IEEE P2520.2.1
Machine Olfaction Devices and Systems used for General Outdoor Odor Monitoring
(SEN/SC/TMODS/OOM/2520.2.1)

Working Group Meeting Minutes
14 February 2022 / 10:00 AM – 11:00 AM (ET)
WG Chair: Ehsan Danesh
WG Secretary: Cynthia Burham

1. Call to Order

The Chair called the meeting to order at 10:03 AM ET. The Chair also announced that the meeting was being recorded for the purpose of preparing minutes.

2. Roll Call and Disclosure of Affiliation

Affiliation FAQs: http://standards.ieee.org/faqs/affiliation.html

The Chair directed participants to a Google Docs link in the Chat window:

https://docs.google.com/spreadsheets/u/2/d/1ydvTFKxRSYRrpT1CX-22zaNkETV4_aqD2NDVSoxxfk8/edit?ouid=114048767493602967276&usp=sheets_home&ths=true

Participants were asked to register for the meeting by placing an X at the intersection between the row including their name and the column including the meeting date. First-time participants and individuals whose information was not already listed within the Google document were instructed to include their name, affiliation and status under the appropriate columns at the bottom of the Google form. Participants were also asked to include their affiliations in parentheses after their name in the Chat window, if using the chat area. A few minutes were allowed for participants to access and complete the sign-in process. The Secretary added the attendance status of participants who did not complete their attendance status directly.

The Chair mentioned to participants that at least two (2) of the most recent four (4) WG meetings must be attended in order to maintain voting rights. In response to a question in the chat area, the Chair also explained the meanings of ‘status’ (‘voting’, ‘non-voting’, ‘member’, ‘non-member’) and ‘quorum’ and their relevance to our meetings.

The participant information from the chat window and from the participant registration document has been merged and may be found in **Attachment A**.

3. Approval of Agenda

The Chair displayed the announced agenda. The Chair confirmed with the secretary that a quorum existed and proceeded with approval of the meeting agenda and the minutes for the WG Meeting held on December 13th 2021. Cynthia Burham moved that the agenda and minutes be approved. Troy Nagle seconded the motion. Both the agenda and minutes were approved without objection to unanimous consent. 15 voting members were required to be in attendance to achieve quorum. There were 21 voting members in attendance when approval was requested.

4. IEEE Patent & Copyright Policies

a. Call for Patents

https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.pdf

Per standard IEEE-SA WG meeting practice, the Chair reviewed the required policy regarding potentially essential patents. No one raised concerns for consideration.

b. Copyright Policy

https://standards.ieee.org/ipr/copyright-materials.html

Per standard IEEE-SA WG meeting practice, the Chair reviewed the required policy regarding copyrights. There were no questions or concerns.

5. Technical Presentation(s) and Discussion

The Chair mentioned the progress being made on the Standard baseline (2520.1) and reiterated the WG's goal to establish a list of relevant chemicals and concentrations applicable to test.

The Chair provided a short review of the composition of reference gas cylinders and the list of chemicals and relevant concentrations for testing from the report by Wolfhard Reimringer discussed during the December 13th 2021 WG Meeting. The materials and concentrations mentioned include: toluene (5.0ppm), dimethyl sulfide (DMS) (5.0ppm), cyclohexane (50.0ppm), ammonia (1.0ppm), hydrogen sulfide (1ppm), and hydrogen (0.5ppm). The Chair reiterated the relevance of these materials and concentrations to the WGs developing table and mentioned carbon monoxide and methane do not affect VOC sensors at background levels. The point was made that background levels of carbon monoxide and methane do not affect VOC sensors.

After the short discussion, the Chair introduced the presenters for the February 14th 2022 WG Meeting.

a. *Presentation by Robbie Wilmont and Fred Farrow-Dunn*

Robbie Wilmot and Fred Farrow-Dunn are researchers at the United Kingdom's (UK's) National Physical Laboratory (NPL). The NPL is the UK's national metrology institute equivalent of the United States' National Institute of Standards and Technology (NIST). Both presenters have extensive experience crafting primary gas reference materials such as volatile organic compounds (VOCs) and odorant mixtures.

Robbie Wilmont may be contacted at: robbie.wilmot@npl.co.uk.
Fred Farrow-Dunn may be contacted at: fred.farrow-dunn@npl.co.uk.

Additional information regarding NPL gas reference materials and VOCs may be found at:

Volatile organic compounds (VOCs) - NPL
Gas reference materials - NPL

The NPL presentation included a review of the organization's history, capabilities, and extensive experience in preparing primary reference materials (PRMs) for VOCs and odorants. NPL's products meets multi-national certification requirements (e.g., MRA, CCQM, NIST Memorandum of Cooperation) and are used internationally. During the discussion, case studies were introduced highlighting NPL's capabilities.

NPL PRMs are prepared gravimetrically, traceable to SI (International System of Units), and validated against in-house measurements. Capabilities include production of ozone, BTEX (benzene, toluene, ethylbenzene, and xylenes), Terpenes, Oxygenated VOCs, and multi-component Bespoke (custom) mixtures. Concentrations, though dependent upon the materials involved, may generally range from parts per billion (ppb) to high parts per million (ppm).

NPL is able to produce gas cylinders holding multiple precursors. They have the capability to successfully work with 'tricky' materials and combinations at various concentrations and pressures of interest. For example, NPL is the only manufacturer of a cylinder including ozone depleting materials that is used for ozone testing across multiple platforms.

One of NPL's central goals is standardization of primary reference materials used for sensor testing. Provided a list of materials and gas compositions of interest, NPL will work interactively with customers to develop Bespoke PRM mixtures and establish fractions to be incorporated and related uncertainties. NPL creates the mixture and develops a testing methodology. Once measured in-house, the material is distributed to the customer for additional testing using their systems/devices. NPL gathers feedback and adjusts the mixture accordingly until standardized. Once standardized, the materials are made commercially available. The speakers indicated that the materials and concentrations listed in W. Reimringer's table may be easily provided by NPL.

In response to a question regarding materials that are liquid at room temperature, the speakers indicated that relevant liquids are loaded into a transfer vessel which is weighed before and after transfer to establish gravimetric uncertainties. Proprietary software is used to determine the pressures necessary to prevent the liquid from condensing out. The speakers indicated that some liquids having too high or too low a vapor pressure may not be effectively incorporated into a gas reference material as they may condense out. Determinations must be made on a case-by-case basis to determine whether manufacture of Bespoke mixtures is feasible. NPL has a great deal of experience incorporating liquids into gas mixtures and is able to provide information to stabilize cylinders for use in field. If changes in temperature or pressure cause condensation, NPL may also provide instructions to restore the mixture.

With respect to relative mixtures, NPL uses gas phase tables and their software program to determine ranges in which materials may be successfully manufactured. NPL easily supplies typical materials through dilution of a parent to a cylinder. Certain high vapour pressure materials such as formaldehyde are within NPL's repertoire; however, they are limited in range with 5% uncertainty and stability for 1 year. Generally, materials have stability over 5 years. Custom materials may also be created upon request. Though lower concentrations are feasible, formaldehydes are generally produced at a concentration of 10ppm.

NPL will assist customers in establishing conditions necessary to manufacture and maintain requested mixtures at the concentration of interest. NPL will also carry out stability tests for those cases in which they have limited experience. For custom materials, NPL relies on their programs, experience, and trial and error to develop the material. Measurements will occur across weeks and months to determine stability and to create records for comparison.

In response to additional questions, the speakers addressed canister pressure levels, vapour pressure, and reactivity between components. All of these factors are material dependent; specifics are available for standardized materials and will be determined for custom materials.

In response to a question regarding storage cylinders, the speakers indicated that these are produced by trusted manufactures and are generally made from aluminum and include linings/coatings the type of which depends on the material being stored. The lifetime of the gas cylinders is generally 5 years, though specific lifetimes is material dependent and related to drift rates.

b. General Discussion:

Concerns were evidenced, after the presentation, regarding the need for concentrations lower than those mentioned in W. Reimringer's discussion. For example, concentrations may be required to be in parts per billion (ppb) rather than ppm. Diluting the original concentrations further in field may negatively affect results obtained. Determining whether detectability at very low concentrations is necessary is important to standard development. If concentrations are above threshold, sensors will be overwhelmed and the reference material, irrelevant.

Another issue mentioned involved the requirements of an electronic nose (e-nose). An e-nose has nuanced detection capabilities. If an odorant is so concentrated that it overwhelms the e-nose, the e-nose becomes a mere detector of the specific odorant. Standardization requires sensitivity to threshold. Hydrogen sulfide was mentioned as an odorant that must be detectable at very low concentrations for a sensor to be effective. The concentrations of interest must be well below the 1ppm concentration mentioned in the W. Reimringer table.

Surrogates were mentioned as an alternative to establish threshold concentrations providing relevant results. Surrogates are effective in creating mixtures excluding very reactive substances while maintaining detectability of relevant odorants. An example was given involving hydrogen sulfide in hog farm mock-ups. Instead of including hydrogen sulfide in the odorant, fatty acids were used to create the relevant odor without the 'offending' substance so that the other elements within the mixture might be detected at their relevant concentrations rather than the sensor being overwhelmed by hydrogen sulfide.

In response to a question regarding carrier gases, nitrogen was suggested to be very effective. Stability studies might be conducted on the issue. Oxygen was suggested as a carrier gas to be avoided.

The Chair indicated that materials relevant to the WG, including presentations, links, and documents may be found at the WG website:

https://sagroups.ieee.org/2520-2-1/

The Chair mentioned that subgroups crating a list of relevant chemicals and concentrations will be the focus of the WG over the next few months. Subgroups may be created to continue discussion outside the regular WG meeting.

The next WG deadline is 7/8/2022 for initial standard draft v1.0 approval.

6. Approval of Agenda and Previous Meeting Minutes

The Chair received a motion from Cynthia Burham, seconded by Troy Nagle, to approve the agenda and the December WG meeting minutes. The motion passed without objection to unanimous consent. The number of voting members in attendance required for quorum was 15. There were 21 voting members in attendance.

7. Unfinished Business/Action Item Review

There was no unfinished business.

8. New Business

There was no new business.

9. Future Meetings

The next meeting of the WG will take place at 10 AM EDT on March 14, 2022. The next following WG meeting is scheduled for 10 AM ETD on April 11, 2022. The meetings will immediately precede the P2520.3.1 WG meetings. An attempt will be made to keep the meetings to one hour in length, although one or both meetings may be longer than one hour in order to ensure all relevant points within the agenda are addressed.

10. Adjourn

The WG Chair asked for a motion to adjourn. Susan Schiffman made the motion. Cynthia Burham seconded the motion. Without objection to unanimous consent, the Chair adjourned the meeting at 10:56 AM EDT.

Attachment A: Meeting Participants (33)

Last Name	First Name	Affiliation
Peaslee	David	SPEC Sensors, LLC
Sabry	Yasser	Faculty of Engineering, Ain Shams University
Danesh	Ehsan	Alphasense Ltd
Staerz	Anna	Massachusetts Institute of Technology
Burham	Cynthia	University of Texas at Austin
Izquierdo	Cyntia	Olores.org website
Gami	Hirenkumar	Miami University - OH
Li	Hua-Yao	Huazhong University of Science and Technology
Covington	James	Professor, School of Engineering, University of Warwick
Kuna	Kishore	Honeywell Technology Solutions
Capelli	Laura	Politecnico di Milano
Carneiro	Magnovaldo	Virtual University of Sao Paulo State - Univesp
Isz	Sandrine	Alpha MOS
Reimringer	Wolfhard	3S - Sensors, Signal Processing, Systems GmbH
Suciu Jr.	George	Beia RO/AT/BE
Lozano	Jesus	Universidad de Extremadura
Manikandan	M Sabarimalai	Indian Institute of Technology Bhubaneswar
Palma	Susana	NOVA university of Lisbon
Chen	Allen C	Self
Herrier	Cyril	Aryballe
Nagle	Troy	ECE, NC State University
Roman-Gonzalez	Avid	Business on Engineering and Technology S.A.C. (BE Tech)
Saffell	John	Alphasense Ltd.
Sagar	A S M Sharifuzzaman	Sejong university, South Korea
Schiffman	Susan	North Carolina State University
Zarra	Tiziano	Università degli Studi di Salerno
Wilmot	Robbie	National Physical Laboratory
Moraru	Camelia	BEIA Ro
Farrow-Dunn	Frederick	National Physical Laboratory
Raja	Manjula	SRM University AP
Mulla	MohammadYusuf	Research Institutes of Sweden (RISE)
Singh	VR	??
Alam	Md Faizul	??