IEEE P2520.1 Working Group #17
Meeting Minutes
26 September 2022
WG Chair: James Covington
WG Secretary: H. Troy Nagle
Meeting link:
https://ieeesa.webex.com/ieeesa/j.php?MTID=m051f652c43c5f047b8fdc7cfc785bbc1

1. **Call to Order**
   Chair called meeting to order at 10:33 AM EDT. He 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 asked the participants to sign-in at this link:
   https://docs.google.com/spreadsheets/d/1x3Le7jd_5h3bgiNcYMZIfjIbzE2XdE0U8Daon00O8Ks/edit#gid=0.
   The Chair asked the Secretary to check for a quorum. No new members were participating. The List of Participants is shown in **Attachment A**. A quorum was achieved (15 of the 18 voting members were present).

3. **Approval of Agenda**
   The Chair asked for approval of the agenda. Troy Nagle made the motion; Fengchun Tian seconded. Without objection to unanimous consent, the motion was adopted.

4. **Approval of Previous Meeting Minutes**
   The Chair asked for approval of the July 25 Meeting Minutes as circulated. Etienne Bultel made the motion; Ettore Massera seconded. Without objection to unanimous consent, the motion was adopted.

5. **IEEE-SA 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.

6. **Technical Presentation:**
   There was no technical presentation. Instead, the major focus for this meeting was:
   - *Overview of activities for the following 4-6 months*
     Our plan is to refine the testing levels once the chemical lists are completed.
   - *Funding of test activities*
     We will prepare a new TAB CoS proposal based on specific tests cases to prove the standard is practical. The tests could begin in 2023Q2.
   - *Updates and discussion of chemicals list*

Covered in Agenda Item 7.

7. Discussion of Current Draft

Level 3 Pass/Fail Criteria:

At this point in the meeting, the Chair gave a brief update on options for the Level 3 Pass/Fail Criteria. The following points were summarized:

- Level 3 is based on quantification of three chemicals
- Similar to our other levels, we have changes in concentration, temperature and humidity over time
- Pass/fail criteria will be based on "error"
- Much easier to define the error over accuracy and more accepted
- Based currently on MAPE (Mean Absolute Percent Error), with some consideration of RMSE (Root Mean Square Error)

Appendix A: The Chemicals List:

Next, the WG then focused on the list of chemicals for Appendix A. The following characteristics are driving our deliberations. The chemicals should be:

- Relatively safe and stable
- Easily accessible/purchasable
- Applicable to most VOC analyzers
- Available in different forms (cylinder/liquid/permeation)

We will:

- Provide five examples and let the other standards in the series define their own compositions.
- Include examples with gas cylinders and three with liquid chemicals.
- Recommend that testing be done at 25% to 200% of defined concentrations.

A series of questions were offered for consideration:

- *Should cylinders only be in air or is nitrogen allowed?*
  Some sensors do not respond in nitrogen. Dilution devices are available for up to 1/1000. Dilutions of 1/50 are more

- *Can chemicals be diluted in water?*
  After discussion, water dilution is okay if resulting humidity is controlled. Henry's law must be followed. Sample extraction can be from a simple static or a more complex dynamic headspace. Solubility in water is also an important factor. Toluene in water would be fine. Ethanol in water would be a problem. So, in general, water dilution can cause problems and is not recommended. We should give examples of good practice in our guide. Verification of test chemical concentrations at the sample input port will be required. Mineral oil is a diluent option. Paraffin or propylene glycol are other options. They are used for dilutions in olfactometry but human data may be lacking.

Should we have min/max as a function of odor detection threshold?
It was suggested that we base the standard's test concentrations on multiples of the odor detection thresholds (100 was suggested). Dose response curves suggest that this multiple could range for 10 to 1000. Steven's law relates perceived intensity to concentration raised to the n^{th} power. The values of n vary widely. Each test chemical's concentration should be specified individually.

- *Should we consider chemicals for TO-14A/TO-15/TO-17?*
  Attachment B shows the lists that were considered. Only toluene on the TO-14A list might be considered. We are considering a few chemicals on the TO-15/TO-17 that are not on the TO-14A.

The Chair then reviewed chemical lists for Appendix A (five columns). Our recent version of Appendix A is displayed below. WG participants assigned to each group are: Group 1 (James Covington and Ehsan Danesh), Group 2 (James Covington, Ehsan Danesh, and Radislav Potyrailo), Group 3 (Carlos Diaz), Group 4 (Etienne Bultel), and Group 5 (Krishna Persaud and Susan Schiffman)

STRUCTURE OF APPENDIX A

Group 1 – GAS Bottle	Chemical	CAS	ODT (ppm/v)	Conc. ppm
Chemical A	Isobutylene	115-11-7	10	20
Chemical B	Ethanol	16-64-5	0.52	1
Chemical C	Hexane	110-54-3	1.5	3
Group 2 – GAS Bottle	Chemical	CAS	ODT	Conc.
Chemical A	Hydrogen Sulphide	7783-06-4	0.00041	0.1
Chemical B	Ammonia	7664-41-7	1.5	10
Chemical C	Isopropanol	67-63-0	26	100
Group 3 – Liquid	Chemical	CAS	ODT	Conc.
Chemical A	n-butanol	71-36-3	0.038	0.02
Chemical B	Propanoic Acid	79-09-4	0.0057	0.006
Chemical C	Dimethyl Sulfide	75-18-3	0.0030	0.006
Group 4 – Liquid	Chemical	CAS	ODT	Conc.
Chemical A	Ethyl Acetate	141-78-6	0.87	50
Chemical B	Acetone	67-64-1	42	50
Chemical C	Acetic Acid	64-19-5	0.0060	50
Group 5	Chemical	CAS	ODT	Conc.
Chemical A	Isoamyl acetate	123-92-2	2	
Chemical B	Isoamyl alcohol	123-51-3	250-300	
Chemical C	Phenylethyl alcohol	60-12-8	750-1100	

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Further refinements of the Groups were then reported and discussed.

- **Group 1: isobutylene, ethanol, and hexane**

GROUP 1

Group 1 – GAS Bottle	Chemical	CAS	ODT (ppm/v)	Airgas	Air Products	Air Liquide	BOC	Conc. ppm
Chemical A	Isobutylene	115-11-7	10	10, 20, 50, 100	8, 10, 100, 1000 ppm in Air	1–999 ppm, 1000–6000 ppm in Air; 1–999 ppm, 1000–10000 ppm in N2	50, 100 ppm in Air	20
Chemical B	Ethanol	16-64-5	0.52	10, 100	130, 192, 260 ppm in N2	0.1–99, 100–950 ppm in N2	10–300 ppm in N2	1
Chemical C	Hexane	110-54-3	1.5	25	1000, 1200, 5000 ppm in Air	10–999 ppb, 1–49 ppm, 50–5000 ppm in N2 and Air	0.5–9.9 ppm, 10–700 ppm, 50–99 ppm, 100–700 ppm in Air; 0.5–9.9 ppm, 10–700 ppm, 50–99 ppm, 100–700 ppm in N2	3

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The Group 1 chemicals table has increased to nine columns. Ethanol is only available in nitrogen. ETO was offered as an option for ethanol. Further exploration is needed.

- **Group 2: hydrogen sulfide, ammonia, and isopropanol**

GROUP 2

Group 1 – GAS Bottle	Chemical	CAS	ODT (ppm/v)	Airgas	Air Products	Air Liquide	BOC	Conc. ppm
Chemical A	Hydrogen Sulphide	7783-06-4	0.00041	0.5, 25	5, 10, 20, 25, 40, 50, 100, 150, 250, 500 in air and N2	1-999ppm in air	1000-10,000ppm in N2	0.1
Chemical B	Ammonia	7664-41-7	1.5	10, 100	25, 50, 100, 500 in air and N2	1-10,000ppm in air	2-10,000ppm in N2	10
Chemical C	Isopropanol	67-63-0	26	100	N/A			100

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The chemicals in Group 2 are unchanged. No alternatives were offered. The detection levels for these three are greatly different. Can we find a better sulfide to replace H2S? PELs and STELs should be identified if appropriate (add another column).

- **Group 3: n-butanol, propanoic acid, and dimethyl sulfide**

No changes were considered for Group 3.

- **Group 4: ethyl acetate, acetone, and acetic acid**

Group 4	Chemical	Sample Concentration (~ x 100 ODT)	Formulation?	CAS	ODT	P sat (20°C) (hPa) Source: wikipedia …	C max théorique (ppmv)
Chemical A	Butanol	4-250	X/X	71-36-3	0.038 ppm 2,5 ppm	6	6 000
Chemical B	Nonane	200 – 4700	X/X	111-84-2	2.2 ppm 47 ppm	4.2	4 100
Chemical C	Propyl acetate	25 – 60	X/X	109-60-4	0.24 ppm 0.67 ppm	33	33 000
C'	Butanone	500	X/X	78-93-3	**** 5.4 ppm	105	103 000
	Dilution in triethylcitrate, or mineral oil. Validation with PID measurement. Correction factors for 10.6eV lamp can be found easily. Preconcentration on Tenax should be ok if needed. ODT source : Nagata et. Al https://www.env.go.jp/en/air/odor/measure/02_3_2.pdf ODT source : INRS https://www.scalair.nc/images/phocadownload2/generalite/Seuils%20olfactifs_INRS.pdf						

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The Group 4 chemical options have changed. Test concentrations were set to 100x threshold which give concentrations that might be toxic. Formulations may be added as a column. Validation by PID is recommended. Correction factors for 10.6 eV lamps are available. Diluent options, triethyl citrate and mineral oil, are still under consideration. Breakthrough must be avoided if Tenax is used for preconcentration. Further investigation will review chemicals that are used to train human panelists.

- **Group 5: isoamyl acetate, isoamyl alcohol, and phenylethyl alcohol**

GROUP 5

Group 5	Chemical	Concentration (ppm)	CAS	ODT (ppb in water)	Conc. ppm
Chemical A	Isoamyl acetate (banana-like)		123-92-2	2	
Chemical B	Isoamyl alcohol (fusel oil, whiskey, banana)		123-51-3	250-300	
Chemical C	Phenylethyl Alcohol (Rose)		60-12-8	750-1100	
Chemical D	2-methoxy-3-methylpyrazine (Roasted nut)		2847-30-5	3-7	
Chemical E	Gamma-Octalactone (Coconut, creamy)		104-50-7	7	
Chemical F	2-Octenal (Green, citrus, cucumber)		2548-87-0	3	
Chemical G	Phenylacetaldehyde (Green, floral, sweet)		122-78-1	4	
Chemical H	Beta-Pinene (Woody, resinous)		127-91-3	6	
Chemical I	Propanethiol (Cabbage, onion)		107-03-9	3.1	

See http://www.thegoodscentscompany.com/
Dipropylene glycol

The Group 5 list of options has been expanded. The first three as originally proposed have greatly different detection thresholds. Six new options with similar detection thresholds from the Leffingwell list were offered. Each has a FEMA number. Dipropylene glycol is a commonly used diluent. Further study on the toxicity of the Group 5 options will be undertaken.

8. **New Business/Activities for the Next Meeting**
   There was no New Business.

9. **Future Meetings**
   The Chair announced the next meeting of the WG will take place on October 31 at 10:00 AM EDT.

10. **Adjourn**
    The one-hour meeting time-period having expired and without objection to unanimous consent, the Chair adjourned the meeting at 11:37 AM.

https://www.aidic.it/cet/18/68/007.pdf

Attachment A: Participants (17)

NAME	AFFILIATION
Carlos Diaz	Ambiente et Odora
Christopher Jensen	Self
Cyril Herrier	Aryballe
Duke Oeba	Egerton University, Kenya
Ehsan Danesh	Advanced Sensing Technologies Ltd.
Etienne Bultel	Aryballe
Fengchun Tian	Chongqing University
James Covington	University of Warwick
Katayoun Emadzadeh	Self
Krishna Persaud	University of Manchester
Louis-Ray Harris	University of West Indies, Mona
Paul Kagan	AWLDM Systems
Radislav Potyrailo	GE Research
Sandrine Isz	Alpha-MOS
Susan Schiffman	North Carolina State University
Susana Palma	NOVA University of Lisbon
Troy Nagle	North Carolina State University

Attachment B: TO-14A, TO-15/TO-17 Chemical Lists

EXAMPLE CHEMICALS – TO14

Spectra's base TO-14A calibration standard consists of 39 components at concentrations of either 1 ppm or 100 ppb in a balance of VOC free nitrogen (N_2) with other concentrations available as custom mixtures. All TO-14A standards have one-year stability. In addition Spectra supplies 41 and 43 component TO-14A standards, as well as, a variety of subsets.

39 Component TO-14A

Benzene (71-43-2)
Bromomethane (74-83-9)
Carbon Tetrachloride (56-23-5)
Chlorobenzene (108-90-7)
Chloromethane (74-87-3)
1,2-Dibromoethane (106-93-4)
1,3-Dichlorobenzene (95-50-1)
1,4-Dichlorobenzene (541-73-1)
p-Dichlorobenzene (106-46-7)
1,1-Dichloroethane (75-34-3)
1,2-Dichloroethane (107-06-2)
1,1-Dichloroethene (75-35-4)
cis-1,2-Dichloroethene (156-59-2)
1,2-Dichloropropane (78-87-5)
cis-1,3-Dichloropropene (10061-01-5)
trans-1,3-Dichloropropylene (10061-02-6)
Chloroethane (75-00-3)
Ethyl Benzene (100-41-4)
Trichlorofluoromethane (75-69-4) (Halocarbon 11)
Dichlorodifluoromethane (75-71-8) (Halocarbon 12)
1,1,2-Trichlorotrifluoroethane (76-13-1) (Halocarbon 113)
Dichlorotetrafluoroethane (76-14-2) (Halocarbon 114)
Hexachloro-1,3-Butadiene (87-68-3)
Styrene (100-42-5)
1,1,2,2-Tetrachloroethane (79-34-5)
Tetrachloroethylene (127-18-4)
Toluene (108-88-3)
1,2,4-Trichlorobenzene (120-82-1)
1,1,1-Trichloroethane (71-55-6)
1,1,2-Trichloroethane (79-00-5)
Trichloroethene (79-01-6)
1,2,4-Trimethylbenzene (95-63-6)
1,3,5-Trimethylbenzene (108-67-8)
Vinyl Chloride (75-01-4)
o-Xylene (95-47-6)
m-Xylene (108-38-3)
p-Xylene (106-42-3)

EXAMPLE CHEMICALS – TO15/17 NOT ON TO-14

Acetone (67-64-1)
Allyl Chloride (107-05-1)
Benzyl Chloride* (100-44-7)
Bromodichloromethane (75-27-4)
Bromoform (75-25-2)
1,3-Butadiene (106-99-0)
2-Butanone (MEK) (78-93-3)
Carbon Disulphide* (75-15-0)
Cyclohexane (110-82-7)
Dibromochloromethane (124-48-1)
trans-1,2-Dichloroethene (156-60-5)
1,4-Dioxane (123-91-1)
Ethyl Acetate (141-78-6)
4-Ethyltoluene (622-96-8)
n-Heptane (142-82-5)
n-Hexane (110-54-3)
2-Hexanone (MBK) (591-78-6)
4-Methyl-2-Pentanone (MIBK) (108-10-1)
Methyl-Tert-Butylether (MTBE) (1634-04-4)
2-Propanol (67-63-0)
Propylene (115-07-1)
Tetrahydrofuran (109-99-9)
Vinyl Acetate (108-05-4)
Vinyl Bromide (593-60-2)
2,2,4-Trimethylpentane (540-84-1)

** No stability guarantee on these components*
152, 1 ppm 1 year. All other concentrations, six months.