Netherlands Technical Agreement

NTA 9055

(en)

Air quality - Electronic air monitoring - Odour (nuisance) and safety

Luchtkwaliteit - Elektronische luchtmonitoring - Geur(overlast) en veiligheid

ICS 13.040.99

November 2012

Normcommissie 390 146 "Luchtkwaliteit"

NEN

©2014 Nederlands Normalisatie-instituut
Postbus 5059, 2600 GB Delft
Telefoon (015) 2 690 390, Fax (015) 2 690 190

Content

Foreword

Detecting changes in the composition of the ambient air using an electronic nose (e-nose) is a frequently used technique that has been introduced recently. E-noses can be used to continuously or incidentally monitor gaseous emissions that pose a risk of odour nuisance and safety risks.

Annex A contains a publication describing how the DCMR Environmental Protection Agency Rijnmond in the Netherlands uses this technology for the qualitative detection of any possible early negative effect on people living in the local neighbourhood (odour nuisance). This also enables an early investigation to be initiated which could enable action to be taken as a proactive measure to prevent any escalation of the situation.

At the request of the DCMR Environmental Protection Agency Rijnmond, the Dutch Ministry of Infrastructure and Environment (I&M) set up a project to lay down the requirements placed on the e-nose in a Netherlands Technical Agreement (NTA). This concerns an e-nose to be used to monitor changes in the composition of the ambient air for purposes of odour (nuisance) monitoring and safety. The request is supported by normcommissie 390 146 “Luchtkwaliteit” (Standards Committee 390 146 on Air Quality) and various parties in the market.

This NTA was drawn up by the Working Group “NTA Electronic nose”, with the following members:

Mr Van der Lee (chair)	TNO, The Hague
Mr Van Belois	Van Belois Environmental Consultancy, Arnhem
Ms Bilsen	VITO, Mol (Belgium)
Mr Boerman	EMS, Sint-Annaland
Mr Boonacker	Province of Groningen, Groningen
Mr Bootsma	Comon Invent, Delft
Mr Bos	c-it, Zutphen
Mr Desmidt	DCMR, Schiedam
Mr Fikenscher/Mr Groot	Municipality of Ede, Ede
Mr Groeneveld	TNO EELS, Rijswijk
Mr Van der Hart	EMS, Sint-Annaland
Mr Hauzer	U.C. Technologies, Zaltbommel
Mr Kalwij	VNO-NCW, The Hague
Mr Kroon	Circlair, Haren
Mr Landman/Mr Te Pas	Province of Gelderland, Arnhem
Mr Leuwerink	Tata Steel, IJmuiden
Ms Milan	DCMR, Rotterdam
Mr Mulder	ESD-SIC B.V. on behalf of VNCI, The Hague
Mr Oord	c-it, Zutphen
Ms Van Putten	RIVM, Bilthoven
Mr Riggelink	Afvalzorg, Assendelft
Mr Schiricke	EnviVice, Eindhoven
Mr Veenings	Province of North-Holland, Haarlem
Mr Veenstra	Witteveen+Bos, Deventer
Mr Visser	Province of North-Brabant, ’s-Hertogenbosch
Ms Van de Vusse	Vusse Milieuadvies, Amsterdam
Ms Baas (secretary)	Netherlands Standardization Institute (NEN), Delft

Air quality – Electronic air monitoring – Odour (nuisance) and safety

1 Scope

1.1 Purpose

The purpose of NTA 9055 is to draw up a list of requirements for using an electronic nose (e-nose) to detect changes in the composition of the ambient air.

1.2 Scope

The scope of NTA 9055 concerns using e-nose technology to support the detecting of changes in the composition of ambient air by gaseous emissions that pose a risk of odour nuisance and safety risks.

An e-nose can give an impression of a gas mixture, just like the human nose can for an odour mixture. The e-nose shall be calibrated for this (training). An e-nose will never equal the human nose and conventional gas detection equipment, but it may supplement sensory odour perception and conventional gas detection techniques.

NTA 9055 can be applied to the following fields:

— continuous monitoring

  Odour measurements are usually performed using the human nose. A group of qualified assessors use their noses to determine the number of European odour units per m^3 contained in an odour sample or to demarcate an odour plume in the ambient air. These two methods have been laid down in the standard for determining odour concentration (NEN-EN 13725:2003) and, respectively, the standard for measuring an odour plume [5] that is being developed. Both methods provide a snapshot indication of the odour emissions. Since this does not allow for continuous odour monitoring, it can be difficult to identify the specific circumstances that cause a nuisance. However, e-noses do allow continuous monitoring. Continuous monitoring using e-noses, combined with a knowledge of current process and weather conditions, makes it possible to identify the cause of odour nuisance in a targeted way.

— information for risk assessment

  The e-nose technology is a tool that enables information to be gathered quickly and in a targeted manner in the event of sudden major emissions, e.g. as a result of an incident. This concerns information on the dispersion of both hazardous and non-hazardous, and both odorous and non-odorous, gaseous substances. This information can serve as the basis for a risk assessment that can be used to make decisions as to alerting, scaling up, de-alerting and deploying and controlling measurement teams. In this manner, the e-nose also plays a role in safety monitoring.

— emission detection and process monitoring

  The e-nose technology can be used for emission detection and for process monitoring in industrial applications. Using the e-nose as a management tool offers diverse advantages. Insight into the odour emission means that a company can minimise odour nuisance and can optimise its processes without causing odour nuisance. The company can also anticipate possible nuisance by making changes to its process. And, in addition to this, if the authorised body holds a company responsible for causing odour complaints, it is easier for the company to substantiate that it has, or has not, caused the nuisance.

1.3 E-nose technology

1.3.1 General

E-noses feature sensor technology that enables a distinction to be made between different types of gas. Several types of e-nose are available in the market, each with their own operating mechanisms. Examples

are e-noses based on polymer sensors, semiconductor sensors or piezo-acoustic sensors. The characteristic feature of e-noses is their broad-spectrum sensitivity. Since, in principle, they are not substance-specific, they can be used to detect several gaseous substances. This is an important difference with analysis instruments intended to detect specific components such as CO, SO_2 and NO_x analysers.

E-noses feature pattern detection technology that enables the e-nose's output (i.e. pattern) for an unknown mixture to be compared to previously measured patterns of known gas mixtures.

After training, the e-nose can distinguish between different types of gas and give an indication of the concentration level. This means that e-noses record changes in the air in a semi-qualitative and a semi-quantitative manner.

NOTE Annex C explains the basic operating principle of e-noses.

1.3.2 Additional information on e-noses for odour nuisance and safety risks

The e-nose is used to continuously and incidentally monitor gaseous emissions that may result in odour nuisance or a safety risk. The e-nose gives an indication of how strongly the odour is perceived by humans, and gives an indication of certain gas concentrations.

If an e-nose is used, it provides information that supplements:

— the odour perception recorded, such as complaints. Complaints are received by control rooms, recorded in logbooks by those living in the neighbourhood, or stem from odour investigations. An added value of the e-nose is that it supplies objective data in case of complaints and that it can serve as a warning system;

— odour investigations carried out by accredited research agencies at the same site, such as gas bag sampling and measurements by sniffer teams. An added value of the e-nose is continuous recording in relation to semi-qualitative and semi-quantitative analysis;

— measurements carried out by a gas measurement expert at the same site, e.g. using single gas and multi-gas detectors, beepers, leak detectors, gas detection tubes or a 'photo ionization detector' (PID). An added value of the e-nose is continuous recording, non-specific change detection, and semi-qualitative and semi-quantitative analysis;

— measurements carried out by a fixed gas detector at the same site. An added value of the e-nose is its broad-spectrum sensitivity that enables several components to be recorded and the effects of cross-sensitivity to be reduced.

NOTE A (trained) e-nose can be used under different meteorological conditions to compare odour contours that have been calculated using dispersion models (e.g. STACKS and PLUIM-plus).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NVN 2818 (nl)	*Odour quality – Sensory determination of the hedonic tone of an odour using an olfactometer*
NTA 9065	*Air quality – Odour measurements – Odour measurement and calculation*
NEN-EN 13649	*Stationary source emissions – Determination of the mass concentration of individual gaseous organic compounds – Activated carbon and solvent desorption method*

NEN-EN 13725	*Air quality – Determination of odour concentration by dynamic olfactometry*
NEN-EN 14412	*Indoor air quality – Diffusive samplers for the determination of concentrations of gases and vapours – Guide for selection, use and maintenance*
NEN-EN-ISO 16017-1	*Indoor, ambient and workplace air – Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography – Part 1: Pumped sampling*
NEN-ISO 16200-2	*Workplace air quality – Sampling and analysis of volatile organic compounds by solvent desorption/gas chromatography – Part 2: Diffusive sampling method*
ASTM D5466-01	*Standard Test Method for Determination of Volatile Organic Chemicals in Atmospheres (Canister Sampling Methodology)*

3 Terms and definitions

The following terms and definitions apply to the use of this NTA.

3.1
control room
operations centre from where a company or a body controls, checks and monitors a situation

3.2
emission
release per unit of time of one or more pollutants to the air

3.3
e-nose
electronic nose
instrument with sensors intended to detect gaseous substances

NOTE Gaseous substances can be both odorous and non-odorous gases. The characteristic feature on this is the broad-spectrum sensitivity. Specific training of the e-nose creates the possibility of identifying substance types by comparing the 'fingerprint' of the sample with that of substances from a database. The e-nose is suitable for semi-qualitative and semi-quantitative analyses.

3.4
European odour unit
one European odour unit is the quantity of odorants that, when evaporated in one cubic metre of neutral gas under standard conditions, elicits a physiological response in a panel (detection limit) equal to the response elicited upon evaporation of 123 µg n-butanol (CAS No. 71-36-3) in one cubic meter of air under standard conditions (concentration is 0,040 µmol/mol)

[NEN-EN 13725, 3.1.19]

3.5
gas chromatography mass spectrometry
method to separate an air mixture into separate components (GC) which are then detected and identified (MS)

3.6
odour
organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances

[NEN-EN 13725]

3.7
odour concentration
number of (European) odour units in a cubic metre of air (ou_E/m^3) under standard conditions

NOTE Since 2003 the European odour unit ou_E/m^3 is used; before 2003 in the Netherlands the odour unit was indicated as ge/m^3. Conversion: 1 ou_E/m^3 = 2 ge/m^3.

3.8
odour emission
quantity of odour emitted per unit of time, expressed in European odour units, equal to the odour concentration in the air flow emitted multiplied by the standard flow rate of the air flow

3.9
odour sample
quantity of the odour-containing process air emitted that is reproducibly and representatively collected in an odour-free and inert material such as Nalophane odour sampling bags, stainless steel cylinders and canisters for odour analyses with an olfactometer

3.10
monitoring
systematically collecting and presenting data for a prolonged period of time in order to follow a situation and show any changes

3.11
odour unit
ou_E
see European odour unit

3.12
olfactometer
dilution instrument for presenting odour to a panel under reproducible conditions

3.13
panel
group of odour assessors qualified according to NEN-EN 13725

3.14
training
building a mathematical model that enables the substances/mixtures that should be detected to be distinguished from non-relevant substances/mixtures (semi-qualification) and an indication to be given of the concentration level (semi-quantification)

4 Symbols and abbreviations

ou_E	European odour unit
DCMR	Environmental Protection Agency Rijnmond
GC-MS	gas chromatography mass spectrometry
PID	photo ionization detector

5 Methodology for using an e-nose

5.1 Training e-noses

5.1.1 General

The signal of a non-trained e-nose can be used to detect changes. The e-nose will then issue a warning that gaseous emissions are taking place. The plume is followed as regards time and place.

Training enables correlations to be made between raw e-nose data and sensory or instrumental perceptions. Thus, trained e-noses record changes in the composition of the air in both a semi-qualitative and a semi-quantitative manner.

NOTE It is important to note that this 'training' does not have to take place at the level of individual electronic noses, but rather at the level of the network formed by the electronic noses. In the latter event, requirements are placed on the mutual reproducibility of the measurements by electronic noses (i.e. do different electronic noses provide the same signal if the same input is offered).

Train the fixed or mobile e-nose as follows:

— Record an e-nose's signal while that e-nose is exposed to air of a different composition.

— Record the sensory or instrumental perception that occurs as a result of exposure to the same air.

— Record the correlation between e-nose data and sensory or instrumental perceptions, such that the relevant sensory or instrumental perceptions can be reproduced if the same e-nose data is recorded repeatedly. Record the band within which the e-nose data is considered to be 'the same' (i.e. sufficiently equal).

After having been trained, e-noses record changes in the composition of the air in a semi-qualitative and/or a semi-quantitative manner.

NOTE 1 Annex D goes into the training aspects more deeply.

NOTE 2 The quality characteristics after training cannot be recorded unambiguously. This is due to such factors as dependence on the type of e-nose, pattern detection technology, application and the training set. Annex E provides a practical example of the performance of an e-nose network during a two-year period.

5.1.2 Training at the measurement site

Train the fixed or mobile e-nose at the measurement site as follows:

— Collect the e-nose data together with information provided by other means of detection gathered at the same place and time.

— Make the correlation between e-nose data and the other information.

Examples of other means of detection are:

— sensory perception by annoyed people, control room operators or by assessors with certified noses;

— a gas measuring expert reading out substance-specific gas detection measuring instruments, such as CO, SO_2 monitors, or a semi-substance-specific gas detector such as a PID;

— measurements using analytical instruments for gas analysis, such as mobile GC-MS;

— results of laboratory analyses of air samples such as gas sample bags and canisters (see 6.3);

NEN
CONNECT

ALTIJD DE ACTUELE NORM IN UW BEZIT HEBBEN?

Nooit meer zoeken in de systemen en uzelf de vraag stellen: ‘Is NTA 9055:2012 en de laatste versie?’

Via het digitale platform NEN Connect heeft u altijd toegang tot de meest actuele versie van deze norm. Vervallen versies blijven ook beschikbaar. **U en uw collega’s** kunnen de norm via NEN Connect makkelijk raadplagen, online en offline.

Kies voor slimmer werken en bekijk onze mogelijkheden op **www.nenconnect.nl**.

Heeft u vragen?

Onze Klantenservice is bereikbaar maandag tot en met vrijdag, van 8.30 tot 17.00 uur.

Telefoon: 015 2 690 391
E-mail: klantenservice@nen.nl