

## **RESEARCH STATUS**

### **HARMFUL SUBSTANCE CONCENTRATION IN THE AIR OF VEHICLE CAB/COMPARTMENT DUE TO ACCESS OF EXHAUST GASES AND FUEL VAPOURS**

Transmitted by the Russian Federation

#### **1. Introduction**

During the 122nd and 123rd sessions of WP.29, the Australian documents were introduced (documents Nos. 1 & 3). Those documents contained proposals concerning development of the Global Technical Regulations in regards to introduction a device responding on inadmissible change of quality of air in the vehicle passenger compartment.

Since more than 20 years the Russian Federation applies Federal Standard concerning quality of air in the vehicle passenger compartment, the Russian Federation feels reasonable to inform WP.29 in regards of related experience.

#### **2. Historical Notes**

The first time the Federal Standard GOST 12.1.005 was entered into force in 1976 due to initiation of the Ministry of Health. It specified the requirements to the quality of the air of the workspaces, including the vehicle driver's workspace, in regards to concentration of harmful substances coming from the sources located on a vehicle, i.e. exhaust gases, fuel vapors, etc.

Since that time the standard has been modified in terms of test methods. Currently it has being revised in terms of requirements as well as approach in general, taking into account the current level of vehicle design as well as consumer expectations.

#### **3. Background**

The research of vehicle drivers' work conditions from the standpoint of sanitary and hygiene has been carrying out in the Soviet Union and now in the Russian Federation. The results of that research indicated that the drivers' working activity is influenced by different harmful factors. The most important of those factors is toxic influence of exhaust gases and vapors from vehicle fuel and exhaust systems at the time of vehicle usage. It is well known that the drivers' working activity requires permanent concentration of attention to the driving

conditions that are kept changed, permanent readiness to avoid traffic collisions, and responsibility for the life of all traffic participants.

The research results indicated that 100% of the drivers being surveyed evaluate their work as very hard. Almost 80% of working time drivers are permanently concentrated on moved information subjects, with average density of information signals 1,352 in an hour.

As well known, the major part of toxic gases penetrated to the vehicle cab air are carbon monoxide (CO), nitrogen oxides (NO, NO<sub>2</sub>), different carbohydrates (mostly methane group) (C<sub>m</sub>H<sub>n</sub>). Appearance of such toxic components in the cab air considerably deteriorates drivers' response actions in regards to their stability, concentration on and switching the subjects of attention by 10.5%, endurance of hand muscels deteriorates by 26%. Almost all the drivers indicate deterioration in health and fatigue by the end of work day.

The Table 1 presents some of criterions of negative influence of toxic components of vehicle exhaust gases on the human health.

**Table 1** Criterions of negative influence of toxic components of vehicle exhaust gases on the human health.

Harmful Substance	Concentration (mg/m <sup>3</sup> )	Influence Time	Symptoms
$\tilde{N}\hat{I}$	6	25 minutes	Reduction of color and light eye sensibility
$\tilde{N}\hat{I}$	30	3 hours	Reduction of accuracy of visual perception of space and night eyesight
$\tilde{N}\hat{I}$	50 - 60	2 hours	Reduction of hearing, change in heart rhythm
NO <sub>2</sub>	0.14	5 minutes	Reduction of color eye sensibility
NO+NO <sub>2</sub>	12	25 minutes	Irritation of eye and nasal areas, reduction of diffusion CO <sub>2</sub> in lungs
$\tilde{N}_2\hat{I}_3\tilde{N}\hat{I}\hat{I}$	0.6	5 minutes	Irritation of eye and nasal areas
$\tilde{N}_2\hat{I}_3\tilde{N}\hat{I}\hat{I}$	2.0	5 minutes	Extreme irritation of eye and nasal areas
$\tilde{N}_mH_n$	300	Several hours	Influence similar to that of drugs, instability of nerve system response

The development of the standard setting the test procedure for harmful substance evaluation, norms and criterions of their concentration in a vehicle cab / compartment air was one of the measures objected to reduction of influence of toxic components on driver and passengers through improvement of quality of produced vehicles.

#### **4. Development of the Russian Federal Standard GOST R 51206 "Road Vehicles. Harmful Substance Concentration in the Air of Cabs and Compartments. Specifications and Test Methods"**

The standard entered into force in 1999.

The evaluation criterions of harmful substance concentration in vehicle cabs / compartments were the limits of allowable concentrations in the air of workspaces (LAC<sub>st</sub>) specified in the standard GOST 12.1.005.

The list of toxic substances and related  $LAC_{st}$  and comparable levels of maximum concentration of those in the air of residential areas ( $LAC_{ra}$ ), as allowed in Russia, is shown in the Table 2.

**Table 2** The requirements to the concentration of toxic substances in the air of vehicle cabs / compartments ( $LAC_{st}$ ) and in the air of residential areas ( $LAC_{ra}$ )

Toxic Substance	$LAC_{st}$ (mg/m <sup>3</sup> )	$LAC_{ra}$ (mg/m <sup>3</sup> )	Type of fuel
$\tilde{N}\tilde{I}$	20	5	All types
$NO_x$ , total	5	-	All types
NO	5	0,4	All types
$NO_2$	2	0,085	All types
$\tilde{N}_mH_n$	300	-	All types
Carbohydrates $\tilde{N}_1$ - $\tilde{N}_5$	-	50	All types
Carbohydrates $\tilde{N}_6$ - $\tilde{N}_{10}$	-	30	All types except CNG
$\tilde{N}_2\tilde{I}_3\tilde{N}\tilde{I}\tilde{I}$	0,2	0,03	Diesel

The tests are performed on M- and N-category vehicles.

The test procedure is performed by measuring concentration of harmful substances listed in the Table 2 (first column) in the air of vehicle cabs / compartments at two conditions:  
 I – at constant speed motion ( $50 \pm 5$  km/h) at constant gear;  
 II – on standing vehicle with idling engine at minimum rpm.

The standard sets the test conditions in regards to heating, ventilation, air conditioning system performance, windows, hatches, and sun roofs.

## 5. Some Results

Among chosen for analysis more than 100 domestic and imported vehicles of all categories being tested according to the GOST R 51206 for the purpose of a vehicle type approval, the number of samples not complying with the requirements was not more than 2.5%.

The basic reasons of incompliance, which percentage is shown on the chart, were as follows:

### A) Related to vehicle design:

- non-successful choice of position of edge(s) of exhaust system of air inlets of heating / ventilation systems relatively to air-dynamic parameters of air flow around the vehicle body;
- non-successful design of fuel tank(s) or other fuel system components;
- non-successful design of sealants

### B) Related to the particular vehicle assembly technical conditions:

- defects in vehicle assembly in particular to the sealant mountings;
- similar defects but appeared in the vehicle exploitation.

## 6. Further Development

The current level of vehicle quality and number of vehicles in-use in the Russian Federation requires certain changes in mind in terms of what is the vehicle for its user. Before we used the approach to the vehicle as drivers' workspace. Now almost 90% of the fleet is in private use, buses and trucks are equipped with the places for sleeping and other improved living conditions. Thus, now the vehicle should be considered not only as a workspace, but also as a space of human inhabitation.

Accordingly, the requirements to the harmful substance concentration in the air of all category vehicle cabs / compartments should be established basing on evaluation of the cabs / compartments not as a workspace, but as a space of inhabitation in terms of air.

The results of preliminary analysis indicate that such an approach will not cause troubles with homologation of vehicles, which design is free of defects indicated above.

At the same time, setting the requirements more strict will increase the role of inspection of pollution caused by carbohydrates and nitrogen oxides, which is important from the hygienic standpoint, but requires additional collection of data.

The further development of the standard supposedly will be related in addition to:

- inspection of vapors of the plastic interior materials in the conditions simulating heating by solar radiation;
- inspection of effectiveness of air filters in the ventilation system.

## 7. Conclusions

- Provision of quality of air in vehicle cabs / compartments is important factor of traffic safety.
- The Russian Federation applies national standard related to the provision of compliance of the air in vehicle cabs / compartments to the Sanitary Regulations. Currently this standard is being specified.
- The Russian Federation Authorities do not see the reasons for requiring a device acting in case of exceeding sanitary norms.
- In case, if WP.29 would consider importance of the discussed problem for world community, and development of the Draft Regulations would correspond with the approach of the Russian Federation, the Russian Federation is ready to cooperate in development of such a standard.

**Chart. The Basic Reasons of Incompliance of the Tested Vehicles to the Requirements of GOST R 51206**

