CURRENT METHODS DESIGN INNOVATION OF EMISSIONS MEASUREMENT

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Summary: This article deals with the current methods of measuring innovation performance of vehicles in operation. Measurements are performed at regular intervals and measurement methodology is a middle way between the cost of performed measurement and presentation skills test. The reason for upgrading the current methods of measuring emissions is to find the highest number of vehicles that produce unacceptably high levels of harmful emissions, since these emissions threaten not only human health but also the environment.

Key words: transport, emissions measurement, emission control station

INTRODUCTION

Traffic is still developing and has a great influence both on us and on our surroundings. Facilitates people's lives, but also threatens a mainly negative impact on the environment. Externalities resulting from transport are not only positive, but also negative, such as noise, emissions, etc.

According to the European Environment Agency (1), decreases the production of harmful emissions (such as NOx, carbon monoxide, particulate matter,..) in all Member States, the European Environment Agency for the period from 1990 to 2010. This improvement is considered a consequence of stricter homologation regulations.

Currently, in the Czech Republic is a large number of vehicles that produce harmful emissions, and many are in poor condition. According to Automotive Industry Association in the Czech Republic (2) at the end of 2014 is a total of 6.78 mil vehicles and their number is increasing. With the number of cars their average age also increases. This age reached in 2014 for passenger cars by 14.5 years.

Many research reports confirmed that the necessary introduction of stricter emission tests for vehicles in use in order to reduce the overall production of harmful emissions is caused by the relatively small number of vehicles. A quarter of all harmful emissions are caused by only about 5% of the vehicles that are in the worst condition (3).

For these reasons, it is necessary to continue to tighten existing limits and finding new solutions and innovating current tests, in order to at least maintain and preferably improve the quality of the environment and not to endanger human health.

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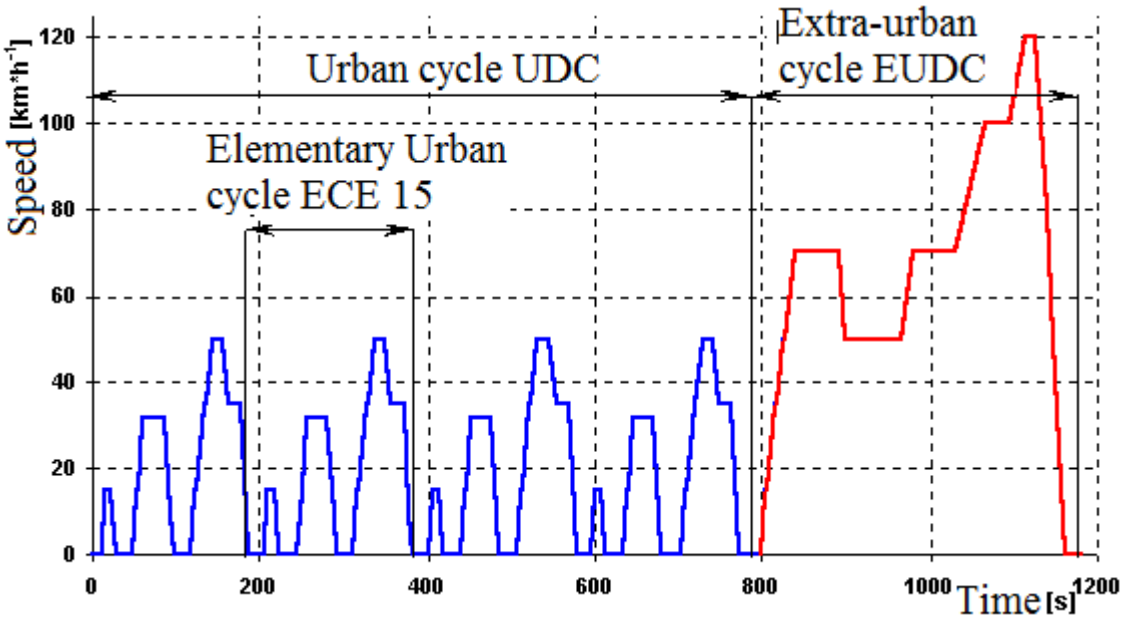
1. MATERIAL AND METHODS

Draft of driving cycle is based on the cycle that was used in the European Union for the homologation of vehicles up to 3.5 tons. This cycle is called New European Driving Cycle – NEDC (4). Although it is called a new, so this was introduced more than 15 years ago and in two years methodology should be changed and the cycle World Light Duty Test Procedure (WLTP) has to embark (5). Figure 1 shows a measurement on installed vehicle test, which is designed for vehicles up to 3.5 tons.

Source: Authors

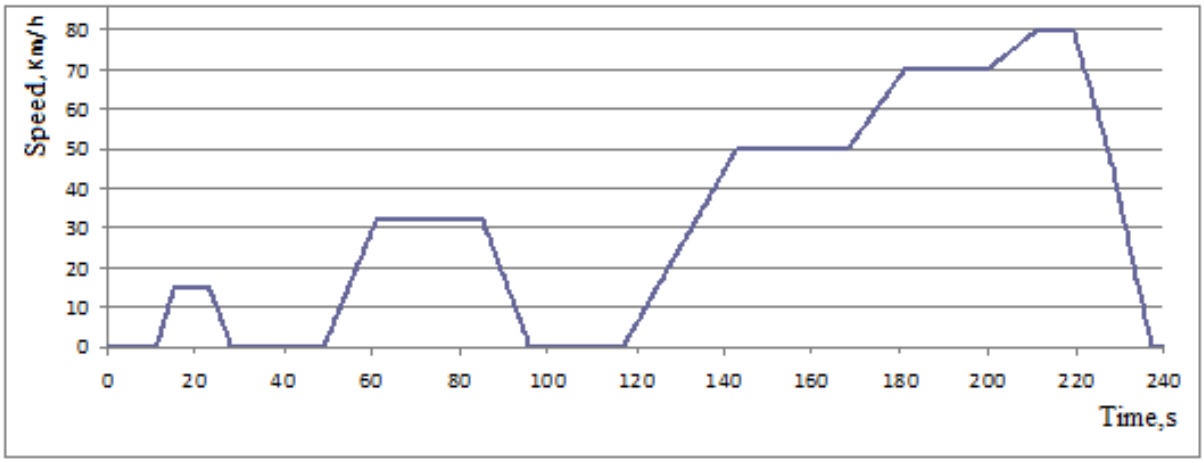
Fig. 1 – Test vehicle on the chassis dynamometer

The homologation cycle (see Fig. 2) is too long for measurement of vehicles in use, therefore it was shortened and corresponds to the cycle length of the IM 240, which is used in the USA for measuring emissions of vehicles in operation (6). The original unabridged cycle IM 240 is not suitable due to the relatively abrupt changes in vehicle speed during the test, and also due observance of the speed limit. The newly designed driving cycle is on Figure 3.



Source: (5, 6)

Fig. 2 - During the test cycle for homologation emission vehicles up to 3.5 tons



Source: Authors

Fig. 3 - The speed curve of the proposed test cycle

Emission measurements were gathered by using emission analyzer VMK to allow measurement of basic harmful emission with frequency of 1 Hz. Using this analyzer it is possible to determine the output of harmful emissions during dynamic loading methods through driving cycles. In the figure 4 is a harmful emissions analyzer VMK and Table 1 shows the basic characteristics of the analyzer.

Source: Authors

Fig. 4 – Emission analyzer VMK

Tab. 1 - The parameters of the emission analyzer VMK

Measured component	Range	Distinction	Measurement accuracy
CO	0 - 10 % vol	0,01 % vol	0 - 0,67 %: 0,02 % absolutely, 0,67-10 %: 3 % from the measured values
CO2	0 - 16 % vol	0,1 % vol	0 – 10 %: 0,3 % absolutely, 10 – 16 %: 3 % from m. v.
HC	0 - 20 000 ppm	1 ppm	10 ppm or 5 % from m. v.
NO_X	0 - 5 000 ppm	1 ppm	0 - 1000 ppm: 25 ppm, 1000 - 4000 ppm: 4 % from m. v.
O_2	0 - 22 % vol	0,1 % vol	0 – 3 %: 0,1 % 3 – 21 %: 3 % from m. v.

Source: Authors

2. RESULTS AND DISCUSSION

Programming the driving cycle was the first to enable the monitor view the current speed limit and the vehicle driving cycle, which determine the upper and lower tolerance of deviations from the desired speed (+ - 2.5 km / h). Driving cycle has been programmed in the system ControlWeb from Moravian Instruments Inc., in which application was programmed that graphically displays performed driving cycle (see Figure 5).

Source: Authors

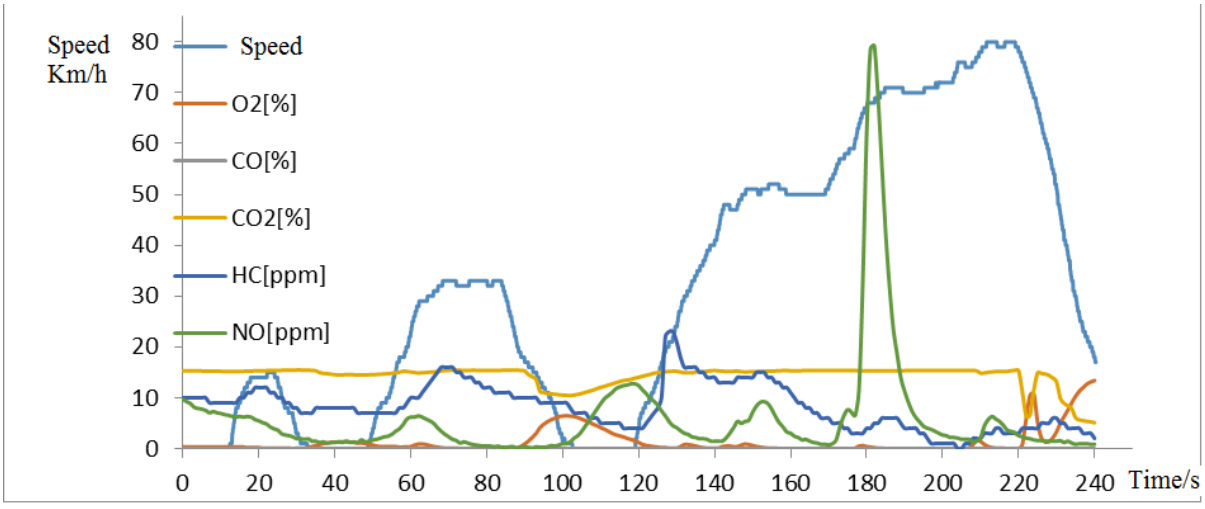
Fig. 5 - Application for driving cycles

Individual components of harmful emissions were analyzed during the proposed test cycle with a frequency of 1 Hz. Figure 6 shows the course of the production of harmful emissions versus time cycle. Table 2 presents summary results of measurements on one vehicle Skoda Octavia 2.0 FSI with the two drivers (7).

Tab. 2 - producing harmful emissions during the test cycle

Measured vehicle	Average emissions for the proposed inspection test					
Octavia 2,0 FSI	Fuel N95	CO [%]	CO_2 [%]	NO [ppm]	HC [ppm]	O_2 [%]
	Average A	0,000228	14,31473	47,92946	8,261411	1,351452
	Average B	0,00095435	14,29456	22,69295	4,406639	1,440664

Source: Authors



Source: Authors

Fig. 6 - Production of individual components of harmful emissions during the driving cycle

CONCLUSION

The new draft of the inspection test is relatively simple and there is the possibility of measuring emissions at a certain level of engine load what better correspond to the actual operation of the vehicle. Because of this test is used for more objective evaluation of the environmental loads of vehicles. The production of carbon monoxide is considered as a limiting element.

From the analysis of emissions it is evident that the greatest change is achieved in the production of carbon monoxide. Measured vehicle Škoda Octavia 2.0 FSI was in good condition. The problem could be the experience of the observer, which is manifested by the relatively large difference in the production of harmful emissions for drivers A and B. For that reason it is necessary to choose the measuring staff very carefully.

The cycle World Light Duty Test Procedure should be valid from September 2017. However, there could be postponement and the New European Driving Cycle (NEDC) would be still used until 2020. *"Emissions* (from energy production and use, transport, industry, etc.) *grew more quickly between 2000 and 2010 than in each of the three previous decades"* (8), because of it is necessary to put emphasis on the reducing emissions not only from the transport.

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