

# AA Troubleshooting and Maintenance Guide

Tips, tricks, and good advice for ensuring your AA instruments achieve the best performance



## Introduction

The objective of this article is to present some real-world tips and tricks that can help you look after and maintain your atomic absorption (AA) instruments – and help you improve your analyses. Guidelines will be provided to help you with both troubleshooting and maintenance. Some of these tips may be familiar, but there should be at least a few new ideas relating to maintenance tips or troubleshooting guidelines to improve performance of instruments, applications, or improve ease of use.

Agilent Technologies commissioned an independent survey of lab managers from different market segments. The primary objective of the survey was to understand lab managers' pain points and find out what their most pressing concerns were. The survey was conducted by Frost & Sullivan via a 30-minute online questionnaire in four countries: Germany, UK, USA, and China. A total of 700 people were surveyed, varying in experience, company size, role and primary function.

Lab managers face challenges that are largely linked to maintaining instruments and dealing with the increasing complexity of testing requirements. Just over half of the laboratories process 500 to 1,000 samples per week, and 45% of survey respondents said that there is pressure to increase the number of samples over and above their current capacity. Productivity is limited largely by the time consumed in preparing the sample, instrument downtime because of scheduled maintenance or unplanned downtime, and method transfer/validation of new instruments. When asked to select the main causes for unplanned downtime, respondents cited issues with sample preparation (78%), instrument breakdown (64%) and operator/technician error (45%). Interestingly, the survey highlighted 1 in 5 respondents consider laboratory size to be a challenge with 75% believing that space-saving designs of instruments can help overcome this challenge.

## Hollow cathode lamps

Agilent hollow cathode (HC) lamps are available in both coded and uncoded formats. Coded lamps have extra pins on the base allowing the instrument to identify which element the lamp is for. This means the instrument can locate and automatically start the lamp, even if it has been placed into the wrong position in the instrument. Uncoded lamps provide the best value and are compatible with all Agilent and most AA systems from other manufacturers (except PerkinElmer and Shimadzu). For improved sensitivity and lower detection limits, Agilent also offers a range of high-intensity, boosted discharge lamps known as UltrAA lamps. These UltrAA lamps use the standard lamp current, but apply an additional boost discharge within the lamp to increase emission intensity. The boost current is supplied from a secondary control module (either integrated into the instrument or supplied from an external module). Agilent UltrAA lamps are a comprehensive range of high-intensity boosted discharge hollow cathode lamps that can replace conventional lamps for AA determinations. UltrAA lamps lower detection limits for the most demanding flame, furnace and vapor AA applications, and offer:

- Up to 30% more sensitivity, compared with a standard HC lamp
- Extended calibration range while retaining analytical precision
- Longer lamp lifetimes, exceeding 8,000 mA hours of operation
- Plug and play for simpler operation

Agilent Zeeman AA systems can feature an integrated (factory fitted) control module. Field upgrades are available for other Agilent AA systems, ensuring wide compatibility. The range of UltrAA high intensity lamps can be used with all Agilent AA instruments. For superior cost-effective performance with challenging applications, select high intensity UltrAA lamps. Agilent UltrAA lamps lower detection limits for the most demanding AA applications.

Agilent lamps provide many advantages for atomic absorption users. First, they provide the optimum performance – a combination of the proprietary cathode composition and unique lamp processing procedures ensures good intensity and sensitivity, low noise and long-term stable operation. Second, the lamps are also designed to provide very long service, the result of proprietary cathode composition and optimum gas fill within the lamp. Typical lifetime for Agilent lamps exceeds 5,000 mA hours of operation, reducing operating costs and downtime through lamp failure. Third is better stability – Agilent lamps are pre-conditioned to be ready for use immediately out of the box. This can lead to improved productivity and optimal instrument performance without needing to condition the lamp initially. Next, Agilent lamps are designed to provide improved spectral purity. As shown in Figure 1, the Agilent lamps have a unique black "getter" patch that comes from a unique lamp processing procedure. This patch is a thin layer of activated zirconium, which helps to absorb some impurities that may be present in the lamp during operation, improving spectral purity throughout the life of the lamp. The final advantage is quality – Agilent lamps are manufactured by hand in an ISO 9001 certified environment and use proven processing steps. Prior to shipment, every lamp is analytically tested to ensure that it meets Agilent's demanding standards for intensity, noise and stability. Test equipment is regularly calibrated.



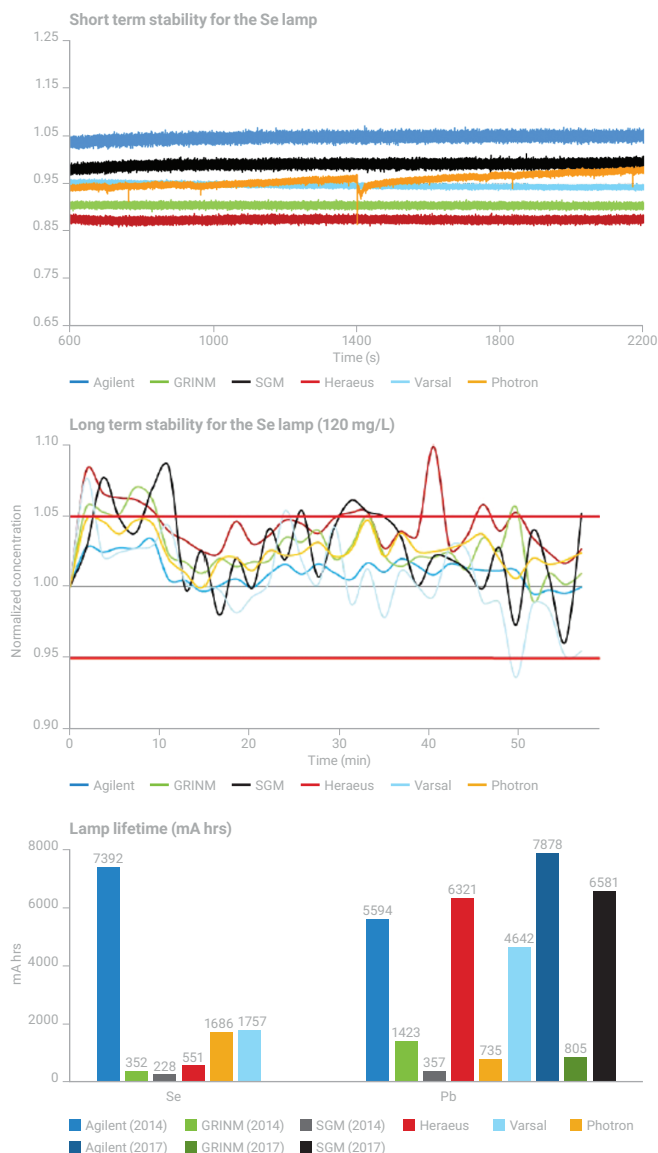
**Figure 1.** Characteristic black "getter" patch from unique lamp processing. May also see some cathode material deposited during lamp processing.

## Performance

Performance of Agilent HC lamps is demonstrated by a competitive analysis that can be found at [www.agilent.com/cs/library/competitiveanalysis/Public/5991-5023EN.pdf](http://www.agilent.com/cs/library/competitiveanalysis/Public/5991-5023EN.pdf). Lamps that require excessive stabilization times or lamps that never reach equilibrium can create problems for the analyst. Once analysis begins, drift in lamp intensity can change the analytical signal, introducing significant errors. This is especially critical at trace levels where the drift could even be more than the sample absorbance.

Figure 2 shows the short-term stability for selenium (Se) lamps with the Agilent lamp shown in light blue against other competing lamps. This stability trace is shown after a 10-minute warm up time. While most lamps were suitably stable the lamp represented by the orange trace never appeared to stabilize. Long-term stability is also shown, based on the measured absorbance for a calibration standard at a concentration of 120 ppm. The solid red lines show control limits of  $\pm 5\%$  variation from the expected result. The Agilent lamp (light blue) provides the best overall stability with the average precision being  $<1\%$  RSD for all measurements over this 1 hour period, compared with the worst result, which was  $>3\%$  RSD.

The lower chart shows the lamp lifetime for both the selenium (Se) and lead (Pb) lamps. The Agilent lamp (blue colours) gave the longest life for both of these elements, well over four times longer than the nearest competitor for the Se lamp, and around 20% longer than the nearest competitor for the Pb lamp.

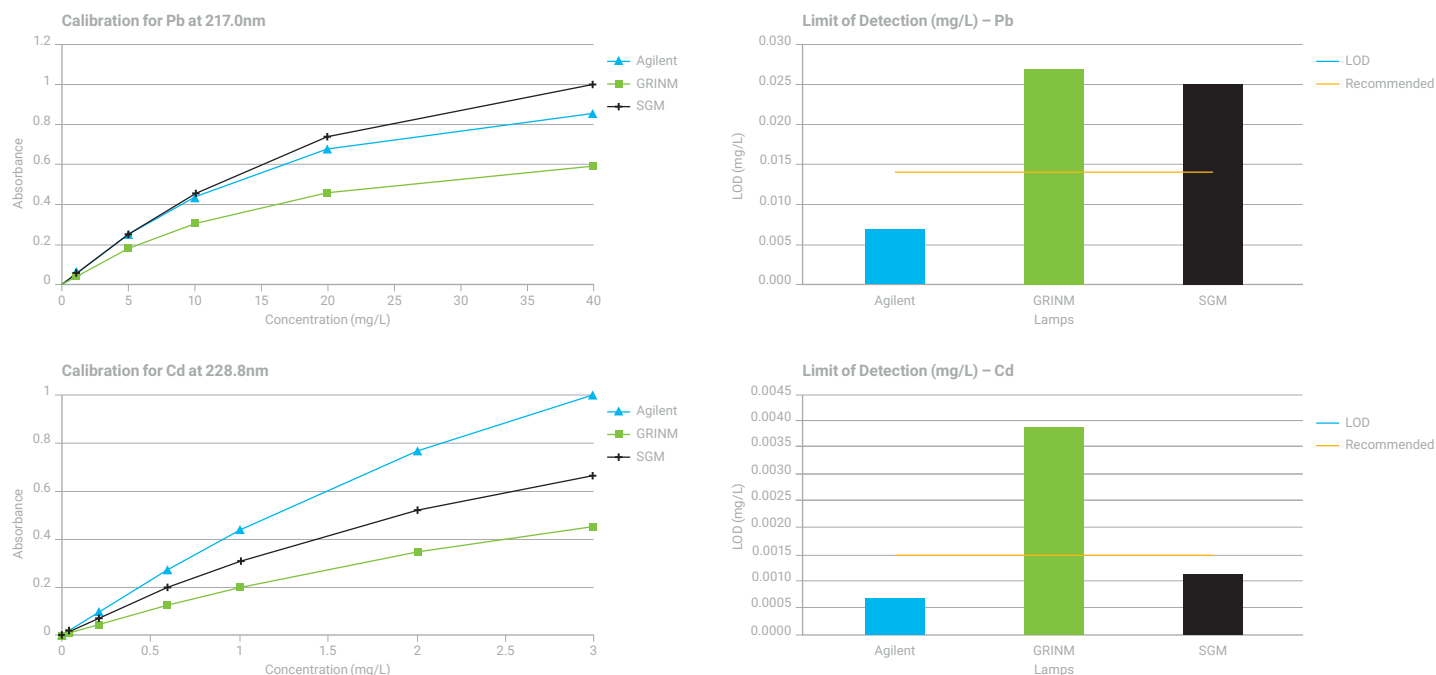


**Figure 2.** Agilent lamps deliver superior stability and longest operational lifetime compared to competing lamps.

A comparison of calibration curves for lead (Pb) at 217.0 nm is shown in Figure 3. The Agilent lamp provides good sensitivity, equivalent to the performance of the SGM lamp. A comparison of calibration curves for cadmium (Cd) at 228.8 nm is also shown. The Agilent lamp provides the best sensitivity and linearity. The instrument detection limits for these two elements is also compared. In each case, the Agilent lamp provided the best (or lowest) detection limit, significantly better than the lower priced competitive lamps.

The study also examined the performance/lifetime of the Agilent lamp with several major competitors with respect to arsenic (As), cadmium (Cd), gold (Au), copper (Cu) and sodium (Na) lamps. The Agilent lamp gives the longest life for each of these elements, well over 2.5 times longer than the nearest competitor for most of the elements, and about 25% longer than the nearest competitor for the sodium lamp.

There are several misconceptions about the use of multi-element lamps with the AA technique. For example, many users think that multi-element lamps have shorter lamp life and degrade analytical performance. Agilent offers an extensive range of multi-element lamps that offer similar performance to the range of single-element lamps. As we've shown for the range of multi-element lamps, each gives a satisfactory life – debunking the myth of shorter lifetimes. In terms of performance, when the lamp is operated at the recommended current for the multi-element lamp, the sensitivity achieved with the multi-element lamp is comparable to that achieved with a single-element lamp. There may be a slight degradation in the detection limit achieved, but that change is relatively small. Concerns about poor performance of a multi-element lamp is also a myth.



**Figure 3.** Comparison of calibration curves for lead (Pb) and cadmium (Cd), confirms that the Agilent lamp provides good sensitivity and linearity, and improved (lower) detection limits.

Figure 4 compares performance for a number of elements in a multi-element lamp for Co/Cu/Cr/Fe/Mn/Ni. As shown in the traces on the left, short-term stability for each element is very good after an initial warm-up period. The right side shows the expected calibration graph for the elements listed taken from the flame AAS cookbook. The larger calibration graph shows the sensitivity achieved for those elements using the multi-element lamp. The measured sensitivity matches the performance expected from the cookbook – again confirming there are no performance compromises when using a multi-element lamp, operated using recommended conditions for that lamp type.

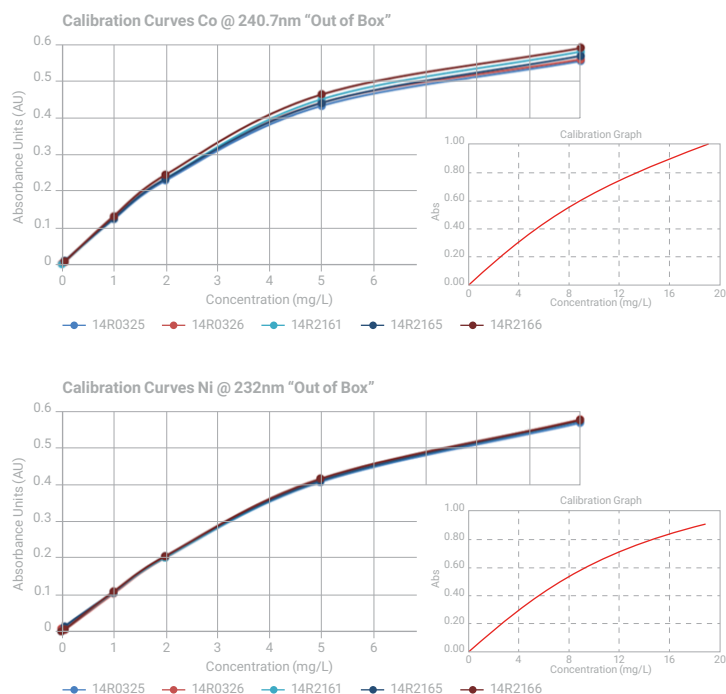
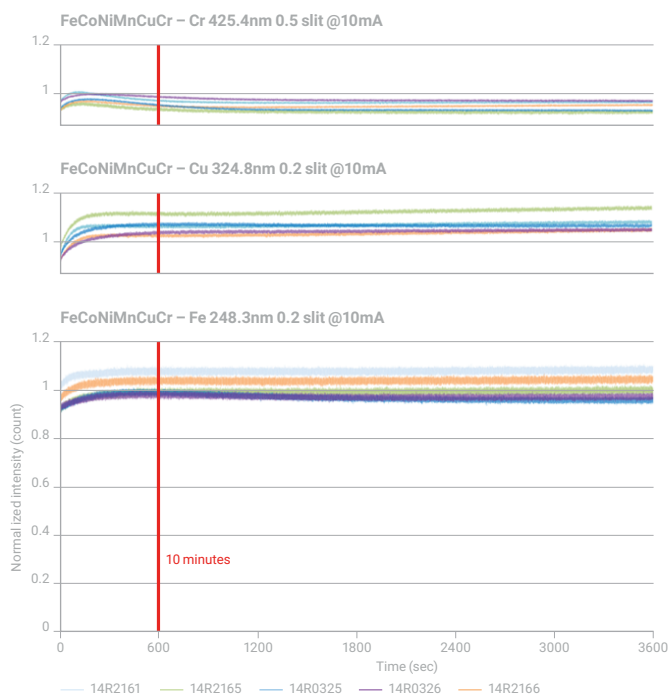
## Operational tips and recommendations

As noted earlier, multi-element lamps often require different operating conditions to that used for a single element lamp. The lamp current, recommended slit width and even the recommended wavelengths may be different when using a multi-element lamp. However, when operated using the recommended conditions, the performance of the multi-element lamp is equivalent.

There are more things to keep in mind when working with any HC lamp. First, consider general care and operation of the lamp. The lamp is fragile, so avoid any undue shock or stress. Also, ensure that there are no fingerprints on the end window of the lamp where the light passes into the optical system of

the instrumentation. Oil and grease from your skin can build up on this surface and reduce the transmission of the light into the optics, degrading performance. This is especially critical for elements that have emission wavelengths in the UV region or for elements that are relatively low intensity, such as lamps for As, Se, and Ni.

It is always good practice to allow the lamp to warm up for about 10 minutes at the start of the analysis enabling the output to stabilize and, as already highlighted, to work with the recommended operating conditions – for the Agilent lamp these are conveniently listed on the label on the base (including the recommended current, wavelength and spectral bandwidth). When working with the lamp it is good to monitor performance – in particular, the percent "Gain" value shown or displayed during optimization. You should compare this value with the typical Gain values that are available on the Agilent website ([www.agilent.com/en/support/icp-ms/kb005762](http://www.agilent.com/en/support/icp-ms/kb005762)). A significant change in the Gain value for the lamp can indicate that the lamp is reaching the end of its operational life. If working with a graphite furnace system, we recommend that you align the lamp without the furnace work head in the light path – align the lamp first, then place the work head in position and align the work head so that you are achieving maximum light throughput through the work head of the graphite furnace system.



**Figure 4.** Agilent's multi-element lamps provide excellent short-term stability and excellent sensitivity for Co, Cu, Cr, Fe, Mn, and Ni, with no performance compromise when used under recommended conditions.

Another type of source lamp that should be considered is the Deuterium lamp, which is used for background correction in your AA system. In most AA instrumentation, the Deuterium lamp is used particularly in that wavelength range between 200 to 400 nm. We do not use it above 400 nm as there is no useable output from the lamp. Most of the background observed is between 200 to 400 nm. The Agilent background correction system provides good capability so it can correct up to 2.5 absorbance units in background and provide fast correction with less than a 2 ms delay between readings – this can minimize the correction error that occurs when working with the background corrector.

Other common questions about the Deuterium lamp include:

- Is the lamp always on? No. The lamp will only be on when the instrument is being initialized, then it is switched off unless you are using background correction in the current method you are running.
- What is the lifetime of the lamp? It is hard to quote a specific value because there are so many variables but, typically, we see lifetimes that exceed 1,000 hours of operation. For most users who are working with the background corrector frequently, the lamp will typically need replacing on an annual basis.

Now consider some other tips to help you maximize the performance of your AA system.

## Preventing nebulizer blockage

One of the most important considerations when looking to prevent nebulizer blockage is to rinse the nebulizer both between samples and, especially, for a few minutes at the end of the run before extinguishing the flame. This allows removal of any remaining sample residue from the nebulizer and can help to prevent blockage occurring. Sample preparation also plays a critical role here – any large particles must be removed from the sample. This means either filtration or centrifugation of samples. If the latter, when working with an autosampler, or even when manual sampling, sampling above the level where there is any sediment in the sample vessel is essential. When wiping sample capillaries between samples, lintless wipes should be used or fibres can build up with the potential for nebulizer blockage. When a nebulizer is blocked, the best solution is to disassemble the nebulizer completely and sonicate the components in a detergent solution in an ultra-sonic bath. The nebulizer can then be rinsed and re-assembled. It is also possible to immediately remove the blockage with a cleaning wire but only as a short-term solution. However, it is always best to think "prevention" and take care with sample preparation and rinsing the sample introduction system.

Tuning the atomization system can also help us to reduce nebulizer blockage. So, for most applications the mixing paddles should be fitted inside the spray chamber. Optimize the impact bead position so that you're getting the best combination of sensitivity and precision. Use narrow bore capillary tubing. If you want better sensitivity, then you can take the mixing paddles out. You can adjust the impact bead further away from the nebulizer. If you fit wide bore tubing, you will get a much higher uptake rate, and that means you will get an improvement in sensitivity. Your noise level will go up a little bit, but signal will also go up dramatically. So, overall signal-to-noise performance will be better. For more difficult samples where there are higher levels of dissolved solids, you should first ensure the mixing paddles are in place. Then adjust the bead for maximum sensitivity, and rotate the bead adjuster at least half a turn clockwise closer to the nebulizer from the optimum sensitivity position. That means you're going to trade off sensitivity a little bit – perhaps reduce this about 10%, but by being closer to the nebulizer, there will be less chance of blockage of the sample introduction system. And, of course, that means you can get better long-term performance and stability.

It is important to consider the procedures that you go through at the end of the day once analysis is complete, as this also has a big impact on how the instrument performs. The recommended shutdown procedure is as follows:

- Aspirate the rinse solution for a few minutes before shutting off the flame (to wash out the nebulizer and remove any remaining sample residue)
- Extinguish the flame and allow the burner to cool
- Remove the burner and pour at least 500 mL of water through the spray chamber (to wash out any acid residue from the liquid trap)
- Empty the waste vessel
- Shut off the gases at the supply to the instrument
- Close the software
- Switch off the instrument

Following this procedure will flush out all of the sample introduction system and rinse out all the acid residue. This means less chance of blockage and less chance of degradation in the instrumentation.



## Maintenance of the sample introduction system

Here are some guidelines that can help you with cleaning the atomization system. The burner is probably the one that many users struggle with. For cleaning the burner, we recommend polishing the burner, and particularly the inside of the burner slot. Use a metal polish, something that you use for cleaning brass. We use a material called "Brasso", but if that's not available, another liquid metal polish recommended for cleaning brass will work very well. Use the burner cleaning strip to introduce the metal polish inside the burner slot (Figure 5A). Then, use the card to polish the inside of the burner slot on both sides. The more it is polished, the better it is going to perform. In the end it will give you much better performance and much better resistance to blockage if you have a clean and well-polished burner.

Cleaning the spray chamber is straightforward – disassemble and wash in a detergent solution. It is also critical to monitor the condition of the components inside, particularly the glass impact bead. Figure 5B shows the condition of a bead that is well used. This one is quite badly pitted. If you see a lot of indentations or pitting on the surface of the bead, then it is not going to perform very well in terms of breaking up the flow of sample. You should replace the bead immediately if it has this appearance. The impact bead is critical because it allows you to control the performance of the instrument. The external bead adjuster allows you to control the position of the bead. By adjusting the bead position, you can tune the instrument to achieve the sensitivity you need. If you move the bead further away from the nebulizer, you will see an increase in signal. The signal should go through some maximum, then as you move the bead position further away, the absorbance will go down again. Positioning of the bead is critical to helping you achieve good performance.



**Figure 5.** (A) Clean the burner by polishing using a metal cleaning fluid such as "Brasso" on the burner cleaning card. (B) The glass impact bead should be replaced if it is badly pitted.

## Accurate standards

Whether you are using a flame AAS (FAAS) for routine work or graphite furnace AAS (GFAAS) for ultra-trace analysis, the accuracy of your results depends entirely on the accuracy of your prepared calibration standards. Any errors in these standards—caused by incorrect preparation, contamination, or degradation—will lead directly to inaccurate results. In FAAS, these inaccuracies may not be immediately apparent and can accumulate over time, leading to poor data quality or failed QC checks. With GFAAS, even the slightest error in standard concentration or purity can have a significant impact due to the high sensitivity of this technique, and the small injection volumes involved. Accurate standards ensure confidence in quantification, and can reduce unexpected troubleshooting, prevent unnecessary reruns, and support method validation and regulatory compliance.

## What are the different quality standards (RM versus CRM)?

In atomic spectroscopy workflows, both Reference Materials (RMs) and Certified Reference Materials (CRMs) are valuable, depending on the precision required. When choosing a standard, it is important to understand the distinction between RMs and CRMs.

Both RMs and CRMs are tested using high-performance instrumentation and come with a Certificate of Analysis. One major difference is that CRMs are subjected to additional quality control steps, including testing for homogeneity and long-term stability (typically over 2 to 3 years). CRMs are then certified for homogeneity and long-term stability, making them essential for high-precision applications and or for regulated methods where full traceability and defined measurement uncertainty are required.

RMs are manufactured in the same ISO 17025 and 17034 accredited facilities as CRMs, ensuring they are traceable, tested, and a cost-effective alternative for routine analysis, method development, or internal quality control checks where enhanced homogeneity or stability testing past their shelf life is not critical. Choosing the right level of certification depends on whether your lab needs ISO/IEC 17025 traceability and regulatory compliance or simply reliable, consistent performance.

## Agilent standards manufacturing process

Agilent CRM and RM standards are formulated and manufactured using rigorous quality controls to ensure exceptional purity, accuracy, and full traceability. All standards are gravimetrically prepared using ultra-pure raw materials and typically validated for trace-level impurities using Agilent ICP-MS systems. Production occurs in ISO-9001 certified facilities, with testing performed in ISO/IEC 17025-accredited laboratories. Certification complies with ISO 17034 guidelines, ensuring traceability to the NIST SRM 3100 series elemental standards. The final products are packaged in acid-leached, pre-cleaned HDPE bottles and sealed in protective bags to guard against contamination during shipping and storage. All RMs and CRMs are backed by stability studies demonstrating a shelf life of one year or more. RMs and CRMs are both supplied with a comprehensive Certificate of Analysis (CoA) with certified concentrations. The CoA for the CRMs provides expanded data, including measurement uncertainty and trace impurity levels for up to 68 elements.

## Tips for preparing standards for your workflow

Proper preparation of calibration standards is critical to ensuring accurate, reproducible, and traceable results with your analyses. Even small mistakes with dilution, storage, or matrix matching can introduce significant errors, especially when working at trace concentrations or with complex sample matrices.

Follow these essential lab practices when using or preparing standards to help improve the accuracy and reliability of your calibration standards:

- **Use in-date standards:** Always check and use standards within their expiration date (especially important for low-concentration or organic-based solutions). Expired standards may have low concentrations due to degradation or precipitation.
- **Calibrate pipettes and glassware:** Regularly calibrate and verify your pipettes and glassware. Regular verification ensures accurate volume delivery and minimizes dilution errors.
- **Perform serial dilutions:** Avoid large single-step dilutions to reduce errors. Use intermediate dilution steps to improve accuracy and reproducibility.
- **Stabilize working standards:** Acidify your prepared standards using the appropriate acid, based on the analyte, to stabilize metal ions and extend shelf life. Follow supplier guidance on acid type (e.g.  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{HF}$ , or mixed acids), concentration and compatibility.
- **Matrix match:** Prepared calibration standards should closely match the acid matrix in which your samples are prepared to avoid ionization or other enhancement/suppression effects in the atomizer.
- **Storage:** Store your prepared standards in pre-cleaned, high-purity HDPE or PFA containers. Avoid glass containers to prevent contamination and adsorption losses.
- **Reduce contamination risks:** Use only natural (uncolored) pipette tips to avoid trace metal contamination (especially for elements such as zinc, cadmium, and iron).
- **Prepare fresh standards as needed:** Prepare fresh standards frequently (daily for ultra-trace work). This is particularly important for volatile or unstable elements, or when working at trace concentrations ( $< 1$  ppm).
- **QC Checks:** Include reagent blanks with each batch to check for potential background contamination. Use spike recoveries and matrix spikes to confirm method performance and identify matrix effects.



## Reducing potential contamination

Contamination can distort sensitivity and skew calibration curves. It can occur at any point in the workflow: storage, handling, digestion, dilution, or measurement. Common sources include working with poor quality (impure) reagents, improperly maintained water systems, colored pipette tips, or leachable elements from solutions stored in glassware. Cross-contamination between high and low concentration standards can also occur.

Follow these essential lab practices when using or preparing standards to help minimize contamination:

- **Review the CoA:** Always check the CoA for every reagent and consumable used during sample preparation for potential contaminants. Even between different batches of the same product, impurity levels can vary significantly.
- **Use ultra-pure 18.2 MΩ·cm deionized water.**
- **Use natural (uncolored) pipette tips:** While colored tips may add interest in the lab, use only natural (uncolored) pipette tips to avoid trace metal contamination (especially for elements like zinc, cadmium, and iron).
- **Validate digestion workflows:** Choose your digestion method (microwave, hot-block, acid) based on sample matrix and target analytes. Verify accuracy by running a CRM through the full digestion and analysis workflow to verify recovery and accuracy.
- **Use QC checks in each batch:** Include reagent blanks with each batch to check for potential background contamination. Use spike recoveries and matrix spikes to confirm method performance and identify matrix effects.

## Why select Agilent standards?

Agilent standards are trusted worldwide for their exceptional purity, traceability, and performance. Offering both single- and multi-element RMs and CRMs, Agilent supports a wide range of applications, including heavy metals in wastewater, nutritional elements in food, and wear metals in petroleum products. Agilent also offers specialty metallo-organic, biodiesel, and solvent-based standards, along with tuning and wavelength calibration solutions to verify instrument performance.

In addition, Agilent can offer custom inorganic standards allowing you to order the exact elements required in the concentrations needed, together with the matrix that you want those standards in, with assured fast delivery. Custom standards are manufactured to your specific requirements, then are qualified and certified by our team of expert chemists in our ISO 9001, 17025, and Guide 34 accredited facility.

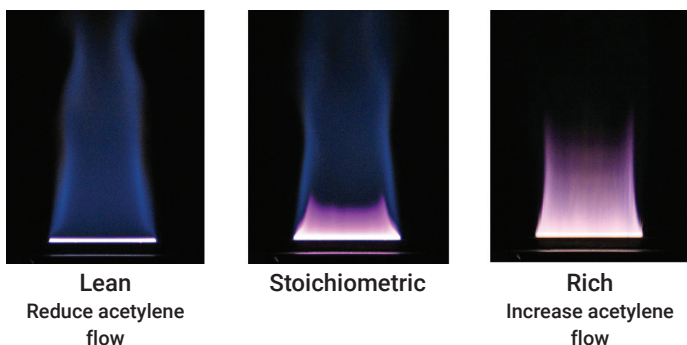
Sourcing your standards from a trusted provider like Agilent is essential. Backed by detailed impurity profiles, NIST traceability, and rigorous quality control, Agilent delivers consistent, reliable standards to ensure confidence in your analytical results.

## Analytical sensitivity

One of the last checks to do to improve the performance of your instrumentation is to check the analytical sensitivity that you are getting. One of the things that many users have trouble with is burner alignment. You need to optimize the burner position vertically, horizontally, and rotationally. The best way to do this is to use burner aligning and cleaning strips. You can position these on the burner, then use the target area as a way to ensure the burner is correctly aligned with respect to the light from the HC lamp. In that way you can do a very quick visual check to verify that the light beam is running parallel to the burner slot. It is also good practice to check the nebulizer uptake rate. Ideally it should be in the range close to 5 mL/min. If necessary, you can adjust the nebulizer or clean it if there is a partial blockage and you have a low sample uptake rate. Once you have done those preliminary adjustments, you should aspirate a standard, then optimize the system for maximum sensitivity. Focus on things such as the impact bead position so that you can use the adjuster to make sure that you are getting the best sensitivity and best precision.

Next, focus on the flame chemistry – the flame stoichiometry is especially critical for elements that use the nitrous oxide/acetylene flame, but even for elements that work with an air acetylene flame. By adjusting your gas flows you can change the sensitivity and optimize your performance.

Adjustment of the acetylene flow becomes much more critical when using the nitrous-oxide/acetylene flame. Figure 6 provides an example of optimization conditions for the nitrous-oxide acetylene burner. Usually when working with this burner type, it is because you are needing to measure the more refractory elements. And these elements need extra acetylene to be added into the flame, to get good atomization, and be able to get a good signal. Typically, when running with the nitrous-oxide flame, you need to add extra acetylene into the flame. In the analytical conditions in the cookbook, you will often see references in the notes to the feather, or the height of the cone in the flame. This refers to the height of the colored region which you can see in Figure 6. To achieve a rich flame, you need to increase the acetylene flow up to 8 L/min.



**Figure 6.** Flame appearance with the nitrous-oxide/acetylene burner with different conditions. Most elements requiring the nitrous-oxide/acetylene flame give best sensitivity with a rich flame.

## Recommended maintenance schedule

Here are some guidelines to help you with maintenance. These are recommended maintenance schedules for flame AA. Note that these are recommended conditions only – the timings may vary depending on your application and on your workload. Adjust these as necessary based on your own usage.

The most important thing are the checks that you need to do every time you run your instrument. Check that there is enough gas in the cylinders at the start of the run, especially important for the acetylene to make sure that there is no carryover of acetone into the gas box of the instrument. Check that the exhaust is working correctly. Check the nebulizer uptake rate and inspect the burner to make sure it is clean and OK for analysis. Then you should be ready to start your analysis.

At the end of the run, follow the recommended shut down procedure to wash out the sample introduction system, then empty the waste container. It is also good practice to wipe down the exterior surfaces of your atomic absorption system especially in the sample compartment to remove any acid residue that may have built up on those surfaces.

On a weekly basis or perhaps as necessary, clean both the burner and the flame atomization system. While doing that, inspect the components, particularly the impact bead and the condition of all the O-rings, to make sure they are in good condition. If the O-rings are knicked, damaged, or obviously stretched, replace them immediately; otherwise, they will not do their job and will not produce a good seal. Periodically check the optical windows on the instrument and clean as necessary.

If you follow these procedures, you should be able to achieve good and consistent performance from your instrumentation.

## Key Consumables for AA

Here are some broad guidelines on the common types of consumables and supplies that you may want to have on hand to support usage of your instrumentation. All instruments will need HC lamps as well as the standards that are used for calibration (CRMs). For flame AA it is mostly parts for the sample introduction system, such as impact beads, burner cleaning strips, nebulizer components, capillary tubing etc. that you want to have on hand. If you have a blockage or a breakage, you can disassemble the nebulizer, replace the component, and continue the analysis.

Although we have not focused on the other AA techniques in this article, there are also some key consumables you may want to have to hand. For graphite furnace AA systems you should have graphite tubes, sample vials, dispensing capillary and syringe for the autosampler, and matrix modifiers. For vapor generation AA systems you should have quartz atomization cells, peristaltic pump tubing, and connecting tubing.

Agilent offers a range of consumable kits, or operating supplies kits, that basically bundle all the supplies you need into one part number. Agilent has offerings for flame AA (Figure 7) and graphite furnace AA, as well as some other techniques, or some of the other accessories that you may be using. Each of these kits includes all the components that you would need to support operation of your instrument for typically one year of routine operation.

### Components in the Operating Supplies Kit (p/n 190034100)

1 Nebulizer venturi, PEEK
1 Nebulizer capillary kit
1 Nebulizer block, fluorinated
1 pack of 5 Glass impact beads
1 pack of High solids capillary tubing, 3m
1 Mark 7 O-ring, for aqueous samples
1 pack of 5 Mixing paddles, fluorinated
1 pack of 100 Burner cleaning and alignment cards



**Figure 7.** The Mark 7 atomization system operating supplies kit includes the recommended supplies to support up to 12 months of routine operation of your instrument.

Having one of those kits is a convenient way of ensuring that you have the spares you need at the time that you need them. These operating supplies kit can be ordered on a yearly basis to ensure optimum instrument performance all year long.

## The Agilent atomic spectroscopy lineup

Figure 8 highlights Agilent's atomic spectroscopy instrumentation lineup. Driven by insights from customers from around the world, Agilent has created an innovative atomic spectroscopy portfolio – spanning instruments, consumables, standards, services, software, and more – to bring that confidence to your lab. Agilent offers a comprehensive range of instrumentation ranging from flame AA systems all the way through to high-end ICP-QQQ ICP-MS that provides MS/MS capability to enable unique control of interference removal in reaction mode. Regardless of the technique that you are working with, regardless of the type of analyses you are doing, you can be confident that Agilent will have the products that you need for your particular application.

## Summary

This overview provides some tips and guidelines to help you achieve best performance, and to help you achieve quality data from your instrumentation. Most of the challenges that you face are dependent on the condition and setup of your sample introduction system. By focusing on the setup, condition, and maintenance of your sample introduction system – the burner, spray chamber, and nebulizer – and completing the proper maintenance on those areas, this will help you achieve the best performance.

Deposits anywhere in the sample introduction system can affect the rate sample is introduced into the flame, contributing to signal drift and potentially introducing contamination. Proper maintenance of this area can help you improve your results, improve the data quality and overcome potential issues. Establishing routine maintenance procedures can help you to provide analysts with simple ways of identifying and correcting the problems.

These tips and guidelines will help you maintain your instrumentation and help you achieve the best performance and productivity from your instrumentation.



**Figure 8.** Agilent's atomic spectroscopy instrumentation lineup.

## Resources

Finally, here is an overview of additional resources that are available to help you. Agilent has recently introduced the "AA Resource Hub", an information page for all atomic absorption instrument users ([explore.agilent.com/aas-resource](https://www.agilent.com/aas-resource)). One key feature of the "AA Resource Hub" are the maintenance and troubleshooting videos that cover flame, atomic absorption, graphite furnace atomic absorption, and HC lamps.

Below is a list of additional resources available to support atomic absorption users:

- [Lamp FAQs](#)
- [Atomic absorption parts and supplies](#)
- [Application notes](#)
- [Consumables catalog for spectroscopy](#)
- [Standards/CRMs](#)
- [Webinars for atomic spectroscopy](#)
- [Essential AAS Instrument Supplies](#)
- [Interactive Periodic Table](#)

## Agilent CrossLab

From Insight to Outcome

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