooth and even sample flow.

Maintaining tubes – what to check? Two key things on pump tubing, roundness of tube and elasticity. There should not be any "flat" spots when rolled between thumb and fingers, and replace the pump tubing if obviously stretched.

Selecting which tubing should be used for an application is based on two key factors, resistance to the solvent in use and flow rate of sample required. Flow rate corresponds to the pump speed and the internal diameter of the tubing as indicated by the coloured tabs.

Figure 6. Change peri-pump tubing that looks or feels worn or has a strange colour. Ensure tabs are secure.

What to look for? Erratic liquid flow, check tension from clamps on peristaltic pump. Bubbles in the liquid stream, check tubing and connectors for deposits, kinks, burrs, damage. Bad recovery or carryover on "indicator" elements (Ag and platinum group elements – Ru, Rh, Pd, Os, Ir, Pt) that tend to become unstable first when the pump tubing has got an "active" internal coating.

Figure 7. Visually inspect the cones.

Pay attention to the interface cones

Why and When to Clean Your Interface Cones?
The maintenance interval for cone cleaning is dependent on the application and sample matrix, so the best advice is to use the instrument checks and software flags for typical performance indicators to develop your maintenance schedule. The necessity to clean the cones depends on analytical requirements for detection limits, sensitivity, precision (%RSD) and background (cps), but a general guide is to avoid excessive cone cleaning. If the instrument performance meets your requirements, then don't clean the cones.

Other reasons to clean the cones? Interface vacuum changing, if there is an excessive buildup of deposits on the orifice causing blockage, non-circular shape, or if the cone has become unusually discolored.

If analyzing different sample types where a major element in the first sample type is a trace element in the second, more extensive cleaning of the sample introduction system – including the cones – may be required.

Figure 8. Agilent's LED measuring magnifier (5190-9614) is a tool to help users achieve optimum ICP-MS instrument performance and maximum cone life.

A conditioned cone has a uniform coating that leads to long term stability.

What's the Right Way to Clean Interface Cones?
In order to preserve surface conditioning and maximize cone lifetime, the gentlest possible cleaning approach should be used – just enough to restore performance. For routine cleaning between batches of similar sample types a simple clean with pure water is often sufficient. Dip a cotton swab (9300-2574) in pure water and clean both sides of the cone, rinse with pure water, ultrasonicate the cones in pure water for at least 5 mins (preferably 20 mins) and repeat as required (aim for water to stay clean). Only if required clean with a 2% Citranox solution (5188-5359), ultrasonicating for max. 2-3 mins. Then rinse with pure water and ultrasonicate in pure water for at least 5 mins.

Condition new or cleaned cones prior to use. Conditioning reduces drift caused by deposition of sample matrix on the clean cone surface. Aspirate your sample matrix for 30 mins and then your blank/rinse solution for 10 mins. Alternatively aspirate 6020 Interference Check solution A (5188-6526) diluted 10 times in General Purpose mode for 30 mins.; follow with a 5% HNO_3 solution for 10 mins.

Are You Using the Right Interface Cone? These guides will help you pick the right sampling cone, skimmer cone, and skimmer base for your instrument configuration and application.

Check that you're using the right skimmer base, nickel-tipped skimmer cones use the stainless steel base, while platinum-tipped cones use the brass skimmer base. Using the wrong skimmer base means the skimmer cone is not operating at its optimum temperature, which can lead to reduced lifetime.

ICP-MS Cone Selection Guide

ICP-MS Selector

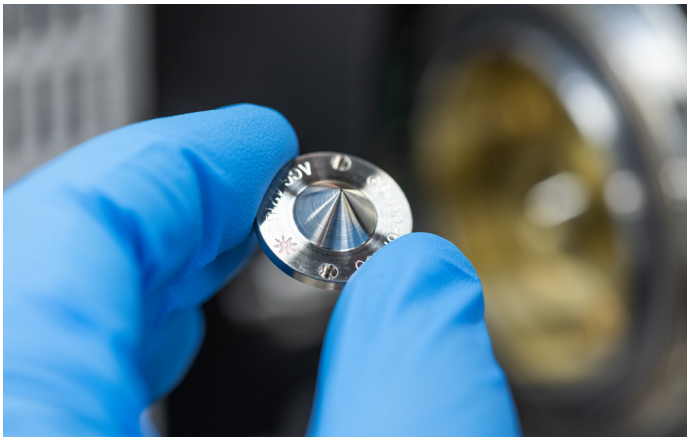

Figure 9. Brand new or thoroughly cleaned cones should be conditioned by running a moderate matrix prior to sample analysis. This creates an insulating coating that helps prevent drift.

Figure 10. Establishing routine maintenance procedures and utilizing smart self-health checks using Early Maintenance Feedback (EMF) can provide analysts with a simple means of identifying and correcting problems.

The right amount of maintenance – Early Maintenance Feedback (EMF)

Insufficient maintenance can degrade performance as well as causing unplanned downtime and unnecessary service calls. Poor performance leads to lower data quality and an increase in sample remeasurements. On the other hand, performing unnecessary maintenance wastes time and increases consumable costs, for no real benefit.

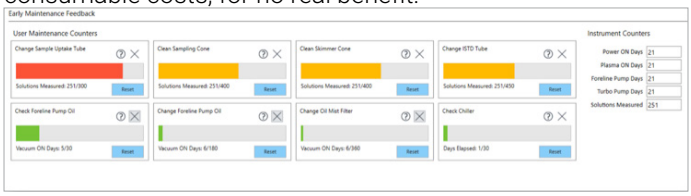

Figure 11. EMF sensors and counters determine when maintenance is needed, based on actual usage – rather than at pre-determined time intervals. Traffic-light color-coded alerts ensure maintenance tasks are never missed or done too frequently.

Recommended procedures at end of the day

1. Aspirate rinse solution for a few minutes before shutting off the plasma. Include additional rinse solutions at the end of unattended batches
2. Extinguish the plasma and switch off the chiller
3. Remove the sample capillary from the rinse, start the peristaltic pump again and pump any remaining rinse solution from the spray chamber
4. Release the pressure bars on the peristaltic pump tubing and remove the bridges from the securing slot, or check the option for post-run peripump rotation if running unattended
5. Empty waste vessel
6. Leave mains power and argon on to keep instrument in stand-by mode (ensures fastest start-up)

Need further guidance?

If you would like additional advice combined with tips and tricks to help ensure you are able to achieve the best performance, refer to the ICP-MS Resource Hub and the Smart Self-Health Checks guide:

ICP-MS Resource

Smart Self-Health Checks for ICP-MS Instruments

www.agilent.com/chem/icpms-healthcheck

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