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83nd GRPE, 1-4 June 2021
Agenda item 12

Status Report of the VIAQ (Vehicle Interior Air Quality) Informal Working Group

Geneva, June 1-4, 2021

Chair: Andrey KOZLOV, Russian Federation

Co-Chair: Jongsoon LIM, The Republic of Korea

Secretary: Andreas WEHRMEIER, BMW

ToR for the Third Stage

Terms of reference and rules of procedure for the IWG on Vehicle Interior Air Quality

Background. The group considered the inclusion in the scope of interior air pollutants from outside sources as a possible extension of the mandate at third stage. As an extension of the existing Mutual Resolution on VIAQ, this will take into account not only interior air emissions generated from interior materials and exhaust gases from the vehicle entering into the cabin but also outside air pollution sources. The list of outside air pollutions could include CO, NO, NO2, SO2, O3 volatile organic compounds (VOC), aldehydes, aromatic and aliphatic hydrocarbons, particulate number (PN) and mass (PM) and microbiological substances, e.g. allergens, fungi, bacteria and viruses. As an extension of the existing Mutual Resolution on VIAQ, this will take into account not only interior air quality but also the air cleaning efficiency of the vehicle air handling & treatment system.

Objective. This proposal expands on the issues of the vehicle interior air quality, addressing outside air pollutants entering into the vehicle cabin and the interior air cleaning efficiency, to develop a test procedure in a recommendation by including Part 4 in the Mutual Resolution No. 3.

Scope and work items. Outside air pollutants entering into the vehicle cabin and their cleaning efficiencies

(a) Collect the information and research data on relevant air pollutants and similar issues, and understand the current regulatory requirements with respect to vehicle interior air quality in different markets.

(b) Review, assess and develop new test procedures suitable for the measurement methods of air pollutants entering into the vehicle cabin and their cleaning efficiencies (including test modes, sample collection methods and analysis methods, etc.)

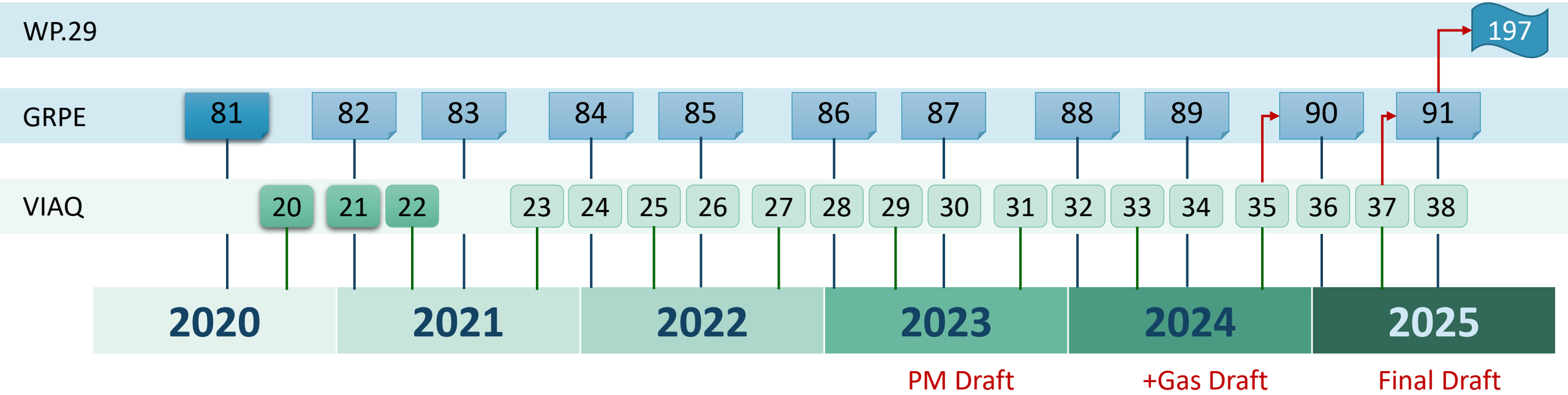
(c) Discuss the potential of air pollutants in the vehicle interior air with toxicologists.

(d) Develop a draft for test procedures in a recommendation.

VIAQ IWG Meetings since the last GRPE session

- **22nd VIAQ IWG Meeting**
  - Webex, 27th April 2021
  - Half a day

Timeline



Data collection → Analysis of existing test procedures → Tests by VIAQ IWG members → **Developing of harmonized test procedure**

Stage 3. Phase 1

Stage 3. Phase 2

The objective and tasks for the Phase 1

Objective:
globally: development of a harmonized (at the UN level) methodology for assessing the effectiveness of air cleaning in the cabin of a complete vehicle
1 phase of work: development of a methodology for the concentration of particles measuring in the passenger compartment of a car in real driving conditions and assessment of the effectiveness of the cabin air cleaning systems regarding particles

Tasks:
1. Development of the draft of the test procedure
2. Carrying out field experiments on various vehicles in various driving conditions with various settings / configurations of the interior ventilation system
3. Analysis of the obtained data (with the development of the method of post-processing of the data), their submission for consideration in the VIAQ group
4. Development of a methodology for measuring the concentration of particles in the passenger compartment under real driving conditions
5. Analysis of the data obtained with an assessment of the effectiveness of the cabin air cleaning system
6. Development of a methodology for assessing the effectiveness of a cabin air cleaning system for a car regarding to particles in real driving conditions
7. Presentation of the methodology and results of experimental studies on the VIAQ group

Comparative analysis of different VIAQ test methodologies

The purpose of this analysis is to compare different vehicle interior air test approaches to develop PM measurement test method.

The items

1. Vehicle Category
2. Criteria for excluding a vehicle from tests
3. Test Vehicle age/millage
4. Meteorological Conditions
5. Test Conditions
6. Sampling Points/Sampling Lines
7. Background air pollution level
8. Cabin air filter age
9. PM and gas components to be Measured
10. Measurement Methods
11. Test equipment requirements
12. Gas Analysers Calibration
13. Test Modes
14. HVAC Modes
15. Test Procedure
16. Test Protocol

Literature Review

Index	Publication reference
CEN	CEN/WS 103 Real drive test method for collecting vehicle interior air quality data // Doc. CEN/WS 103 N. 23, 2021 Pham, L., **Molden, N.,** Boyle, S., Johnson, K., & **Jung, H.** (2019). Development of a Standard Testing Method for Vehicle Cabin Air Quality Index. *SAE International Journal of Commercial Vehicles*, 12(2). http://dx.doi.org/10.4271/02-12-02-0012
CabinAir	**Cha Y.** Dynamic and stationary measurement of in-vehicle PM2.5 and the filtration. VIAQ-21-07
Wei	**Wei, D.**, Nielsen, F., Ekberg, L., **Löfvendahl, A.**, Bernander, M., Dalenbäck, J-O. PM2.5 and ultrafine particles in passenger car cabins in Sweden and northern China—the influence of filter age and pre-ionization. Environ Sci Pollut Res 27, 30815–30830 (2020). https://doi.org/10.1007/s11356-020-09214-0
Abi-Esber	Abi-Esber L, El-FadelM (2013) Indoor to outdoor air quality associations with self-pollution implications inside passenger car cabins. Atmos Environ 81:450–463. https://doi.org/10.1016/j.atmosenv.2013.09.040
Zhu	Zhu Y, Eiguren-Fernandez A, Hinds WC, Miguel AH (2007) In-cabin commuter exposure to ultrafine particles on Los Angeles freeways. Environ Sci Technol 41:2138–2145. https://doi.org/10.1021/Es0618797

Literature Review

1. Both AF, Westerdahl D, Fruin S, Haryanto B, Marshall JD (2013) Exposure to carbon monoxide, fine particle mass, and ultrafine particle number in Jakarta, Indonesia: effect of commute mode. SciTotal Environ 443:965–972. https://doi.org/10.1016/j.scitotenv.2012.10.082
2. Jain S (2017) Exposure to in-vehicle respirable particulate matter in passenger vehicles under different ventilation conditions and seasons. Sustain Environ Res 27:87–94. https://doi.org/10.1016/j.serj.2016.08.006
3. Jung HS, Grady ML, Victoroff T, Miller AL. Simultaneously reducing CO2 and particulate exposures via fractional recirculation of vehicle cabin air. Atmos Environ. 2017 Jul;160:77-88. https://doi.org/10.1016/j.atmosenv.2017.04.014
4. Huang J, Deng F, Wu S, Guo X (2012) Comparisons of personal exposure to PM2.5 and CO by different commuting modes in Beijing, China. Sci Total Environ 425:52–59. https://doi.org/10.1016/j.scitotenv.2012.03.007
5. Kaur S, NieuwenhuijsenM, Colvile R (2005) Personal exposure of street canyon intersection users to PM2.5, ultrafine particle counts and carbon monoxide in Central London, UK. Atmos Environ 39: 3629–3641. https://doi.org/10.1016/j.atmosenv.2005.02.046
6. Knibbs LD, de Dear RJ, Morawska L, Mengersen KL (2009) On-road ultrafine particle concentration in the M5 East road tunnel, Sydney, Australia. Atmos Environ 43:3510–3519. https://doi.org/10.1016/j.atmosenv.2009.04.029
7. Knibbs LD, De Dear RJ, Morawska L (2010) Effect of cabin ventilation rate on ultrafine particle exposure inside automobiles. Environ SciTechnol 44:3546–3551. https://doi.org/10.1021/es9038209
8. Qiu Z, Song J, Xu X, Luo Y, Zhao R, Zhou W, Xiang B, Hao Y (2017) Commuter exposure to particulate matter for different transportation modes in Xi'an, China. Atmos Pollut Res 8:940–948. https://doi.org/10.1016/j.apr.2017.03.005
9. Tartakovsky L, Baibikov N, Czerwinski J, Gutman M, Kasper M, Popescu D, Veinblat M, Zvirin Y (2013) In-vehicle particle air pollution and its mitigation. Atmos Environ 64:320–328 https://doi.org/10.1016/j.atmosenv.2012.10.003

Analysis conclusions

1. The analytical review of published papers describing VIAQ research showed a wide range of approaches, measured substances and particle dimensions, different test modes and conditions, different HVAC settings etc. Most works are research or pilot study.
2. Only some publications contain of relatively detailed description of test methodology and test conditions and they were analysed in this document.
3. Most comprehensive test methodology description is in the document CEN/WS 103 N. 23.
4. Our informal working group could use this information for developing our own harmonized methodology taking into account researchers experience worldwide.
5. Most important criterions for our methodology will be: to find worse case scenario; to minimize cost and test time; to ensure accuracy and repeatability of tests in different laboratories; to harmonize test conditions and test procedure worldwide.

Information discussed last meeting

Company	Presenter Name	Document Title	Document No.
VolvoCars	Dixin Wei	PM 2.5 and UFP in Sweden and Northern China – The influence of filter age and pre-ionization	VIAQ-22-04
CabinAir	Yingying Cha	Vehicle filtration performance for testing at different locations where the dominant particle size is different	VIAQ-22-05
AIR	Nick Molden	Update on method validation. Results of further testing	VIAQ-22-06
NAMI	Andrey Kozlov	Comparative analysis of different VIAQ test methodologies Working items feedback form	VIAQ-22-07 VIAQ-22-08
Cambustion	Mark Peckham	Passenger car cabin air vent [NO] measurements with a fast response CLD	VIAQ-22-09
Stellantis	Juliette Quartararo	Methodology for PM measurements in real driving conditions	VIAQ-22-10
Renault	Didier Moigneu	Air treatment for vehicle interior air quality	VIAQ-22-11

Feedback form

	VIAQ-22-08
Name	
Organization	
Items	**Comments, suggestions**
Criteria for excluding a vehicle from tests	
Test Vehicle age/millage	
Meteorological Conditions	
Test Conditions	
Sampling Points/Sampling Lines	
Background air pollution level	
Cabin air filter age	
PM and gas components to be Measured	
Measurement Methods	
Test equipment requirements	
Gas Analysers Calibration	
Test Modes	
HVAC Modes	
Test Procedure	
Test Protocol	

Next VIAQ IWG Meetings

- **23st VIAQ IWG Meeting (TBD)**
  - Brussels, Belgium, November, 2021
  - or Paris, France, November, 2021
  - Two days
- **24st VIAQ IWG Meeting (TBD)**
  - Geneva, Switzerland, January, 2022
  - Half a day