



Nitrosamine Analysis Buyer's Guide

A practical overview of total and targeted nitrosamine testing and the equipment used



Nitrosamine Analysis at a Glance

Nitrosamines have become a focus across pharmaceuticals, food, cosmetics, packaging, rubber, toys, and carbon capture. Many teams now need a clear understanding of how these compounds form, how to test for them, and what type of analysis is appropriate for their products or processes.

This guide gives you a straightforward overview of nitrosamine testing. It explains the two main approaches used across industry, how they differ, and the instruments involved. The aim is to help quality and technical teams understand the options and decide which route fits their requirements.

There is no single method that suits every situation. Total nitrosamine analysis gives an overall value for all nitrosamines present. Targeted analysis measures individual nitrosamines and provides confirmation when you need it. Both options play different roles in quality control. In many cases, they work together to give a complete picture of risk, product performance, and compliance.

You will see how each method fits into real testing workflows, the strengths of each approach, and the practical points to consider when choosing a route. The aim is to give you a clear view of the options before you look at specific systems.

In This Guide

- Why nitrosamine testing matters
- How they form
- Total nitrosamine analysis
- Targeted nitrosamine analysis
- Comparison table
- Decision tree
- Air monitoring and exposure
- Practical setup points
- FAQs
- Next steps

Why Nitrosamine Testing Matters

Nitrosamines can form during production, storage, or handling in several industries. They have been found in pharmaceuticals, food products, cosmetics, rubber materials, toys, packaging, and carbon capture systems. Their presence often links back to ingredient interactions under heat, pH changes, or other processing conditions.

Regulators are now reviewing more products and processes for nitrosamine risk. Some sectors already have defined limits and reporting requirements. Others are bringing in new regulations as more information becomes available. Many manufacturers are being asked to show how formation could occur and to test when the risk is present.

Testing gives clear data that helps teams understand what is happening in their process. It can show whether formation is linked to raw materials, equipment, pH, heat, or storage. It also helps confirm the effect of any changes made to reduce formation. When run routinely, testing can highlight early signs of an issue before products move further through production.

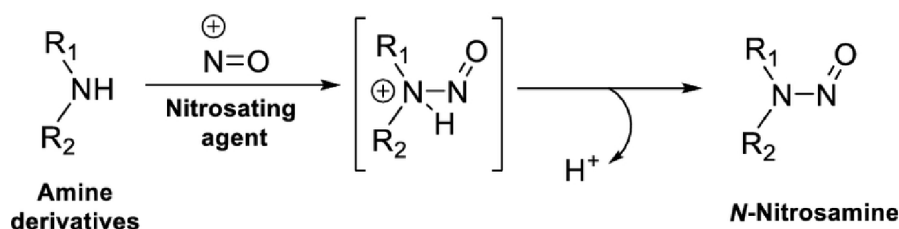
Nitrosamine testing also helps maintain product quality and consistency. It gives practical results that guide day to day decisions and brings attention to problems that may be missed by visual checks or standard measurements.

How Nitrosamines Form

Nitrosamines form when nitrite and amine groups react under the right conditions. This can happen during production, processing, or storage, and is often influenced by heat, pH, or the way materials are handled.

Many raw materials contain amines or nitrite, either naturally or through the way they are processed. When these materials are brought together, small changes in ingredients, temperature, or formulation can create opportunities for nitrosamine formation.

Thermal steps can increase reactivity. Drying, curing, smoking, sterilising, or any process that uses high heat can bring reactive groups together. Storage conditions can have a similar effect when products remain warm for long periods or come into contact with materials that release small amounts of precursors.



Packaging and equipment can also play a part. Adhesives, inks, rubber components, and certain polymers may release trace amounts of nitrite or amine groups, which then interact with the product over time.

Processes that rely on amine-based solvents or nitrogen-rich chemistries bring additional risks. This includes some carbon capture systems and other technologies where long-term chemical behaviour is still being assessed.

Understanding how these reactions occur helps teams identify where formation is most likely and where testing may be needed.

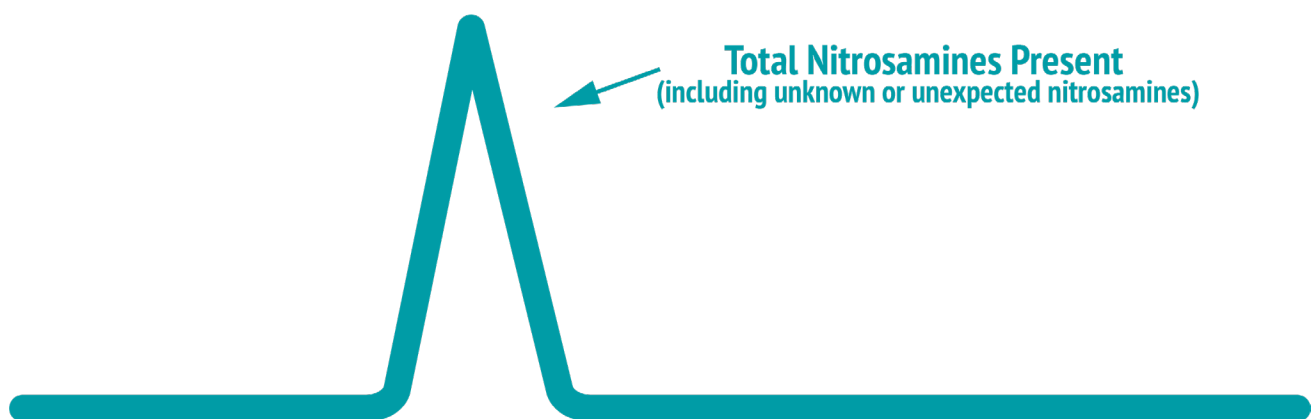
Total Nitrosamine Analysis

Total nitrosamine analysis measures the combined amount of all nitrosamines present in a sample. It gives a single value that reflects the full group, without separating or identifying individual compounds. This makes it a useful first step when you need an overall view of formation risk.

This type of testing is often used for screening. It can show whether nitrosamines are present at all, whether they appear during production, or whether levels change when materials, equipment, or conditions are adjusted. It is also used to track trends over time, especially when processes run at scale or when storage conditions vary.

Total analysis helps teams understand the wider behaviour of their process. It highlights situations where nitrosamine formation is possible and guides decisions on where more focused testing may be required. It is also useful when a quick indication is needed before moving to more specific analysis.

While total analysis gives a clear overall value, it does not confirm which nitrosamines are present. It also cannot show whether a change affects one compound or several. For this reason, total analysis is often paired with targeted testing when individual values or identification are required.



What it offers

- A single value showing the combined level of all nitrosamines
- A quick way to see whether formation is taking place
- Clear indication of increases or decreases over time
- Insight into the impact of changes to materials, equipment, or conditions
- Early warning when formation begins to rise
- A way to decide when targeted analysis is required

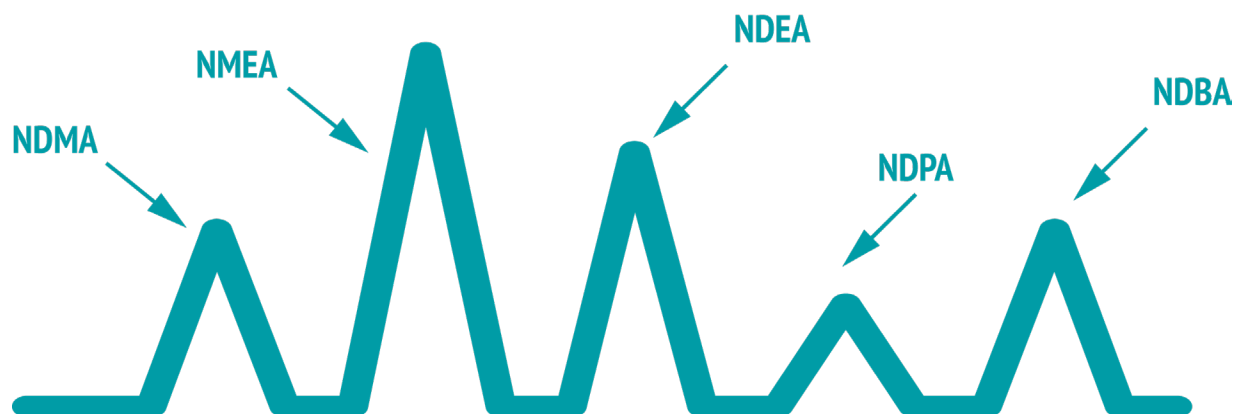
Targeted Nitrosamine Analysis

Targeted nitrosamine analysis measures specific nitrosamines and gives individual values for each one. It identifies which compounds are present and at what levels. This type of testing is used when detailed information is needed for investigation, reporting, or regulatory work.

Targeted analysis is suited to situations where limits exist for individual nitrosamines, where products must meet defined specifications, or where a process needs close monitoring. It can show how each compound behaves during production, storage, or formulation changes and can confirm the source of any issue observed in earlier screening work.

Selective detection plays an important role in targeted analysis. Some detectors respond directly to the nitrosamine functional group, providing clear signals even when samples contain complex backgrounds or low concentrations. This makes targeted analysis effective for identifying regulated nitrosamines and observing unexpected ones as distinct peaks.

Targeted analysis gives precise, actionable data. It is often used alongside total analysis to build a full picture of risk, formation routes, and product performance.



What it offers

- Individual values for specific nitrosamines
- Clear identification of which compounds are present and at what levels
- Data suited to regulated limits and detailed reporting
- A view of how each nitrosamine behaves during production or storage
- Selective detection that highlights known and unexpected compounds
- Results that complement total analysis when a full breakdown is required

Automated Total Nitrosamine Analyser (ATNA)

What it does

The ATNA provides automated total nitrosamine analysis. It measures the combined level of all nitrosamines in a sample and reports a single value that reflects the overall amount present. This makes it useful for screening, trend tracking, and early investigations where a broad view of formation is needed.

The system automates key preparation steps. Samples are vortexed and heated in sealed vials, which releases nitric oxide into the headspace. This vapour is then injected into a thermal energy analyser that responds selectively to the NO group found in all nitrosamines. The signal produced reflects the total amount of nitrosamines released from the sample.

Automation increases throughput and reduces hands-on work. Once samples are loaded, sequences can run unattended, including overnight batches. This makes the system suited to high sample volumes or routine schedules where consistent, repeatable results are needed.

What it offers

- Automated total nitrosamine screening
- High throughput with minimal input
- Unattended and overnight operation
- Stable, reproducible results
- Clear tracking of changes over time
- Fast indication of formation risk
- A trigger point for compound-specific analysis

Typical uses

- Routine checks during production or storage
- Monitoring the effect of process or material changes
- Trend tracking across batches or time periods
- Screening before targeted analysis is carried out
- High volume or continuous testing schedules

Best suited for

- High throughput
- Unattended overnight runs
- Minimal hands-on time
- Fast screening before speciated analysis (if needed)

Space and setup

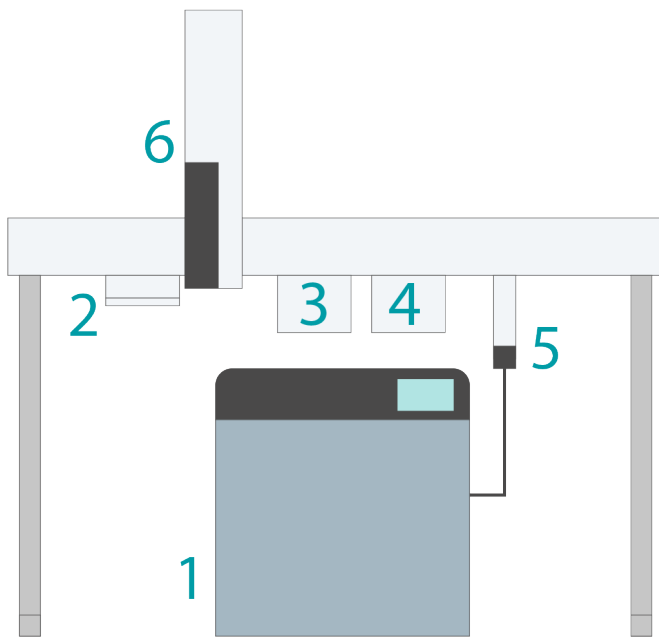
The ATNA sits on a standard laboratory bench. A bench around 95 cm wide and 60 cm deep gives enough room for the instrument and for loading sample vials. A stable surface at a comfortable working height is all that is needed.

The system runs from standard laboratory power and requires nitrogen and oxygen for the detection stage. These can be supplied from a house gas system or from individual cylinders, depending on what the site already uses. Most laboratories have at least one of these options available, so the main consideration is choosing the supply that fits the existing setup.

A computer is needed to run the software and manage sequences. USB ports are used for instrument control, and a network link can be added if results need to be shared or backed up on a central system. Once installed, training covers operation, software use, and routine checks.

Room temperature should remain within a typical controlled laboratory range to keep the system stable during longer sequences or overnight runs.

Automated Total Nitrosamine Analyser (ATNA)



1. Thermal Energy Analyser (TEA)
2. Sample Tray
3. Vortex
4. Heated Agitator
5. Injection Port
6. Syringe



Bench Footprint:
95cm x 60cm



Run unattended,
24hrs a day



Up to 120
samples per hour



One peak for ALL
nitrosamines
present

Manual Total Nitrosamine System

What it does

The manual total nitrosamine system provides a hands-on approach to total nitrosamine analysis. It measures the combined level of all nitrosamines in a sample by releasing nitric oxide during a controlled chemical reaction and detecting the resulting signal. It is based on a traditional glassware setup and is suited to laboratories that need total values but do not require automated throughput.

In this approach, a sample is injected into a heated reaction mixture held within a glass reaction vessel. Hydrobromic acid and ethyl acetate are used to break the nitrosamine structure and release nitric oxide. The vessel is heated and stirred, and the generated vapour moves through a condenser and cold trap to remove unwanted components. A carrier gas then sweeps the nitric oxide to the thermal energy analyser, where it reacts with ozone and produces light that is measured by the detector.

The method follows the same detection principle as automated systems but requires the user to carry out each injection and manage the reaction mixture. It provides total nitrosamine values using a more manual, step-by-step workflow.

What it offers

- Total nitrosamine measurement using established chemistry
- Direct control of every step in the workflow
- A low cost entry point for total analysis
- A clear view of overall nitrosamine levels before targeted testing
- A practical option when automation is not required

Typical uses

- Occasional total nitrosamine checks
- Small batch or investigative work
- Situations where full automation is not required
- Early studies to understand formation pathways
- Screening before targeted analysis is performed
- Research projects that need control over reaction

Best suited for

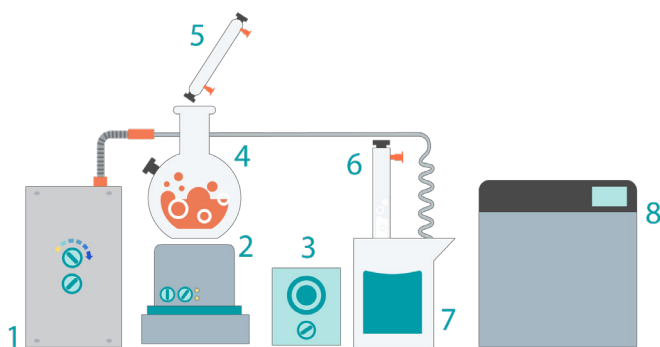
- Low throughput laboratories
- Sites with existing fume hood capacity
- Users who prefer hands-on control over the workflow
- Early stage or exploratory testing before deciding on automation

Space and setup

This system uses glassware, heating, and cooling components and must be housed inside a fume hood. The setup includes an electromantle, condenser, cold trap, chiller, and connections for carrier gas. Space is needed for the glassware assembly, cooling lines, and access for manual injections. A TEA detector is used for the final measurement stage, and a standard laboratory bench beside the hood is typically used for the detector and PC.

Standard laboratory gases are used to sweep the released nitric oxide to the detector. The TEA requires a PC for instrument control and data handling. Training is included to cover operation, safe handling of reagents, and routine checks.

Manual Total Nitrosamine System



1. Immersion Chiller
2. Heater/Magnetic Stirrer
3. Peristaltic Pump
4. Reaction Vessel
5. Double Surface Condenser
6. Cold Trap
7. Coolant Reservoir
8. Thermal Energy Analyser (TEA)



**Glassware
system**



**Fume hood
required**



**Hands-on
method**



**One peak for ALL
nitrosamines
present**

Gas Chromatograph (GC)-Thermal Energy Analyser (TEA)

What it does

GC-TEA provides targeted nitrosamine analysis. It separates individual nitrosamines using gas chromatography and detects them with a thermal energy analyser. This gives a clear, compound-specific result for each nitrosamine present in the sample.

The gas chromatograph separates compounds as they travel through the column. As each nitrosamine elutes, the detector responds to the nitrogen oxide group released during the detection stage. This selectivity allows the TEA to highlight nitrosamines even in complex samples, producing sharp signals for known targets and showing distinct peaks when unexpected nitrosamines are present.

GC-TEA is used when identification and quantification are required. It provides the detailed values needed for regulatory work, investigations, and any situation where total analysis alone is not enough.

What it offers

- Compound-specific nitrosamine results
- Clear identification of known and unexpected nitrosamines
- High selectivity for the nitrogen oxide group
- Sharp, well-resolved peaks for accurate reporting
- Sensitive detection suited to regulated limits
- Data that complements total nitrosamine analysis

Typical uses

- Confirmatory testing after total analysis
- Regulatory reporting for individual nitrosamines
- Batch release checks where specific limits apply
- Investigation of formation pathways
- Detection of unexpected nitrosamines in complex samples
- Routine monitoring when speciated data is required

Best suited for

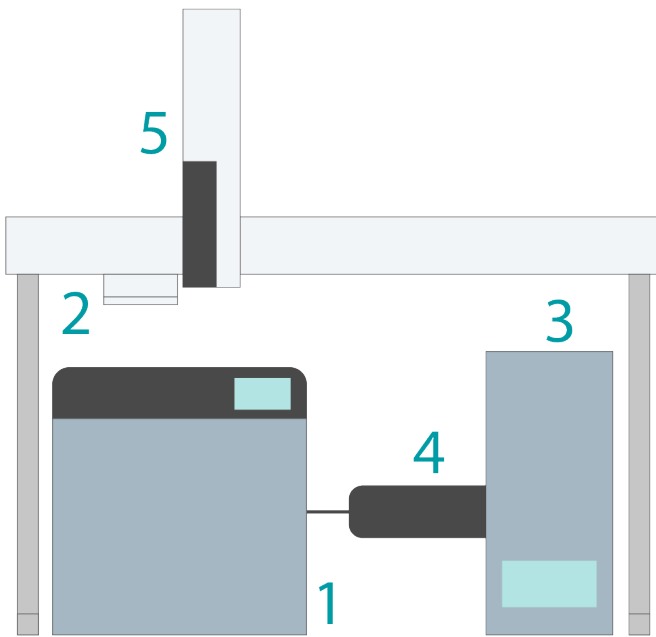
- Compound-specific results
- Regulated reporting
- Detailed investigation
- Follow up after total analysis

Space and setup

The GC-TEA sits under the same autosampler type used with the ATNA, which keeps the footprint similar and allows higher throughput when samples are queued. The system includes a gas chromatograph, a pyrolyser, and the TEA detector. The pyrolyser sits between the GC and the detector and breaks the nitrosamine structure so that nitrogen oxide can be measured.

The GC uses standard laboratory carrier gases. The TEA requires nitrogen and oxygen for the detection stage. A bench with space for the GC, the TEA, and a computer for instrument control is needed. USB ports and network access are used for sequencing and data handling. Training is provided for GC operation, TEA use, and routine checks.

Gas Chromatograph (GC)-Thermal Energy Analyser (TEA)



1. Thermal Energy Analyser (TEA)
2. Sample Tray
3. 500 Series GC
4. Pyrolyser
5. Syringe



Bench Footprint:
95cm x 60cm



Targeted analysis



High sensitivity



**Distinct peaks for
each nitrosamine**

Instrument Comparison

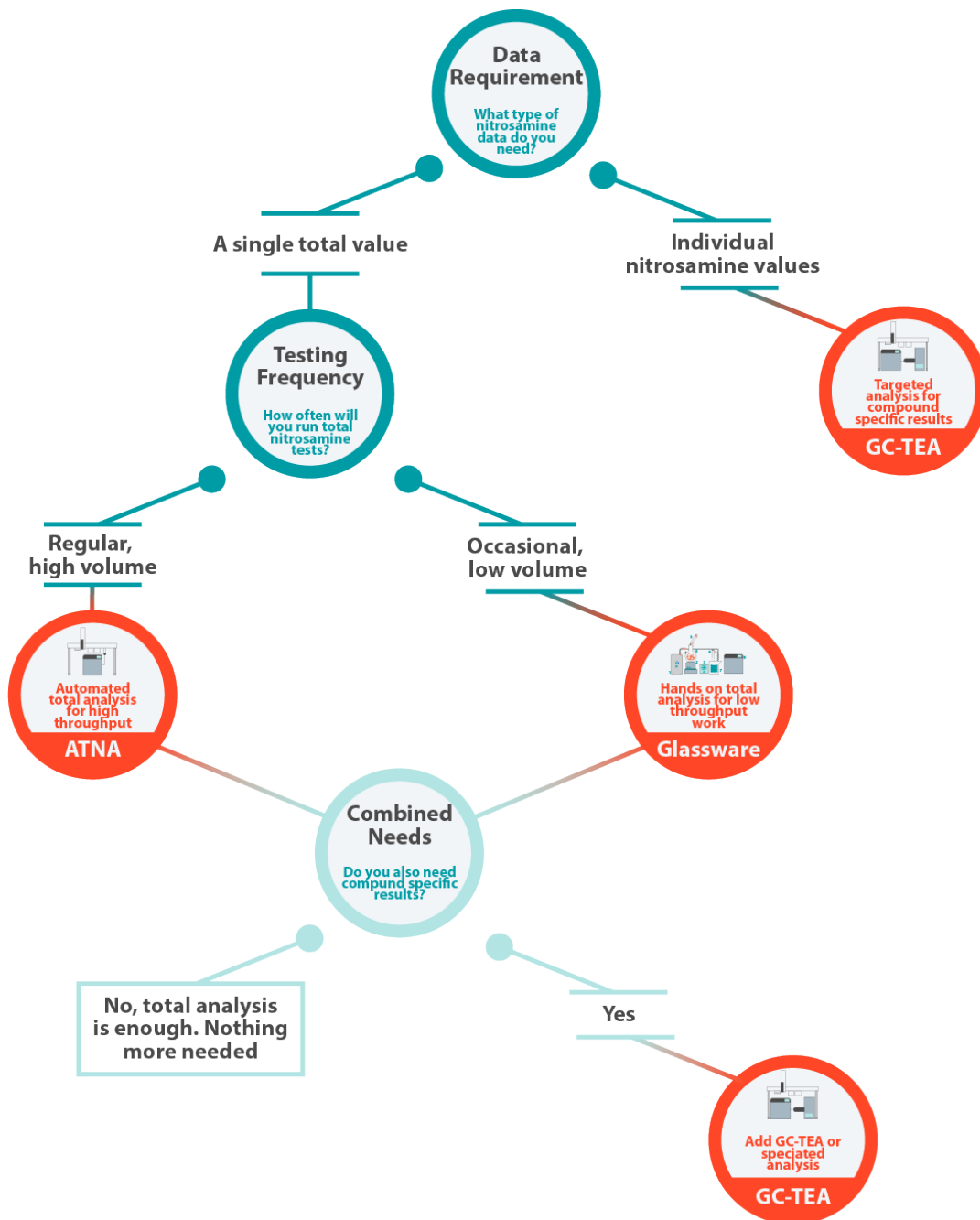
	ATNA	Glassware	GC-TEA
What it measures	Total nitrosamines	Total nitrosamines	Individual nitrosamines
Level of detail	Broad overview	Broad overview	Compound specific
Separation & detection	Automated chemical reaction + TEA	Manual chemical reaction + TEA	GC separation, pyrolyser + TEA
Workflow	Automated vial workflow	Manual glassware workflow	GC workflow with automation
Throughput	High	Low	Medium
Sample handling	Vials, minimal handling	Manual sample injection	Vials, autosampler compatible
Operator involvement	Low	High	Medium
Setup requirements	Bench space, power, gases	Bench space, power, gases, fume hood	Bench space, power, gases
Strengths	Automated, good for screening	Good for screening	Identifies specific nitrosamines
Strengths	Screening only	Labour intensive	More hands on than ATNA

Each instrument in this guide delivers nitrosamine data in a different way. The ATNA provides automated total analysis with minimal input, making it suited to routine screening and higher throughput work, particularly for QC teams. The manual total system uses a glassware setup and offers the same type of total value through a more hands-on workflow, which can be useful for R&D or early investigative work. GC-TEA provides compound specific results and is used when individual nitrosamines need to be identified and measured, often for regulatory reporting or detailed studies.

The table highlights how these systems compare in terms of workflow, space, operator involvement, and the type of data they produce. Some laboratories rely on a single system, while others use total and targeted approaches together depending on workload, investigation needs, or compliance requirements.

The decision tree on the next page builds on this comparison and helps you identify which option aligns with your requirements.

Finding the Right Testing Setup



Each system offers a different way to measure nitrosamines. The ATNA provides automated total analysis and is suited to routine or high-volume work where consistent results and minimal hands-on time are important. The manual total system carries out the same type of measurement through a glassware setup and is better suited to low-throughput laboratories or early investigative studies. GC-TEA gives compound-specific values and is used when individual nitrosamines need to be identified, measured, or reported. Some workflows rely on total analysis alone, while others use both total and targeted data to guide quality checks, investigations, or regulatory work.

Air Monitoring and Exposure Assessment

Why air monitoring matters

Nitrosamines are not only a concern within products or processes. In some environments, they may also be present in the air. This is relevant in workplaces, enclosed spaces, and situations where materials or components may release nitrosamines over time. Monitoring airborne exposure helps assess potential risk to people as well as products.



Air sampling using the ThermoSorb-N

Thermosorbs are air sampling cartridges designed to capture airborne nitrosamines over a defined sampling period. They are placed in the environment being assessed and collect nitrosamines from the surrounding air, allowing exposure to be measured over time rather than at a single moment.

Once sampling is complete, thermosorbs are analysed to determine the level of nitrosamines captured. In many cases, cartridges are sent to a laboratory for analysis. In other setups, testing may be carried out on site using appropriate nitrosamine analysis systems. This allows air monitoring to be carried out on site or through external laboratories, depending on how testing is organised.

Where air monitoring is used

Air monitoring focuses on exposure rather than product composition. It is used alongside product and process testing to give a broader view of where nitrosamines may be present. In some cases, product results alone do not explain potential exposure, particularly when materials release compounds into enclosed or shared environments. Air monitoring helps address this gap by measuring what is present in the surrounding space over time.

Typical uses

- Assessing workplace exposure in manufacturing or processing environments
- Monitoring enclosed spaces where materials may release nitrosamines
- Studying interior environments such as vehicle cabins
- Supporting investigations where airborne release is suspected

Used together, air monitoring and laboratory testing help link what is present in products or processes with what may be present in the surrounding environment. This combined view supports safety assessments, investigations, and longer-term monitoring programmes.



Practical Considerations

Before choosing a system, it helps to think about how nitrosamine testing will fit into your existing laboratory setup. Different approaches place different demands on space, gases, staffing, and workflow, and most laboratories already meet some of these requirements without realising it. The points below outline the practical factors that influence which system is the best fit and how easily it can be integrated into day to day work.

Gas supply

- Nitrogen and oxygen are required for TEA detection
- GC-TEA also needs standard GC carrier gases
- Cylinder or house gas systems are both suitable

Space and placement

- ATNA and GC-TEA sit on a standard laboratory bench
- Footprint is similar when an autosampler is used
- The manual total system must be placed inside a fume hood, with bench space nearby

Workflow and staffing

- Automation suits routine or high-volume schedules
- Manual workflows suit low-throughput or investigative work
- Consider how much hands-on time the team can allocate

Training and operation

- Training is provided during installation for all systems
- Covers software, safe operation, and routine checks
- The level of day to day involvement varies between systems

Integration into existing processes

- Total analysis gives broad screening
- Targeted analysis provides compound-specific values
- Some sites use one approach, others use both depending on workload and reporting needs



Common Questions

What is the difference between total and targeted nitrosamine analysis?

Total analysis gives a single value for all nitrosamines present. Targeted analysis separates and measures individual nitrosamines. Total analysis is often used for screening or trend work, while targeted analysis is used when specific compounds need to be identified or reported.

Do I need both total and targeted analysis?

Some workflows use only one approach. Others use total analysis to screen samples or monitor trends and add targeted analysis when individual nitrosamines need to be measured. The choice depends on workload, reporting needs, and whether compound specific values are required.

What sample types can be tested?

Nitrosamine testing can be carried out on solids, liquids, and many processed materials. The preparation steps vary depending on the matrix, but the detection principles remain the same.

How sensitive is the TEA detector?

The TEA is selective for the NO group found in all nitrosamines. This selectivity allows low-level detection even in complex matrices. Sensitivity depends on the setup, sample preparation, and method conditions, but the detector is widely used for regulated nitrosamine work.

Do I need a GC-MS/MS system for nitrosamine testing?

GC-MS/MS can identify and quantify nitrosamines, but the TEA provides direct, selective detection of the NO group. GC-TEA highlights individual nitrosamines clearly and can also show unexpected peaks, which is useful during investigations or early studies.

How quickly can results be obtained?

For total analysis, most of the time is spent on sample preparation. Once NO is released from the nitrosamines, detection is very fast. GC-TEA run times depend on the chromatographic method, but individual peaks are detected as soon as they elute. Automated systems can run batches unattended, including overnight, which helps shorten turnaround when sample numbers are high.

Next Steps

Ready to look at how nitrosamine testing could fit into your laboratory?

A short meeting is the easiest way to review your options and understand what each system would mean for your workflow.

In the meeting we can cover:

- Your current testing process and any bottlenecks
- The type of nitrosamine data you need
- Total and targeted approaches suited to your workload
- Practical requirements such as space, gases, and staffing
- Package options, pricing, and ongoing support

You can book a meeting at a time that works for you.

Book a meeting to discuss your requirements
<https://bit.ly/nitrosamine-meeting>





Ready to talk? Scan the QR code below or visit <https://bit.ly/nitrosamine-meeting> to book a meeting with our team



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