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

Geneva, January 11-14, 2022

Chair: Andrey KOZLOV, Russian Federation
Co-Chair: Inji PARK, The Republic of Korea
Secretary: Andreas WEHRMEIER, BMW
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.
23rd VIAQ IWG Meeting

- Webex, 25th November 2021
- Half a day

New vice-chair of Informal Working Group was elected:

Inji Park, Chief Researcher
Korea Automobile Transportation Research Institute

Inji Park is in charge of vehicle interior air quality for new vehicles and Korean Green NCAP of VIAQ stream.
**Timeline**

**VIAQ IWG**
Vehicle Interior Air Quality Informal Working Group

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**WP.29**

**GRPE**

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<th>Year</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
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**VIAQ**

- **2020**: Data collection
- **2021**: Analysis of existing test procedures
- **2022**: Tests by VIAQ IWG members
- **2023**: Developing of harmonized test procedure
- **2024**: PM Draft
- **2025**: +Gas Draft Final Draft

**Stage 3. Phase 1**

**Stage 3. Phase 2**
<table>
<thead>
<tr>
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<th>Presenter Name</th>
<th>Document Title</th>
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<tr>
<td>KATRI</td>
<td>Inji Park</td>
<td>Effect of cabin ventilation mode on VIAQ during high PM episode in Korea</td>
<td>VIAQ-23-04</td>
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<td>Fraunhofer IBP</td>
<td>Matthias Brunnermeier</td>
<td>Controllable lab test environment for assessing cabin air quality regarding PM2.5 and CO2</td>
<td>VIAQ-23-05</td>
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<td>AIR</td>
<td>Nick Molden</td>
<td>CEN Workshop 103: Validation of proposed cabin air quality assessment method – results of repeatability and reproducibility testing</td>
<td>VIAQ-23-06</td>
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<td>NAMI</td>
<td>Andrey Kozlov</td>
<td>Measurement of inside and outside PM concentration with one DRX Aerosol Monitor</td>
<td>VIAQ-23-07</td>
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<tr>
<td>NAMI</td>
<td>Andrey Kozlov</td>
<td>The group feedback analysis regarding to test methodology, conditions, equipment</td>
<td>VIAQ-23-08</td>
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<td>NAMI</td>
<td>Andrey Kozlov</td>
<td></td>
<td>VIAQ-23-09</td>
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<tr>
<td>CERTAM</td>
<td>David Preterre</td>
<td>Reproduction of traffic pollution in a test bench to expose a whole car to reproducible scenario of urban pollution: IAQ devices and/or strategies assessment</td>
<td>VIAQ-23-10</td>
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<td>UTAC</td>
<td>Nadir Hafs</td>
<td>Definition of protocol for vehicle in cabin air quality measurements</td>
<td>VIAQ-23-11</td>
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</table>
Working items to develop new VIAQ test methodology

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
# Feedback form

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<th>Items</th>
<th>Comments, suggestions</th>
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<td>Criteria for excluding a vehicle from tests</td>
<td></td>
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<tr>
<td>Test Vehicle age/millage</td>
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<tr>
<td>Meteorological Conditions</td>
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<td>Background air pollution level</td>
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<tr>
<td>Cabin air filter age</td>
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<tr>
<td>PM and gas components to be Measured</td>
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<tr>
<td>Measurement Methods</td>
<td></td>
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<tr>
<td>Test equipment requirements</td>
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<td>Gas Analysers Calibration</td>
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<td>Test Procedure</td>
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<td>Test Protocol</td>
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</tbody>
</table>
Responses from:

CEN/WS 103*

OICA Members

CLEPA (EU Association of Supplier)

UTAC/ES TACA (Paris saclay)

Korea Automobile Testing & Research Institute

CabinAir Sweden AB

The full text feedback tables are in the document VIAQ-23-09
*CEN/WS 103 items from the document “Real drive test method for collecting vehicle interior air quality data” // Doc CEN/WS 103 N 23 2021
1. Vehicle Category (agreed)

Category 1-1
Working items

2. Criteria for excluding a vehicle from tests

Proposals:

Exclusion shall be based on a positive answer to any of the criteria below:

✓ Is the vehicle more than one month aged?
✓ Does the vehicle not have a full service history?
✓ Is there a Malfunction Indication Light showing on the vehicle instrument panel?
✓ Has the vehicle had unauthorised vehicle repairs?
✓ Has any part of the vehicle’s heating and ventilation system replaced with non-original parts?
✓ Through visual inspection of the vehicle, are there any damaged ventilation system relevant components?
✓ Are there any obstructions to the vehicle air intake path?
✓ Is the vehicle not in overall safe operating condition?
✓ Is there any damage to the body of the vehicle, including but not limited to doors, windows and the rear?
Working items

3. Test Vehicle age/mileage

Proposals:

1. 3 000...15 000 km
2. 3 000...160 000 km
3. <25 000 km and age <2 years
4. >5 000 km

This item needs additional discussion
4. Meteorological Conditions

Proposals:

Weather condition: no rain, fog, snow or standing water on the carriageway
Relative Humidity 40...80%
Atmospheric pressure 85...110 kPa

Temperature:
1. -7...+35°C
2. 10...20°C
3. 5...25°C

Temperature range needs additional discussion
5. Test Conditions

Proposals:

- The test must be primarily conducted on city roads and urban locations
- Driving time: Monday to Sunday, 06:00 to 20:00
- Road condition: Paved streets
- It is recommended to avoid long tunnels, high altitudes and construction areas.

Each trip shall meet the conditions below:

- Instantaneous vehicle speed \( \leq 60 \text{ km/h} \)
- Minimum distance: 10 km
- Minimum duration: 30 min
- A normal driving style shall be adopted.
- Average speed: 40...60 km/h
- Average altitude: 0...700 m
- There should be the driver and one passenger present in the vehicle for the duration of the test.
- All outer clothing of the driver should be made of [polyester] to minimise particle generation from the driver.
- The cabin before the test should be cleaned and free of dust or other dirt.

Alternatively:

UN Requirements to RDE

The item needs additional discussion
6. Sampling Points/Sampling Lines

Proposals:

1. The interior sampling point should be at a head-height between the front headrests.

2. The external sampling point should be as close as reasonably possible to the ventilation air intake. Sampling should be isokinetic. Alternatively: Not measured, and used PM10 and PM2.5 data from real-time roadside monitoring stations.

3. The sample lines should be made of a near-zero-loss material such as PTFE for gas and anti-static material for particulates. Not longer than 1 m and with no sharp bends.

The item needs additional discussion.
7. Background air pollution level

Proposals:

PM$_{2.5}$ concentration:
- 5...100 µg/m$^3$
- 10...200 µg/m$^3$
- 81...150 µg/m$^3$
- > 30 µg/m$^3$

The item needs additional discussion
8. Cabin air filter age

Proposals:

HVAC filter age:
- New, OEM-approved
- Normal filters use for 3000 km or Ageing procedure
- Original OEM HVAC filter with max. 3000 km
- Aged filter out of filter replacement cycle which driving mileage 10 000 km~15 000 km
- Both New and Aged

The item needs additional discussion
## Working items

### 9. PM and gas components to be Measured

<table>
<thead>
<tr>
<th>Proposals:</th>
<th>Optionally:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN (10 nm to 10 μm)</td>
<td>small fraction PM (0.1-1 μm)</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>tVOC</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>PAH</td>
</tr>
<tr>
<td>CO</td>
<td>NO$_x$ (NO$_2$ &amp; NO)</td>
</tr>
<tr>
<td>CO$_2$</td>
<td>NH$_3$</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>O$_3$</td>
</tr>
</tbody>
</table>

The item needs additional discussion
10. Measurement Methods

Proposals:

PN concentration: Condensation particle counter (10 nm to 10 μm)
PM concentration (<10 μm): Mini Wide Range Aerosol Spectrometer
Aethalometer
90° light scattering & filter-sampling
CO concentration: Non-dispersive infra-red
Electrochemical cell
CO₂ concentration: Non-dispersive infra-red
NO₂ concentration: Non-dispersive ultra-violet
Chemiluminescent detector

The item needs additional discussion in connection with item 9
## 11. Test equipment requirements

**Proposals:**

- PN concentration: 0 to 1,000,000 #/cm³ (particles: 10 nm to 10 μm)
- PM concentration (<2.5 μm): 0 to 1 mg/m³
- PM concentration (<10 μm): 0 to 1 mg/m³
- CO concentration: 0 to 1 ppm
- CO₂ concentration: 0 to 5,000 ppm
- NO₂ concentration: 0 to 0.5 ppm

**Alternatively:**

- PN concentration: 1 to 2,000 #/cm³
- PM concentration (<2.5 μm): 0 to 100 mg/m³
- PM concentration (<10 μm): 0 to 100 mg/m³
- NO₂ concentration: 0 to 2 ppb

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The item needs additional discussion in connection with items 9 and 10
12. Gas Analysers Calibration

Proposals:

For in-field calibration of the gas analysers, a zero and span calibration shall take place at the start of the test and a zero and span check shall be made at the end of each test that is under two hours in length. For tests longer than two hours, mid-test checks of zero or zero and span may be made (such that the time between checks does not exceed two hours); the analyser may be adjusted to the calibration gases if necessary.

Annual calibration following supplier recommendation

The item needs additional discussion
13. Test Modes

Proposals:

1. Urban (city) driving
2. Real driving conditions
3. Stationary test
4. Laboratory test

The item needs additional discussion
14. HVAC Modes

Proposals:

HVAC system settings:
• Automatic mode (or for manual mode fan speed 50%/medium)
• Temperature 21°C (or for manual mode 50%/medium temperature)
• Fresh air mode
• Air conditioning switched ON
• Ventilation flaps fully open and directed straight ahead

Alternatively:

• Temperature 23°C
• For manual HVAC: xx% fresh, yy% in recirculation
• A/C must be OFF

The item needs additional discussion
15. Test Procedure

Proposals:
1. Cold start operation shall be excluded. To ensure this, the first 10 minutes or the first 2 km of driving under internal combustion engine operation shall be excluded from any test, whichever comes later. This restriction does not apply to vehicles with no internal combustion engine.

2. A test is a continuous stretch of driving that can contain multiple trips.

3. A test may be split up into multiple trips, each of which must meet the trip conditions. A trip shall start from a point at which the vehicle is stationary, with stationary defined as less than or equal to 0.5 km/h. There shall be no overlaps between the trips. A single trip shall be made up of continuous driving. Multiple trips from the same test can, in-between those trips, allow driving that does not meet the boundary conditions of CWA.

4. For test results to be deemed adequate for use in comparing interior air quality performance between models within the scope of this CWA, it shall be required to collect:
   • at least 3 valid trips in total
   • in the required fan speed/ventilation modes
   • on 1 vehicle of its type.

Alternatively:
Measurements with two consecutive vehicles (the test is independent on background pollutant concentration)
16. Test Protocol

Proposals:

The protocol contains
1. Vehicle information (car registration number, mileage, engine type, filter type and age...)
2. Test condition information (testing date, driving locations, ambient conditions, number of passengers...)
3. Reporting of trip results (inside and outside measurement results, filtering efficiency...)

The item needs additional discussion
## Additional research needed

<table>
<thead>
<tr>
<th>Working Item</th>
<th>Research needed</th>
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<tr>
<td>4. Meteorological Conditions</td>
<td>Acceptable ambient temperature range</td>
</tr>
<tr>
<td>9. PM and gas components to be Measured</td>
<td>Which substances concentration to measure (taking into account their toxicity) Include or not CO₂ (non toxic but affects on driver concentration and safety)</td>
</tr>
</tbody>
</table>
| 8. Cabin air filter age              | What is more representative:  
  - New filter  
  - Aged filter  
  - Need to test both                                                                                                                                |
| 13. Test Modes                       | Which combination of test modes is representative regarding VIAQ assessment:  
  - Urban (city) driving  
  - RDE (city + suburban + highway)  
  - Laboratory test                                                                                                                                     |
| 14. HVAC Modes                       | Which combination of HVAC settings is worst case:  
  - Air conditioner ON/OFF  
  - Interior temperature setting  
  - Recirculation ON/OFF                                                                                                                                  |
Next VIAQ IWG Meetings

- 24th VIAQ IWG Meeting (TBD)
  - Brussels, Belgium, April-May, 2022
  - or Paris, France, April-May, 2022
  - Two days