Ellutia
Chromatography Solutions

Thermosorb-N

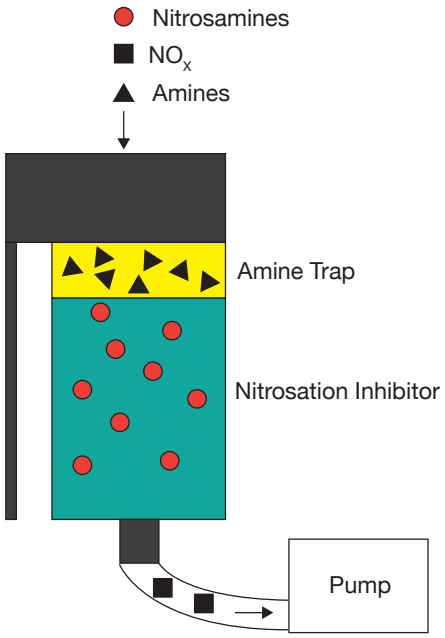
Air Sampling Cartridge

Airborne Nitrosamine Monitoring

Scientists have long been aware that amines can react with various nitrosating agents, under a variety of conditions to form a wide array of N-nitroso derivatives. Amines can also be transnitrosated with already formed N-nitroso or C-nitro compounds via a transnitrosation reaction. In view of all the various pathways for nitrosation of the amine and amine derivatives it is not unexpected that N-nitroso compounds are found in many different areas of the environment. Whilst it is known that nitrosamine are potent carcinogens and may represent a carcinogenic exposure which most people experience on a daily basis, the determination of that exposure is extremely questionable because of the formation of artifacts.

Accurate Reporting

Determination of airborne nitrosamines have been prone to artifact formation (false positives, if solid sorbents are used, and sample loss, i.e., false negatives dues to desorption or degradation in solver if wet traps are used). Nitrosamines are also known to degrade in UV light.



The Ellutia Thermosorb-N offers a method for collecting airborne nitrosamines which overcomes the problems with false positive and false negative results.

Nitrogen oxides can easily react with amines to form nitrosamines. The ease of this reaction suggests that nitrosamines can be artifactually formed either during collection or analysis. To avoid this formation, Thermosorb-N air samplers contain an artifact trap that includes an amine-trapping agent and a nitrosation inhibitor. Nitrosamine levels determined from a sample collected using the Thermosorb-N air sampler, are representative of airborne nitrosamine levels.

In addition to artifact formation, another problem with other collection techniques involved ultraviolet (UV) light degradation of the collected nitrosamines and desorption of the sample over time or temperature. Thermosorb-N air samplers are made of an opaque plastic and employ solid sorbent materials to ensure the sample is not lost.

Monitoring Made Simple

The Thermosorb-N has been designed with the user in mind. The integral clip easily attaches to the pockets or lapels of most work clothes and also permits easy removal. The Thermosorb-N has is designed to be used with personal sampling pumps. End Caps can be stored on the cartridge itself so there is no more hunting around for them when sampling is finished and the cartridge must be sealed.

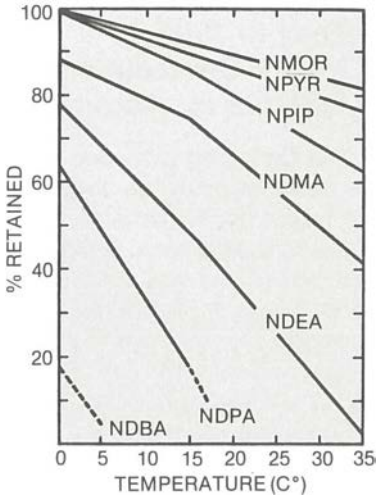
The Large diameter of the Thermosorb-N Air sampler eliminates the need for a backup section in most applications. In cases where unusually large concentrations of N-nitroso compounds are suspected, a second cartridge can be attached to the sampling system “piggyback” style.

The Data Log included with every Thermosorb-N air sampler provides coded labels for the sampler, analysis vials and mailing envelopes to help with sample labelling, as well as providing a convenient form of data entry. The sealable foil pouch provides additional security for transport to and from the field, and as the Thermosorb-N air samplers are constructed of an opaque plastic, there is no UV degradation of the sample.

Once the Sample has been collected with a Thermosorb-N air sampler, analysis is both simple and fast. A solvent back flushing technique is used to elute the sample. The sample can then be analysed by using a gas chromatograph connected to an Ellutia 800 Series TEA.

Freedom From Artifact Formation

When an amine test solution was added to the Thermosorb-n Air Sampler and others (Such as TENAX™, FLORISIL™, activated charcoal, activated alumina and silica gel) and a known volume of NO_x was passed over the sorbents, only Thermosorb-n air samplers had no detectable nitrosamine formation.



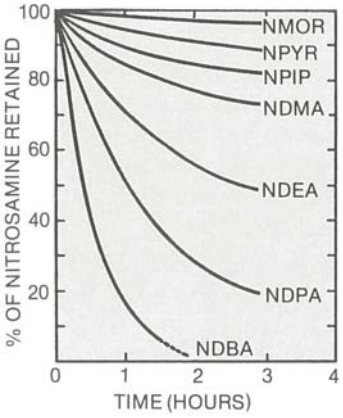
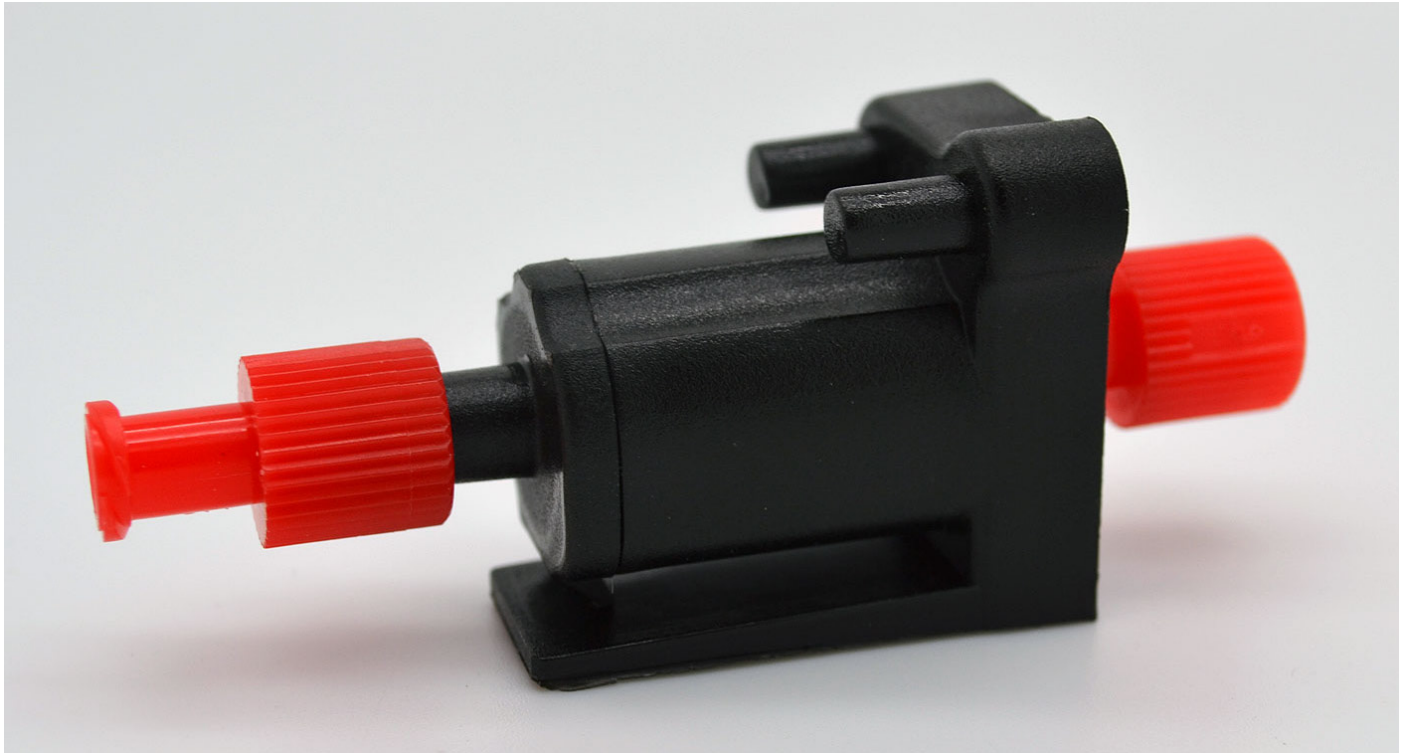


Table 1 - Results of in-situ Formation
After sampling 100l of air containing 1ppm NO + 1ppm NO2 at 2 l/min through Sorbents spiked with 50µg each of 5 amine standards

Sorbent	NDMA	NDiPA	NPIP	NPYR	NMOR
Activated charcoal	5.9	1.7	5.0	1.5	7.9
Activated alumina	1.2	0.1	0.22	0.1	8.9
Florisil	0.59	ND	0.2	0.21	8.1
silica gel	1.9	ND	0.56	0.58	9.0
Tenax GC	0.17	0.45	3.8	1.3	15.5
Thermosorb-n	ND	ND	ND	ND	ND
1N KOH	ND	ND	ND	ND	ND
pH 4.5 ascorbic acid	ND	ND	ND	ND	ND

Nitrosamine Retention

Of the Sorbents that were found to be free of artifact formation only the Thermosorb-n was the only sample method found to quantitatively retain added nitrosamines. When nitrosamine test solutions were added to wet traps (1N KOH or pH 4.5 ascorbic acid), loss of sample was observed over both time and temperature. No Sample loss was observed with the Thermosorb-n air sampler.



Linearity and Precision at Low Concentrations

As shown in table 2, Thermosorb-n air samplers are linear over a wide range of concentrations for seven common volatile nitrosamines. Thermosorb-n air samplers were pre loaded with various nitrosamines at different concentration levels, 100 litre's of air were then passed through the thermosorb-n air samplers at 2 L/min and then eluted and analysed by GC-TEA. The results shown in table 3 demonstrate that Thermosorb-n air samplers are precise at low concentrations (25 ng).

Table 2
Linearity Test %
Recovery

ng Spiked	1000 ng	500 ng	100 ng	25 ng
NDMA	106	94	103	112
NDEA	106	93	99	100
NDPA	100	94	104	89
NDBA	95	99	113	105
NPIP	98	101	103	108
NPYR	94	94	93	89
NMOR	97	92	95	98

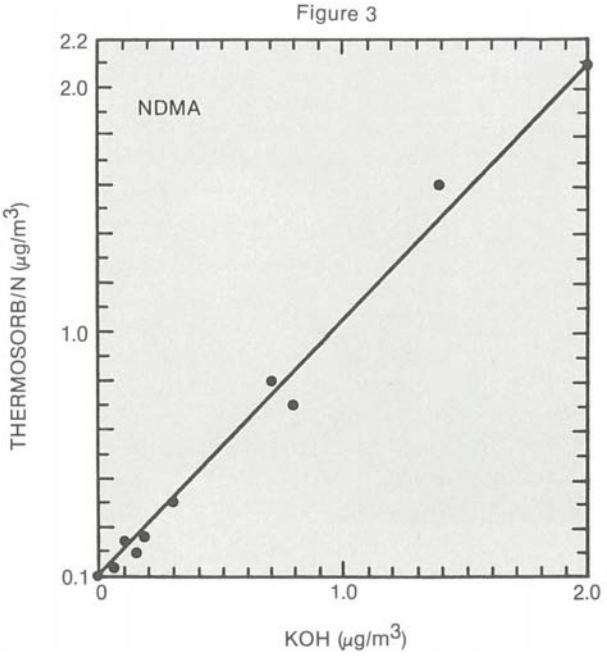
Table 3
Parallel Thermosorb-n Air Sampling at Low Concentrations

Sample No	Volume of Air (liters)	NDMA µg/m³
1	886	0.17
2	1140	0.2
3	781	0.18
4	971	0.19
5	844	0.19

Parallel Field Sampling

Three different industrial environments were samples with both KOH impinger traps and Thermosorb-N air samplers. Analysis was performed immediately after sampling in order to minimise loss from the wet traps. The results are shown in table 3. Thermosorb-n air samplers are as accurate as alkali impinger traps, are easier to use and do not suffer from nitrosamine loss over time and temperature.

Figure 3



Key - Features & Benefits

- Artifact trap and nitrosation inhibitor **- No Artifact Formation**
- Solid sorbent **- No sample loss**
- End caps and sealeble foil pouch **- No pre or post sampling contamination**
- End caps store on sampler, integral clip for personal monitoring **- Easy to use**
- Made of opaque plastic **-No UV degradation of sample**
- Disposable **- No cross contamination**
- Ability to attach a Second Thermosorb-n **- Can be used if large concentrations are expected**
- Flow rates between 0.2 and 4 L./min. **- Suitable for process, environment, or personnel monitoring**

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