

Translated English of Chinese Standard: HJ857-2017

[www.ChineseStandard.net](http://www.ChineseStandard.net) → Buy True-PDF → Auto-delivery.

[Sales@ChineseStandard.net](mailto:Sales@ChineseStandard.net)

# HJ

NATIONAL ENVIRONMENTAL PROTECTION STANDARD  
OF THE PEOPLE'S REPUBLIC OF CHINA

## HJ 857-2017

---

**Measurement method and technical specification for PEMS  
test of exhaust pollutants from heavy-duty diesel and gas  
fuelled vehicles**

重型柴油车、气体燃料车排气污染物车载测量方法及技术要求

**Issued on: September 19, 2017**

**Implemented on: October 01, 2017**

---

**Issued by: Ministry of Environmental Protection of PRC**

## Table of Contents

|                                                                                                    |    |
|----------------------------------------------------------------------------------------------------|----|
| Foreword.....                                                                                      | 3  |
| 1 Scope of application .....                                                                       | 4  |
| 2 Normative references.....                                                                        | 4  |
| 3 Terms and definitions.....                                                                       | 5  |
| 4 Technical requirements and tests.....                                                            | 6  |
| 5 Emission compliance inspection of new production vehicles and in-use compliance inspection.....  | 7  |
| 6 Implementation of the standard.....                                                              | 9  |
| Annex A (normative) Vehicle emission test report requirements .....                                | 10 |
| Annex B (normative) PEMS measurement method for actual road emissions of heavy-duty vehicles ..... | 17 |

# Measurement method and technical specification for PEMS test of exhaust pollutants from heavy-duty diesel and gas fuelled vehicles

## 1 Scope of application

This Standard specifies PEMS measurement method and technical specification for exhaust pollutants from heavy-duty diesel and gas fuelled vehicles. It is applicable to emission compliance inspection and in-use compliance inspection of new production vehicles of heavy-duty diesel vehicles and gas-fueled vehicles that meet stage 5 of GB 17691-2005.

This Standard is applicable to measurement of exhaust pollutants from M<sub>2</sub>, M<sub>3</sub>, N<sub>2</sub> (but excluding low-speed goods vehicles) and N<sub>3</sub> vehicles that are equipped with compression ignition, gas fuel ignition engines with a design speed of more than 25km/h, as well as M<sub>1</sub> vehicles that a total mass is greater than 3500kg.

## 2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For undated references, the latest edition of the referenced document applies.

GB/T 12534, *Motor vehicles - General rules of road test method*

GB/T 15089-2001, *Classification of power-driven vehicles and trailers*

GB 17691-2005, *Limits and measurement methods for exhaust pollutants from compression ignition and gas fuelled positive ignition engines of vehicles (III IV V)*

GB 18352.6-2016, *Limits and measurement methods for emissions from light-duty vehicles (CHINA 6)*

HJ 437-2008, *Technical specification for on-board diagnostic (OBD) system of compression ignition and gas fuelled positive ignition engines of vehicles*

HJ 438-2008, *Durability of Emission Control Systems of Compression Ignition and Gas Fuelled Positive Ignition Engines of Vehicles*

HJ 689-2014, *Limits and Measurement Methods for Exhaust Pollutants from Diesel Engines of Urban Vehicles (WHTC)*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB 17691-2005 and HJ 689-2014 as well as the followings apply.

### 3.1 portable emissions measurement system PEMS

a complete set of emission testing systems, that can be installed in the vehicle, that can simultaneously measure exhaust flow, pollutant concentration, ambient temperature, humidity, atmospheric pressure, and that can conduct real-time measurement or collection of related parameters such as engine speed, torque, load, vehicle speed, latitude, longitude, and altitude.

### 3.2 PEMS method

a method that installs the portable emission measurement system on the testing vehicle, so as to measure the exhaust pollutant emissions when the vehicle is driving on the actual road.

### 3.3 transient cycle

the transient cycle (ETC or WHTC) used when type inspection is carried out for the engine according to GB 17691-2005 or HJ 689-2014.

### 3.4 work-based window

a continuous interval from the trial termination point to the cutoff point; when the cumulative work in the interval is equal to the engine work in the transient cycle, the continuous interval is defined as a work-based window.

### 3.5 window brake-specific emissions

the ratio of the total mass of vehicle exhaust pollutants emitted in the work-based window to the amount of work done in the window, in g/kWh.

### 3.6 work-based window method

a method that evaluates vehicle emissions by comparing the compliance of specific emissions of various work-based windows with those of engine type inspection specific emissions.

### 3.7 average window power percentage

the percentage that the average power of the engine in the work-based window accounts for the maximum net power of the engine.

### 3.8 valid work-based window

### **4.3.2 Determination of test vehicle compliance**

- a) For any pollutant specified in Article 4.1.1, if the proportion of the work-based window that meets the emission limit requirements accounts for 90% or more of the valid work-based window, the test vehicle will be judged as meeting the emission standards. Otherwise, it is determined that the emission exceeds the standard.
- b) Among the valid data points, the data points whose NO<sub>x</sub> emission concentration meets the limit requirements of Article 4.1.2 account for 95% or more of the valid data points, then the test vehicle is determined to meet the emission standards. Otherwise, it is determined that the emission exceeds the standard.

## **5 Emission compliance inspection of new production vehicles and in-use compliance inspection**

### **5.1 Emission compliance inspection of new production vehicles**

**5.1.1** The manufacturer shall formulate scientific and efficient self-inspection procedures in accordance with the requirements of this Standard. Conduct self-inspection on emission compliance of newly produced models (or series). Report the results of the self-inspection to the competent environmental protection authority.

**5.1.2** When the environmental protection authority conducts the inspection of the new production vehicle emission standards on the model (or series), 3 vehicles are randomly selected from the mass-produced vehicles. Determine according to the following rules:

- a) Randomly select 1 vehicle from the 3 vehicles that are drawn in Article 5.1.2. Carry out the actual road emission test according to the method specified in Annex B. If the vehicle meets the requirements of Article 4.1, it is determined as conforming.
- b) If the vehicle does not meet the requirements of Article 4.1, if the manufacturer submits a written application, the environmental protection authority shall conduct the actual road emission test according to the method specified in Annex B for the other two vehicles selected in Article 5.1.2. If both vehicles meet the requirements of Article 4.1, it is determined to be conforming, otherwise it is not conforming.

### **5.2 In-use compliance inspection**

**5.2.1** The manufacturer shall conduct self-inspection of in-use compliance according to the test methods specified in this Standard. The in-use compliance self-inspection of the engine manufacturer shall be carried out on the basis of the engine model (or family). The in-use compliance self-inspection of vehicle manufacturers shall be carried out on

$c_{co}$  - Dry base CO concentration, %;

$\alpha$  - Hydrogen molar ratio.

#### **B.1.4 Test conditions**

**B.1.4.1** The composition of test conditions shall be close to the distribution of road operating conditions when the vehicle is in normal use. Vehicle operating road conditions include urban roads, suburban roads and expressways. According to the vehicle category, the specific distribution and characteristics refer to the provisions of B.1.4.2-B.1.4.6. The actual composition ratio is allowed to have a deviation of  $\pm 5\%$ . Due to some practical reasons, manufacturer can also adjust the test conditions according to the actual situation. However, the relevant situation shall be reported to the competent department of environmental protection.

**B.1.4.2** The test shall be carried out continuously in the order of urban-suburban-high-speed driving. According to the size of the vehicle's driving speed, distinguish the attributes of the vehicle's running road. Urban road: the vehicle speed is between 0-50km/h, and the average speed is 15-30km/h. Suburban road: the first short trip with a vehicle speed exceeding 55km/h is recorded as the beginning of the suburban road, the vehicle speed is not more than 75km/h, and the average speed is 45-70km/h. Expressway: the first short trip with a vehicle speed exceeding 75km/h is recorded as the beginning of the expressway, and the average vehicle speed is greater than 70km/h.

**B.1.4.3** For  $M_1$ ,  $M_2$ ,  $M_3$ , and  $N_2$  vehicles (except urban vehicles), the time allocation ratio of each operating road condition during the test is 20% of urban roads, 25% of suburban roads and 55% of expressways.

**B.1.4.4** For urban vehicles, the time allocation ratio of each operating road condition during the test is 70% of urban roads and 30% of suburban roads.

**B.1.4.5** For  $N_3$  vehicles (except postal and sanitation vehicles), the time allocation ratio of each operating road condition during the test is 10% of urban roads, 10% of suburban roads and 80% of expressways.

**B.1.4.6** The difference in altitude between the start and end points of the test shall not exceed 100m. The cumulative positive altitude increment of the test vehicle shall not be greater than 1200m/100km. The calculation method of cumulative altitude refers to the provisions of Annex DH of GB 18352.6-2016.

#### **B.1.5 Device installation connection**

##### **B.1.5.1 Main unit**

Install the PEMS on the test vehicle as required by the operation. The installation

location is least affected by the following external conditions:

- Changes in ambient temperature;
- Changes in ambient atmospheric pressure;
- Electromagnetic radiation;
- Mechanical vibration;
- Hydrocarbons in the environment (if the hydrogen flame ionization detector (HFID) combustion gas is ambient air).

#### **B.1.5.2 Exhaust flow meter (EFM)**

The exhaust flow meter shall be connected to the exhaust pipe of the test vehicle. It can be connected using short flexible connectors when needed. However, flexible connectors need to be sealed with stainless steel hose clamps or clips. The contact area between the exhaust gas and the flexible connector shall be minimized, so as to avoid affecting the test results at high vehicle speeds and under heavy engine load conditions. The straight pipe length upstream and downstream of the location of the exhaust gas flow meter sensor shall be at least twice the diameter of the exhaust gas flow meter. It is recommended to install the exhaust flow meter behind the vehicle muffler, so as to reduce the influence of transient changes in the exhaust flow on the measurement signal.

The exhaust flow meter must not be installed such that the exhaust back pressure is greater than the engine manufacturer's recommendation. It is also not possible to increase the length of the exhaust pipe by more than 2.5m. The installation of the exhaust flow meter shall comply with local road traffic safety regulations and insurance requirements.

#### **B.1.5.3 Satellite navigation precision positioning system**

The signal receiving device shall be installed as high as possible. At the same time, avoid the interference of all obstacles during the test.

#### **B.1.5.4 ECU data reading device**

The ECU data reading equipment shall be able to record the engine parameters listed in Table B.1 in real time. It can obtain the ECU data of the test vehicle according to standard protocols such as SAE J1939, J1708 or ISO 15031.

#### **B.1.5.5 Sampling system**

The sampling probe shall be installed in accordance with the installation regulations specified by the instrument manufacturer. It is installed after the flow measuring device. The gaseous pollutant heating sampling line (the heating temperature is  $190^{\circ}\text{C}\pm 10^{\circ}\text{C}$ , if applicable) shall be insulated at the connection point between the sampling probe and

Purge the exhaust flow meter as required by the equipment operation. Clean lines and associated measurement ports of condensate and diesel particulates.

**B.2.1.6** Debug engine-related information measurement equipment to ensure correct engine-related data information.

**B.2.1.7** Before the test starts, collect a piece of data in advance. Determine the correctness of equipment installation. Conduct preliminary inspection of readable engine information content.

## **B.2.2 Start of test**

PEMS sampling shall be started before vehicle starts. Measure exhaust parameters and record engine and environmental parameters. The engine coolant temperature must not exceed 30°C at the beginning of the test. If the ambient temperature is higher than 30°C, the engine coolant temperature shall not be higher than the ambient temperature by 2°C at the beginning of the test. When the engine coolant temperature is above 70°C, or when the coolant temperature changes less than 2°C within 5 minutes, whichever comes first. But no later than 20 minutes after the engine starts. The test data begins to be used to determine whether the emissions meet the standards or not.

## **B.2.3 Running of test**

Carry out the test in accordance with the test conditions specified in B.1.4. During the test, the sample gas of all components can be sampled with a sampling probe. Be careful not to allow exhaust gas components (including water vapor, etc.) to condense in the sample gas path of the analysis system. During the test of the particulate sampling filter paper, according to whether the sampling volume is saturated (the pressure drop before and after the filter paper is  $\geq 2\text{kPa}$ ), continuous sampling or interrupt sampling can be selected to replace the new filter paper. After all instrument checks and calibrations are completed, the vehicle continues to drive normally and performs data collection. For emission tests of the same model (or family) and engine model (or family), the same test route with the same road combination must be selected.

## **B.2.4 Ending of test**

**B.2.4.1** The test duration is not less than 3 hours in principle. The non-idle working time shall not be less than 2 hours. When the cumulative power of the test vehicle reaches 3 times the power of the engine ETC cycle or 5 times the power of the WHTC cycle, the test can be terminated early.

**B.2.4.2** It shall use the same calibration gas as specified in B.2.1.4 to check the zero and span points of the gas analyzer. Evaluate the response drift of the analyzer. Compare with the calibration results before the test. If it can be determined that the zero drift is within the allowable range, it is permissible to zero the analyzer before verifying the span drift. After the test, the inspection for instrument drift shall be completed before the PEMS or individual analyzers or sensors are turned off, or before the analyzer is

A non-dispersive infrared (NDIR) absorption type analyzer shall be used.

#### **B.5.2.2 Carbon dioxide (CO<sub>2</sub>) analysis**

A non-dispersive infrared (NDIR) absorption type analyzer shall be used.

#### **B.5.2.3 Nitrogen oxide (NO<sub>x</sub>) analysis**

A chemiluminescence analyzer (CLD) or non-dispersive ultraviolet (NDUV) analyzer shall be used.

#### **B.5.2.4 Total hydrocarbon (THC) analysis**

A hydrogen flame ion analyzer (HFID) shall be used. The temperature of the HFID shall be kept at 453-473K (180-200°C) during measurement.

**B.5.2.5** If other alternative methods that meet the requirements of B.5.2.1-B.5.2.4 are adopted, the alternative methods shall be reported to the competent department of environmental protection.

### **B.5.3 Working principle of particulate sampling and measuring instruments**

#### **B.5.3.1 Particulate sampling filter paper**

It shall meet the relevant requirements of Annex BD.4.1 in GB 17691-2005.

#### **B.5.3.2 Technical requirements for weighing chambers (boxes) and analytical balances**

It shall meet the relevant requirements of Annex BD.4.2 in GB 17691-2005.

#### **B.5.3.3 Working principle of particulate matter online measurement equipment**

The test equipment based on the principle of micro-oscillating balance or acousto-optic method or particle charging method shall be used. If other equivalent methods are used, it shall be reported to the competent environmental protection authority.

### **B.6 Gas**

The shelf life of all calibration gases must be observed. The expiration date of the calibration gas specified by the manufacturer shall be recorded.

#### **B.6.1 Pure gas**

The required purity of each pure gas is subject to the impurity limit requirements given below. The following gases shall be available when working:

- Pure nitrogen:  $\text{THC} \leq 1\text{ppmC}$ ,  $\text{CO} \leq 1\text{ppm}$ ,  $\text{CO}_2 \leq 400\text{ppm}$ ,  $\text{NO} \leq 0.1\text{ppm}$ .
- Pure synthetic air:  $\text{THC} \leq 1\text{ppmC}$ ,  $\text{CO} \leq 1\text{ppm}$ ,  $\text{CO}_2 \leq 400\text{ppm}$ ,  $\text{NO} \leq 0.1\text{ppm}$ ; The

volume fraction of oxygen content is between 18% and 21%.

- Pure oxygen: purity  $\geq 99.5\%$  volume fraction.
- Hydrogen-helium gas mixture ( $40 \pm 2\%$  hydrogen, helium as balance gas):  
THC  $\leq 1 \text{ ppmC}$ , CO<sub>2</sub>  $\leq 400 \text{ ppm}$ .

Specifically prepare according to the needs of the test equipment.

### **B.6.2 Span gas**

A mixture of the following chemical compositions shall be available:

- CO<sub>2</sub>, CO, NO, C<sub>3</sub>H<sub>8</sub> and pure nitrogen
- NO<sub>2</sub> and pure nitrogen
- CO<sub>2</sub>, CO, NO, C<sub>3</sub>H<sub>8</sub>, CH<sub>4</sub> and pure nitrogen
- CO<sub>2</sub>, CO, C<sub>3</sub>H<sub>8</sub> and pure nitrogen

The actual concentration of the calibration gas shall be within  $\pm 2\%$  of the nominal value. The concentrations of all calibration gases shall be expressed in volume fractions (% or ppm). Prepare according to the needs of the test equipment. Concentrations of various components are prepared for ranges of measured emissions.

## **B.7 Auxiliary equipment for test testing systems**

**B.7.1** The test requires the use of various auxiliary equipment to connect and power the portable emissions test system.

**B.7.2** The flow resistance of the flow meters, connectors and connecting pipes used shall not exceed the maximum value specified by the manufacturer.

**B.7.3** Use mounting guards for flexible connectors, environmental sensors, and other equipment as needed.

Use reliable mounting points such as frame, trailer hitch, walkway, payload attachment points. Specially designed clips, suction cups, magnets are recommended. It is recommended to purchase and install commercialized bicycle racks, trailer hitches, luggage racks, where applicable.

### **B.7.4 Auxiliary power**

Under the condition that the normal operation of the vehicle engine is not affected, power can be obtained from the test vehicle or another portable energy source (such as battery, fuel cell, portable generator) can be installed.

**B.7.4.1** Power can be drawn from the test vehicle without affecting the normal operation

**This is an excerpt of the PDF (Some pages are marked off intentionally)**

**Full-copy PDF can be purchased from 1 of 2 websites:**

1. <https://www.ChineseStandard.us>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Select your country (currency), for example: USA (USD); Germany (Euro).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Tax invoice can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with download links).

2. <https://www.ChineseStandard.net>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Add to cart. Only accept USD (other currencies - <https://www.ChineseStandard.us>).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with PDFs attached, invoice and download links).

Translated by: Field Test Asia Pte. Ltd. (Incorporated & taxed in Singapore. Tax ID: 201302277C)

About Us (Goodwill, Policies, Fair Trading...): <https://www.chinesestandard.net/AboutUs.aspx>

Contact: Wayne Zheng, [Sales@ChineseStandard.net](mailto:Sales@ChineseStandard.net)

Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

**----- The End -----**