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80th GRPE, 14-17 January 2020
Agenda item 12

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

Geneva, January 14-17th 2020

Chair: Andrey KOZLOV, Russian Federation

Co-Chair: Jongsoon LIM, The Republic of Korea

Secretary: Andreas WEHRMEIER, BMW

During 173rd WP.29 session in Geneva (14-17 November 2017) Proposal for a new Mutual Resolution (M.R.3) for of the 1958 and the 1998 Agreements concerning Vehicle Interior Air Quality (VIAQ) was adopted (ECE/TRANS/WP.29/2017/136). Final text of Mutual Resolution M.R.3 was published at UNECE site on 1 of November 2018 as the document **ECE/TRANS/WP.29/1143**

United Nations



Economic and Social Council

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World Forum for Harmonization of Vehicle Regulations

Mutual Resolution No. 3 (M.R.3) of the 1958 and the 1998 Agreements

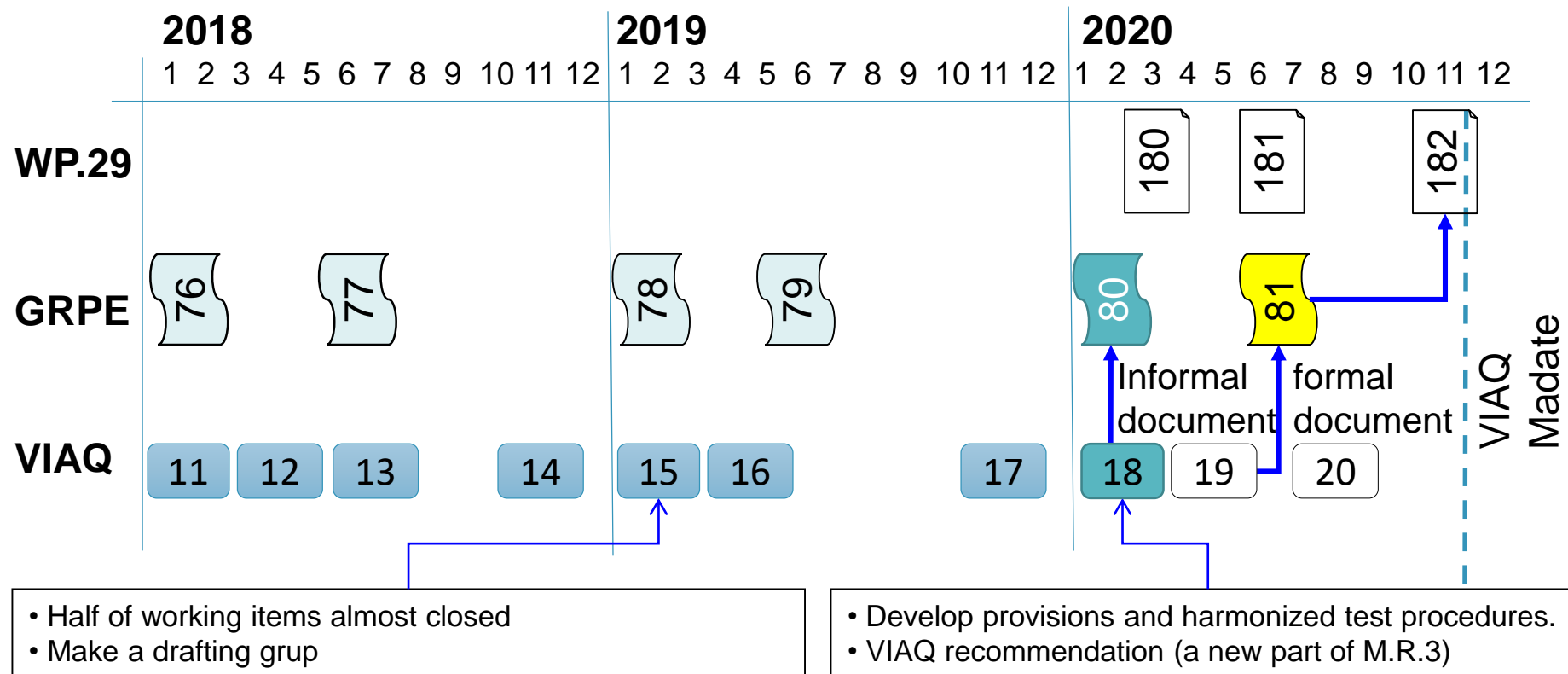
Concerning Vehicle Interior Air Quality (VIAQ)

The text reproduced below was adopted on 14 November 2017 by the World Forum for Harmonization of Vehicle Regulations (WP.29) regarding the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions (1958 Agreement) and on 15 November 2017 by the Executive Committee AC.3 of the Agreement Concerning the Establishing of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles (1998 Agreement) (ECE/TRANS/WP.29/1118, paras. 99-100 and 101). It is based on document ECE/TRANS/WP.29/2017/136.

● Terms of reference

- ✓ Identify and collect the information and research data on interior air quality and its relevance for vehicles, taking into account the activities being carried out by various governments, and non-governmental organizations.
- ✓ Identify and understand the current regulatory requirements with respect to vehicle interior air quality in different markets.
- ✓ Identify, review and assess existing test procedures suitable for the measurement of harmful substance into the vehicle cabin (including test modes, sample collection methods and analysis methods, etc.)
- ✓ Develop provisions and test procedures in a recommendation by including Part 3 in the Mutual Resolution No. 3.

● Timeline



- **January 2020:** Submit the draft document to GRPE
- **June 2020:** Adoption of the draft document by GRPE
- **November 2020:** Adoption of the draft document by WP.29

➤ **17th VIAQ IWG Meeting**

- Munich, Germany, November 6-7th 2019
- Two days

1.Vehicle Category

2.Test Vehicle age/millage

3.Substances to be Measured

4.Meteorological Conditions

5.General Test Conditions

6.Test Modes

7.HVAC Modes

8.Test Procedure

9.Measurement Methods

10.Sampling Points

11.Sampling Method

12.Test Protocol

During last two years by Informal Working Group was developed new Revision 1 of Mutual Resolution 3 on Vehicle Interior Air Quality. The main updates in new Revision are

- 1. Updated the part I for technical rationale and justification taking into account emissions from tested vehicle entering to the cabin with exhaust gases**
- 2. Updated the description of existing regulations and standards in part I**
- 3. Added the part III describing the test procedure for emissions entering to the vehicle cabin with exhaust gases**
- 4. Added 2 annexes describing Idle test setup and the form of the test report**

NO changes in part II describing test procedure for emissions from interior materials are made.

Draft of Revision 1 of Mutual Resolution No. 3 is in the informal document GRPE-80-21

and with track changes in the informal document GRPE-80-22

Part III of M.R.3 (Revision 1) on VIAQ

1. Purpose

The part III of the Mutual Resolution contains the provisions and harmonized test procedure for the measurement of interior air quality, concerning the protection of passengers and driver from harmful emissions entering to the vehicle cabin with exhaust gases.

2. Scope and application

This part of Mutual Resolution applies to category 1-1 vehicle, as defined in the Special Resolution No. 1.²

3. Definitions

For the purpose of this part, the following definitions apply:

- 3.1. "*Test vehicle*" means the new vehicle from series production to be tested, mileage from 3,000 – 15,000 km;
- 3.2. "*Test substances*" means substances to be measured in air. Measured substances are carbon monoxide (CO), nitrogen monoxide (NO), nitrogen dioxide (NO₂).
- 3.3. "*Background concentration*" means the test substance concentrations in the ambient air when the test vehicle engine is OFF;
- 3.4. "*Idle test*" refer to the test in which sampling of substances in the interior air of a test vehicle parked outside back side against the wind direction with engine running at minimal idle speed is performed;
- 3.5. "*Constant speed test*" refer to the test in which sampling of substances in the interior air of a test vehicle moving at a constant speed is performed;
- 3.6. "*Sampling point*" means a point between headrests of front seats;

- 3.7. "*Category 1 vehicle*" means a power driven vehicle with four or more wheels designed and constructed primarily for the carriage of (a) person(s);
- 3.8. "*Category 1-1 vehicle*" means a category 1 vehicle comprising not more than eight seating positions in addition to the driver's seating position. A category 1-1 vehicle cannot have standing passengers.

4. Abbreviations

4.1. General abbreviations

VIAQ	Vehicle Interior Air Quality
HVAC	Heating, Ventilation and Air Conditioning

4.2. Chemical symbols and abbreviations

CO	Carbon monoxide [CAS#: 201230-82-2]
NO	Nitrogen monoxide [CAS#: 10102-43-9]
NO ₂	Nitrogen dioxide [CAS#: 10102-44-0]

5. General provisions

- 5.1. When instructed to include this test procedure in national standards, Contracting Parties are invited to adopt this part of Mutual Resolution regarding the measurement of interior air emissions entering into the cabin with exhaust gases.
- 5.2. This part of Mutual Resolution does not hold regulatory status within Contracting Parties. Contracting Parties refer to the VIAQ recommendation when used for the assessment on vehicle interior air quality with the technical prescriptions of their own standards or regulations.
- 5.3. There are several test methods available for assessing vehicle interior air quality and this Mutual Resolution takes into account these existing standards. There are two type of tests, each with their own testing methodology. These test modes would be subject to optional acceptance by Contracting Parties depending on their situations. Contracting Parties may optionally decide to the test type.
- 5.4. This part of Mutual Resolution will encourage the improvement of vehicle body and air heating, ventilation and conditioning system design to increase air quality inside the passenger cabin.
- 5.5. Substances to be measured are carbon monoxide, nitrogen monoxide, nitrogen dioxide.
- 5.6. Due to the different levels of development, different regional cultures, and the costs associated with interior air quality control technology, the regulatory stringency is expected to be different from region to region for the foreseeable future. The setting of interior pollutant concentration limit values, therefore, is not part of this recommendation for the time being.

6. Normative references

- 6.1. ISO 16000-1:2004 Indoor air – Part 1: General aspects of sampling strategy.
- 6.2. UN Regulation No. 83 - Rev.5 – Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements (Annex 4a - Appendix 7).

7. Requirements for the test vehicle

- 7.1. Test vehicles should only be new vehicles from serial production. Used vehicles are not included. The selection of vehicles should be based on a worst case to minimize testing cost. For the purpose of emissions entering into the cabin with exhaust gases only serial equipment for air purification is allowed in the test cars.
- 7.2. The new vehicle should be driven in the range from 3000 to 15000 km.
- 7.3. General inspection of the test vehicle should be checked before testing.

8. Requirements for the test apparatus, instrument, equipment and facility

- 8.1. Test facility.
 - 8.1.1. During the tests contamination from outside sources has to be prevented. Therefore background measurements of the analytical substances have to be done before and after the test and in constant speed mode. Background concentrations have to be less than 25% of limit concentration. Difference between measurements of background concentrations before and after the test runs should not be more than 10% of limit concentration.
 - 8.1.2. For the purpose of idle test it is possible to use natural wind (if within the specification) or air blower to provide uniform air flow along the tested vehicle with a velocity of 2 ± 1 m/s.
 - 8.1.3. Test facility for idle test is an open parking zone.
 - 8.1.4. Test road for constant speed test is a paved road with the slope up to 6.0%.
- 8.2. Measurement method.
 - 8.2.1. Measurement of pollutant concentration in interior air is possible with using of two methods: on-line or off-line measurement.
 - 8.2.2. On-line measurement should be the preferred method and is carried out directly inside the tested vehicle with appropriate gas analysis equipment.
 - 8.2.3. Off-line measurement should only be used in case of impossibility to maintain on-line measurement equipment inside the vehicle and is carried out by sampling of interior air probes in sealed bags.
- 8.3. Sampling method.
 - 8.3.1. Sampling method in case of off-line measurement is aspiration.
 - 8.3.2. The sampling system consist of: inverter for power supply to sampling system, air pump with flow rate of 2 l/min, air flow meter, clock, sampling bag of at least 30 l and connecting tubes.
 - 8.3.3. The flow rate and duration of sampling is set in accordance with the required sample volume necessary for two parallel samples from one sampling point and is regulated by the requirements of the appropriate measurement procedures and the analytical parameters of the gas analyzer used.

In case of emissions measurement from exhaust gases with on-line gas analysers for CO, NO, NO₂ at least 5 measurements during 15 minutes have to be collected and then use averaged value as a result.
- 8.4. Pollutant concentration measurement methods.
 - 8.4.1. For nitrogen oxides (NO, NO₂):
 - (a) Chemoluminescence (CLD).
 - (b) High-sensitive electrochemical detection (ECD).
 - 8.4.2. For carbon monoxide (CO):
 - (a) Infrared photoacoustic spectroscopy (IRPAS)
 - (b) Electrochemical detection (ECD)
 - (c) None dispersive Infrared detector (NDIR).

8.5. Pollutant concentration measurement limits.

8.5.1. The measuring equipment should provide the lower and upper limits of pollutants measurable concentrations at the presence of other components as in the table below.

Pollutant name	Lower limit of measurement, not less than, mg/m ³	Upper limit of measurement, not more than, mg/m ³
Nitrogen monoxide NO	0.03	4.0
Nitrogen dioxide NO ₂	0.02	2.0
Carbon monoxide CO	1.0	50.0

8.6. Another measurement equipment.

8.6.1. For tests carrying out another measurement equipment are used: thermometer, relative humidity meter, barometer, anemometer. Limit of permissible basic error for mentioned above equipment is presented in the table.

Parameter	Limit of permissible basic error
Temperature	±1°C
Relative humidity	±2.5%
Atmospheric pressure	±0.1 kPa
Wind velocity	±(0.2 +2% from measured value) m/s
Flow rate	±5%

9. Test procedure, test mode, and test conditions

9.1. The preparation procedure.

9.1.1. Take out cabin air filter and replace by new not contaminated one.

9.1.2. Check vehicle for tightness (sealings, windows, doors, trunk, roof). A vehicle with defective components should not be tested.

9.1.3. Ensure exhaust pipe is representative of serial production. Visually check exhaust pipe for tightness.

9.1.4. Before testing pollutant concentration measurement equipment or sampling system should be placed inside a test vehicle and warmed up ahead of test start time in accordance with equipment manual.

9.2. Test conditions.

9.2.1. Ambient temperature in the range from -7°C to 30°C.

9.2.2. Relative humidity from 30% to 90%.

9.2.3. Atmospheric pressure from 85 to 110 kPa

Part III of M.R.3 (Revision 1) on VIAQ

- 9.3. Idle test.
 - 9.3.1. Insure the wind speed is equal to 2 ± 1 m/s in case of testing at natural air movement.
 - 9.3.2. Park the vehicle in a position so the wind direction, natural or simulated, achieves a linear speed of air perpendicular to the rear of the test vehicle.
 - 9.3.3. Locate the sensors to the center point behind the test vehicle to measure wind speed, temperature and humidity. The center point behind the vehicle is 0.5 m from the rear of the vehicle and 1.0 m from ground. During sampling, the sensors will continually monitor at this center point location.
 - 9.3.4. Verify the uniformity of the wind to insure it is constant across the vehicle within the airflow tolerance and perpendicular to the rear of the vehicle. To verify the uniformity, measure the wind speed at two additional points 0.5 m on each side of the vehicle prior to sampling (see Annex V). To verify the wind is perpendicular to the vehicle, use a multi-axis flow meter or another method to verify that the cross wind is less than 15% of the wind airflow at all three locations prior to testing.
 - 9.3.5. Start the engine and warm-up vehicle by driving for a minimum 15 minutes.
 - 9.3.6. After warm-up, park the vehicle by backing into the previous position, such that the wind will force the exhaust gases back towards the vehicle. Set the vehicle's climate system to air conditioner: OFF; recirculation: ON and make sure that outside flaps do not open during test; temperature: manual and coolest level; fan: highest level; dashboard vent: all open and horizontal, and rear vents: closed.
 - 9.3.7. With the engine off, ventilate vehicle for 5 minutes with all doors and windows open. Then close the doors and windows. Check the door seals, windows, doors, trunk, and roof.
 - 9.3.8. During sampling, no people are inside the test vehicle. With the engine off measure the background pollutant concentrations. Start measuring wind speed, temperature and humidity at the center point 0.5 m behind the vehicle and 1.0 m from ground. Sample air from a location between the front seats at least 5 measurements during 15 minutes and then use averaged value as a result. If sampling into a bag for off-line analyzes then take two samples over 15 minutes, one sample for the reported measurement and one as a backup in case of failure. Stop all measurements and proceed to the idle measurement.
 - 9.3.9. Open the door, start the engine, confirm the climate system settings, exit and close the door. This operation should take about one minute. With the engine running in an idle condition measure the vehicle interior pollutant concentration level. Start measuring wind speed, temperature and humidity at the center point 0.5 m behind the vehicle and 1.0 m from ground. Sample air from a location between the front seats, take at least 5 measurements during 15 minutes. If sampling into a bag for post analyses then take two samples over 15 minutes, one sample for the reported measurement and one as a backup in case of failure.
 - 9.3.10. Stop all measurements, open the door and switch engine off. Take another background measurement according to chapter 9.3.8. Vehicle idle test is complete.

Part III of M.R.3 (Revision 1) on VIAQ

- 9.4. Constant speed mode.
- 9.4.1. Start the engine and warm-up vehicle by driving for a minimum 15 minutes.
- 9.4.2. After warm-up, park the vehicle and set the vehicle's climate system to air conditioner: ON; recirculation: ON and make sure that outside flaps do not open during test; temperature setting: 20 degrees by Celsius in automatic climate system or middle position for manual system; fan: highest level; dashboard vent: all open and horizontal, and rear seat vents: closed.
- 9.4.3. With the engine off, ventilate vehicle for 5 minutes with all doors and windows open. Then close the doors and windows. Check the door seals, windows, doors, trunk, and roof.
- 9.4.4. During sampling, no people are inside the test vehicle. With the engine off measure the background pollutant concentrations. Start measuring wind speed, temperature and humidity at 1.0 m from ground. Sample air from a location between the front seats at least 5 measurements during 15 minutes and then use averaged value as a result. If sampling into a bag for on-site analyzes then take two samples over 15 minutes, one sample for the reported measurement and one as a backup in case of failure. Stop all measurements and proceed to the constant speed measurement.
- 9.4.5. Start the engine, confirm the climate system settings. Only two persons are allowed inside the cars during driving test. Start driving and accelerate smoothly to a speed of 50 km/h. Measure the vehicle interior pollutant concentration level. Sample air from a location between the front seats, take at least 5 measurements during 15 minutes. If sampling into a bag for post analyses then take two samples over 15 minutes, one sample for the reported measurement and one as a backup in case of failure.
- 9.4.6. Stop all measurements, park the vehicle and switch engine off. Take another background measurement according to chapter 9.4.4. Vehicle constant speed test is complete.

10. Calculation, presentation of results, and precision and uncertainty

- 10.1. Calculation of results: take at least 5 measurements from gas analysers and use mean values as results.
- 10.2. Data reporting shall use the format in Annex VII. Additions to the report should be agreed on between the client and the laboratory.

11. Performance characteristics

- 11.1. Calibration procedure.
 - 11.1.1. Calibration should be done according to GTR 15.
 - 11.1.2. Calibration can be done by certified gas mixtures or preparation with a gas mixture generator (dynamic gas divider) used for the preparation of binary calibration gas mixtures within the permissible relative deviation of the dilution ratio from the nominal value within $\pm 2\%$; calibration gas mixtures (CGM) of calibrated components (NO in nitrogen, NO₂ in nitrogen, CO in nitrogen) with concentration error $\pm 5\%$; diluent gas in a ballon (synthetic air or nitrogen) with minimum purity 99.999%; connecting tubes from chemically inert materials.
 - 11.1.3. Preliminarily prepare 3...4 variants of dynamic gas divider valves setting to achieve analyzed gas concentration levels in the measurement range.
 - 11.1.4. Consistently set certain analyzed gas concentration level and measure it with calibrated gas analyzer. The difference between the set and measured concentration values (the main relative measurement error), should not exceed 25%.

Part III of M.R.3 (Revision 1) on VIAQ

12. Quality assurance/quality control

12.1. The tests proceeded in accordance to chapter 9 of part III are valid if all quality requirements listed in this chapter are fulfilled.

12.2. Quality control requirements for idle test are listed in the table below.

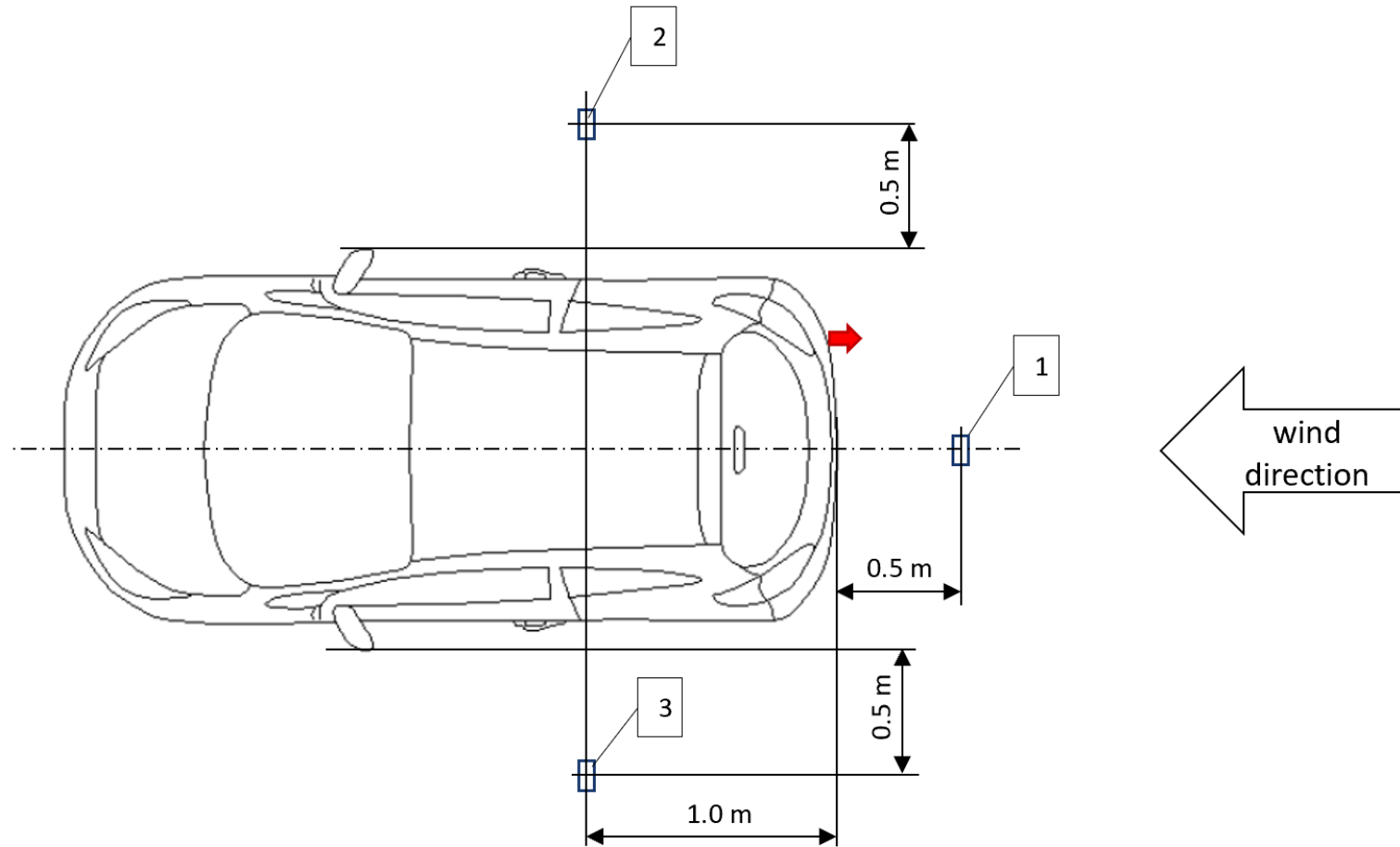
Subclauses	Description	Criterion	Frequency	Comments
9.3.1 9.3.3	Wind speed	2±1 m/s	Each test	
9.3.2 9.3.4	Wind direction	±15 deg.	Each test	Perpendicular to rear of the test vehicle
9.3.3	Relative humidity	30 to 90%	Each test	
9.3.3	Atmospheric pressure	85 to 110 kPa	Each test	
9.3.3	Ambient temperature	-7 to +30°C	Each test	
9.3.4	Uniformity of the wind	±0,2 m/s	Each test	Measure the wind speed at two additional points 0.5 m on each side of the vehicle prior to sampling (see Annex V).

12.3. Quality control requirements for constant speed test are listed in the table below.

Subclauses	Description	Criterion	Frequency	Comments
9.4.4	Wind speed	2±1 m/s	Each test	
9.4.4	Ambient temperature	-7 to +30°C	Each test	
9.4.4	Relative humidity	30 to 90%	Each test	
9.4.4	Atmospheric pressure	85 to 110 kPa	Each test	
9.4.4	Background pollutants concentration	<25% of MAC*	Before test	Control for all measured pollutants
9.4.6	Background pollutants concentration	<25% of MAC* and not more than 10% of MAC from concentrations before test (p.9.4.4)	After test	Control for all measured pollutants

Annex V

Idle test setup



Annex VI

Test report of emissions entering to the vehicle cabin with exhaust gases

Reporting Format and Data Exchange

The data exchange file shall be constructed as follows. Pollutant concentrations as well as any other relevant parameters shall be reported and exchanged as a csv-formatted data file. Parameter values shall be separated by a comma, ASCII-Code #h2C. The decimal marker of numerical values shall be a point, ASCII-Code #h2E. Lines shall be terminated by carriage return, ASCII-Code #h0D. No thousand separators shall be used.

Headers of the Reporting and Data Exchange File

<i>Line #</i>	<i>Parameter</i>	<i>Basic Data Type [A=Alpha or N=Numeric (max length, fractional digits)]</i>	<i>Data Type [Enumeration String, Decimal, Integer]</i>	<i>Total Digits</i>	<i>Fractional Digits</i>	<i>Minimum Value</i>	<i>Maximum Value</i>	<i>Allowed Values for: Enumeration or Description or Units</i>
1	Process Code	N(2)	Integer			0	99	Version of Test Report. 1 st dataset is N=0, highest value is the latest correction of existing dataset
2	Name of Witness	A(250)	String					Only if applicable. Full name of witness, company name and contact information for certification of test. Use "Self-Certified" if no

The final version of Revision 1 of Mutual Resolution (M.R.3) on Vehicle Interior Air Quality has to be submitted to 81th GRPE session not later than 17 of March 2020

➤ **19th VIAQ IWG Meeting (TBD)**

- Paris, France, 9-10th March 2020
- Two days

➤ **20th VIAQ IWG Meeting (TBD)**

- Moscow, Russia, October 2020 (two days)

or

- Brussels, Belgium, October 2020 (two days)