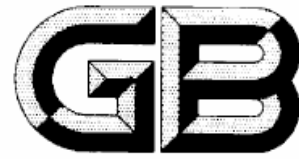


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National Standard of the People's Republic of China

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**Test Procedures and Requirements of Durability of
Emission Control Systems for Heavy-Duty Vehicles**

(Version Submitted for Approval)

Promulgated on 200×-××-××

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Promulgated
by

**The State Environmental Protection Administration of
China**

**General Administration of Quality Supervision, Inspection
and Quarantine, the People's Republic of China**

Contents

Foreword	
ii	
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Fuel for tests	2
5 Durability requirements and tests	2
6 Expansion relating to durability of pollution control device	3
7 Implementation of the Standard	3
Annex A (Normative Annex) Durability running test procedures of emission control systems for heavy-duty vehicles	5
Annex AA (Normative Annex) Durability running test cycles	11

Introduction

This Standard has been drawn up in order to ensure compliance with the “Environmental Protection Law of the People’s Republic of China” and the “Prevention and Control of Air Pollution Law of the People’s Republic of China,” to prevent and control environmental pollution caused by emissions from motor vehicles, and to improve the environment and air quality.

The amendments to the durability requirements and the durability running tests are adopted from the related technical contents of Annex II “Procedures for Conducting the Test for Durability of Emission Control Systems”, and European Directives 88/77/EEC (2005/55/EC) and 2005/78/EC. Additionally, the durability running test cycles stipulated in the Japanese “Heavy-Duty Vehicle Emissions Law of 2005” promulgated by the Engineering and Safety Department, the Road Transport Bureau and the Ministry of Land, Infrastructure and Transport of Japan, are regarded as the recommended cycles.

The Standard stipulates the test procedures and durability requirements for emission control systems for heavy-duty vehicles.

The Standard applies to the durability tests of emission control systems for the type approval test and production conformity inspection of category M2, M3, N2 and N3 motor vehicles fitted with exhaust after-treatment devices and at a designated speed of more than 25 km/h, as well as category M1 motor vehicles with a total mass greater than 3,500 kg.

The Standard stipulates the durability tests of emission control systems for the type approval test and production conformity inspection of motor vehicles fitted with exhaust after-treatment devices in accordance with GB14762-2002 “Emission Limits and Measurement Methods for Exhaust Pollutants from Vehicle Positive Ignition (P.I.) Engines”, Phase II of GB17691-2001 “Emission Limits and Measurement Methods for Exhaust Pollutants from Vehicle Compression-Ignition Engines”, and Phase III of GB17691-2005 “Emission Limits and Measurement Methods for Exhaust Pollutants from Vehicle Compression-Ignition and Gas Fuelled Ignition Engines (China Phases III, IV, V).”

The Standard can be executed using the exhaust after-treatment device, which uses a

variety of independent techniques to carry out the type approval test.

As from the date of implementation, if a vehicle submitted for type approval and production conformity inspection in accordance with the emission standards of GB14762-2002, Phase II of GB17691-2001 or Phase III of GB17691-2005, is fitted with an exhaust after-treatment device, a durability running test must be carried out on it pursuant to the requirements of the Standard, and a test report should be submitted to the type approval authority pursuant to the requirements. Only vehicles which have satisfied the durability requirements stipulated in the Standard and met the related requirements of the national emission standards are granted the type approval and deemed to have passed the production conformity inspection.

The Standard is promulgated for the first time.

Annex A of the Standard is the normative annex.

The Standard was proposed by the Science and Technology Department of the State Environmental Protection Administration of China.

Drafting units of the Standard: the China Automotive Technology and Research Centre and the Jinan Automobile Test Centre.

The Standard was approved by the State Environmental Protection Administration of China on _____ 2005.

The Standard is to be presented by the State Environmental Protection Administration of China.

Test Procedures and Requirements of Durability of Emission Control Systems for Heavy-Duty Vehicles

1 Scope

The Standard stipulates the test procedures and durability requirements of emission control systems for heavy-duty vehicles.

The Standard applies to the durability tests of emission control systems for the type approval test and production conformity inspection of category M2, M3, N2 and N3 motor vehicles fitted with exhaust after-treatment devices and at a designated speed of more than 25 km/h, as well as category M1 motor vehicles with a total mass greater than 3,500 kg.

When the type approval test and the production conformity inspection in accordance with GB14762-2002, Phase II of GB17691-2001 and Phase III of GB17691-2005 are carried out on motor vehicles fitted with exhaust after-treatment devices, they should also meet the durability requirements of emission control systems stipulated in the Standard.

The Standard can be executed using the exhaust after-treatment device, which uses a variety of independent techniques to carry out the type approval test.

2 Normative references

When cited in this Standard, the clauses of the following Standards become clauses of this Standard. By the time the Standard is published, all the versions shown will be valid. All the Standards shall be revised. Any parties using the Standard shall investigate the possibility of adopting the latest version of the following Standards.

- | | |
|---------------|--|
| GB 14762-2002 | Emission limits and measurement methods for exhaust pollutants from positive ignition (P.I.) engines of vehicles and vehicles equipped with P.I. engines |
| GB 17691-2001 | Emission limits and measurement methods for exhaust pollutants from vehicle compression-ignition engines |
| GB 17691-2005 | Emission limits and measurement methods for exhaust pollutants from vehicle compression-ignition, gas fuelled |

	ignition engines (China Phases III, IV, V)
GB 17930	Unleaded petrol (gasoline) for motor vehicles
GB 18047-2000	Compressed natural gas as vehicle fuel
GB 19159-2003	Automotive liquefied petroleum gas
GB/T 5181-2001	Automotive emission – Terms and definitions
GB/T 12548-1990	Motor vehicles – Speedometer and odometer – Calibration method
GB/T 12534-1990	Motor vehicles – General rules of the road test method
GB/T 12678-1990	Reliability running test method for automobiles
GB/T 12679-1990	Motor vehicles – Durability running – Test method
GB/T 15089-2001	Classification of power-driven vehicles and trailers
GB/T 18297-2001	Performance test code for road vehicle engines
GB/T 19055-2003	Reliability test methods for motor vehicle engines
GB/T 19147-2003	Automobile diesel fuels

3 Terms and definitions

3.1 Exhaust after-treatment device

A system installed in an engine exhaust system which reduces pollution emitted by one or several exhaust pollutants, including the catalytic reducer and (or) particulate filter, the executor of the electronic control unit, and its pipelines, etc.

3.2 Catalytic reducer

3.2.1 3-Way catalytic reducer

The catalytic reducer installed in a petrol, NG and LPG-fuelled vehicle exhaust system to carry out redox reaction via catalyst, and at the same time reduce the levels of carbon monoxide (CO), total hydrocarbon compound (THC) and nitrogen oxide (NO_x) in the exhaust.

3.2.2 Oxidised catalytic reducer

The catalytic reducer installed in a diesel, petrol, NG and LPG-fuelled vehicle exhaust system to carry out the oxidisation reaction via catalyst, and at the same time reduce the levels of carbon monoxide (CO) and total hydrocarbon compound (THC) in the exhaust.

3.2.3 Diesel engine nitrogen-monoxide-reducing catalytic reduction system

The catalytic reduction system installed in the exhaust system of a diesel vehicle for catalysing the nitrogen oxide (NO_x) in the exhaust of a diesel engine into N₂ and other harmless substances, such as the selective catalytic reduction (SCR) system, nitrogen-oxide storage reducer (NSR).

3.2.5 Diesel engine 4-way catalytic reducer

The catalytic reduction system installed in the exhaust system of a diesel vehicle to carry out a chemical reaction via catalyst, and at the same time reduce the levels of carbon monoxide (CO), total hydrocarbon compound (THC), nitrogen oxide (NO_x) and particulate matter (PM) in the exhaust.

3.3 Diesel particulate filter (DPF)

The device installed in the exhaust system of a diesel vehicle to reduce the particulate matter (PM) in the exhaust via catalytic reaction or (and) filtering.

3.4 Deterioration factor (ΔG)

The emission increment of a certain exhaust pollutant once a vehicle fitted with the parent engine after-treatment device has reached the mileage or actual utilisation time of the durability requirements stipulated in Table 1. Deterioration factors apply to the engine after-treatment device family, and the determination method for these is applied in accordance with the requirements of Annex A.

3.5 Engine family and parent engine

The engine family and the parent engine should both meet the requirements of the related national emission standards.

4 Fuel for use in test

The fuel for use in the durability running test should be the market vehicle fuel that meets the requirements of the related standard.

5 Durability requirements and test

5.1 If a vehicle is submitted for type approval in accordance with the emission standards of GB14762-2002, Phase II of GB17691-2001 or Phase III of GB17691-2005, and is fitted with the exhaust after-treatment device, its emission control device should meet the durability requirements stipulated in the chapter.

5.2 The engine or vehicle manufacturer shall present the engine-after-treatment device family or the vehicle that meets the requirements of Annex A, and submit the application for a durability running test of the emission control systems, to the type approval authority.

5.3 The durability running test should be performed in accordance with the requirements of Annex A, and carried out under effective supervision. The durability running test stipulated in Table 1 should be completed, and the deterioration factors should be determined. After the mileage test or actual utilisation time of the durability requirements as stipulated in Table 1 is completed or reached respectively, its exhaust pollutant emission should still meet the requirements of the corresponding national emission standards.

Table 1 Durability requirements and test stipulations

Categorisation of Vehicles		Durability Requirements ⁽¹⁾		Permitted Shortest Test Mileage ⁽²⁾ (km)
		Mileage (km)	Actual Utilisation Time (Year)	
Petrol Vehicle		80,000	5 years	50,000
Diesel Vehicle, NG and LPG Vehicles	M1 ⁽³⁾	80,000	5 years	50,000
	M2	80,000	5 years	50,000
	M3 [I, II, A, B (GVM ≤ 7.5t)]	100,000	5 years	60,000
	M3 [III, B (GVM > 7.5t)]	250,000	6 years	80,000
	N2	100,000	5 years	60,000
	N3 (GVM ≤ 16t)	100,000	5 years	60,000
	N3 (GVM > 16t)	250,000	6 years	80,000
<p>(1) Durability requirements shall be regarded as satisfied regardless of whether mileage or actual utilisation time is attained first.</p> <p>(2) The permitted shortest test mileage refers to the shortest mileage of the durability running test when adopting the road test method.</p>				

(3) Only includes category M1 vehicles with GVM greater than 3,500 kg.
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5.4 The deterioration factors should be applied to type approval tests and production conformity inspections of the heavy-duty vehicles to which the Standard applies.

The sum of the deterioration factors determined in the durability running test and the measured exhaust pollutant emission value of the vehicle or the engine-after-treatment device family submitted for type approval by the manufacturer must still meet the type approval limits stipulated in the corresponding national emission standards; otherwise the type approval shall not be granted.

The sum of the deterioration factors determined in the durability running test and the measured exhaust pollutant emission value of the vehicle or the engine-after-treatment device family submitted for production conformity inspection by the manufacturer must still meet the production conformity inspection limits stipulated in the corresponding national emission standards; otherwise the vehicle will not pass the production conformity inspection.

5.5 Mechanical performance requirements for the exhaust after-treatment device

When the durability running test of the vehicle exhaust after-treatment device is being performed, there should be no mechanical malfunction affecting the durability running test, such as cracking, breaking, burning, deformation, gas leakage, load loosening, crushing, etc of the pipeline and shell.

6 Expansion relating to the durability of the pollution control device

When a vehicle (engine) has received type approval, this approval can be expanded to apply to different vehicle (engine) types, provided that the type of engine-pollution control device family in the latter is the same as the one in the vehicle (engine) type which has been approved.

In view of this, vehicle (engine) types with the same parameters as the ones below or with parameters within the stipulated limits are considered as having the same engine-pollution control device family:

6.1 Engine:

- Type (pulse, air pump, etc)

- Tank core distance
- Number of air tanks
- Engine emissions ($\pm 15\%$)
- Structure of tank body
- Number of valves
- Fuel system
- Type of cooling system
 - Burning process

6.2 Pollution control device:

6.2.1 Catalyst reducer: With/Without

- Number of catalyst reducers and catalyst units
- Size and shape of catalyst reducer ($\pm 10\%$)
- Catalyst activation type (oxidisation, 3-way, etc)
- Precious metal content (the same or more)
- Proportion of precious metal ($\pm 15\%$)
- Load (structure and material)
- Pore density
- Type of casing of catalyst reducer
- Position of catalyst reducer (its position and size in the exhaust system should not create an input temperature change in the catalyst reducer of above 50K. Measurement should be performed in stable operating mode so that the adopted emission test cycle is at the highest rotational speed and the maximum load).

6.2.2 Particulate filter: With/Without

- Number of particulate filters
- Size and shape of particulate filter (capacity of filter body $\pm 10\%$)
- Body structure of particulate filter and type of material (wall flow, foam ceramics, etc)
- Particulate filter recycling methods (electric heating, continuous recycling, etc)
- Precious metal content (the same or more) (if any)
- Proportion of precious metal ($\pm 15\%$) (if any)
- Type of casing of particulate filter
- Position of particulate filter (its position in the exhaust system and the standard distance, if it has a catalytic function, should be the same as those

specified in Subsection 6.2.1.).

6.2.3 Air injection: With/Without
— Type (pulse, air pump, etc)

6.2.4 EGR:
— With/Without

6.3 Engines with the same family characteristics must have similar exhaust emission characteristics.

6.4 They must meet the requirements stipulated in Chapter 8 “Vehicle Installations” of GB 17691-2005.

7 Implementation of the Standard

7.1 If the vehicle submitted for type approval and production conformity inspection in accordance with the emission standards of GB14762-2002, Phase II of GB17691-2001 or Phase III of GB17691-2005, is fitted with the exhaust after-treatment device, a durability running test must be carried out on it pursuant to the requirements of the Standard, and a test report must be submitted to the type approval authority in accordance with the requirements. Only vehicles which have satisfied the durability requirements stipulated in the Standard and met the related requirements of the national emission standards are granted the type approval and deemed to have passed the production conformity inspection.

7.2 The Standard shall be implemented as from the date of promulgation.

Annex A
(Normative Annex)
Test Procedures of Durability Running of
Emission Control Systems for Heavy-Duty Vehicles

A.1 Outline

The Annex stipulates the durability running test procedures for emission control systems for heavy-duty vehicles and the methods used to determine the deterioration factors.

The Annex stipulates the durability running test procedures, including the on-road durability driving test for the whole vehicle and the engine table durability running test.

The on-road durability driving test cycle for the whole vehicle and the engine table durability running test cycle stipulated in “Annex AA – Durability running test cycles” are the recommended test cycles.

The Annex also stipulates the maintenance to be carried out during the durability running test, including both emission-related and non-emission-related maintenance.

A.2 Selection of engine for durability running test and determination of deterioration factors

A.2.1 Select a parent engine from an engine family on which to carry out durability running and emission tests in order to determine the deterioration factors once the mileage in the durability requirements table is attained. The method of selecting a parent engine from an engine family should meet the requirements of the related national emission standards.

A.2.2 The parent engines of different engine families can be combined with the exhaust after-treatment devices adopted for these families to further form the engine after-treatment device families. The number of engine air tanks and their parameters can be different, but the technical specifications and installation requirements of the exhaust after-treatment devices must be the same. If the manufacturer can provide the type approval authority with data to prove that the emission characteristics of these engines are similar, then they can be included in the same engine-after-treatment

device family.

A.2.3 Before the durability running test, the manufacturer must first select a representative engine family in accordance with the methods for selecting a parent engine stipulated in the related national emission standards, in order to carry out the test, and then submit a test report to the type approval authority for reference.

A.2.4 If the type approval authority considers that the worst emission rate of another engine in comparison with the engine after-treatment device family is more representative, the type approval authority, together with the engine manufacturer, must select that engine for testing.

A.3 Durability running test procedures

The durability running test is divided into a whole vehicle on-road durability driving test and an engine table durability running test. The manufacturer can choose either of these.

A.3.1 Whole vehicle on-road durability driving test

Vehicles fitted with the selected engine after-treatment device family (refer to Subsection A.2) will undergo the on-road durability driving test. The road-mileage section of the test is decided on by the manufacturer on the basis of good engineering practice. It should seek to include roads typical of different areas. For the requirements of the test road, please refer to the requirements of Subsection 4.2 in GB/T 126/78.

The manufacturer can also choose the whole vehicle on-road durability driving test cycle (**AA.2**) recommended in Annex AA – Durability running test cycles.

A.3.2 Engine table durability running test

The selected parent engine after-treatment device family (refer to Subsection A.2) will undergo the engine table durability running test. The operating mode of the engine table durability running test is decided on by the manufacturer on the basis of good engineering practice.

The manufacturer can also choose the engine table durability running test cycle (**AA.3**)

recommended in Annex AA – Durability running test cycles.

The manufacturer should provide effective data and analysis to confirm the correlation between the engine table running test time and the whole vehicle on-road durability driving test mileage indicated in Subsection **A.3.1**.

A.4 Application for a durability running test

Before the test, the manufacturer should submit a durability running test application to the type approval authority for approval. The application should contain details of how the durability running test is to proceed. As a minimum requirement, the following should be indicated:

- Parameters of the parent engine for testing
- Parameters of the after-treatment device
- Test procedures (A.3)
- Stable performance mileage (time) of the engine after-treatment device family (A.8)
 - Road-mileage section (A.3.1) and mileage (A.9) of the whole vehicle on-road durability driving test; or the engine table running test cycle and test time, and their correlation to the road-mileage section and mileage of the whole vehicle on-road durability driving test (A.3.2)
 - Measurement of the type of exhaust pollutant during the durability running test, the measurement method and the interval mileage (time) (A.10)
 - Methods for determining deterioration factors (A.11)
 - Maintenance (A.12)

A.5 Preparation of test vehicle (engine)

A.5.1 Preparation of test vehicle

A.5.1.1 When the whole vehicle on-road durability driving test procedures are adopted, the vehicle to undergo testing can be a dedicated test vehicle, or an actual in-service vehicle.

A.5.1.2 The test vehicle should be in good working order. Its engine and pollution control device should be new.

A.5.1.3 The driving test distance should not be more than 2,000 km. The mileage can be included in the stable-performance driving mileage of the engine-after-treatment device, but cannot be included in the durability driving mileage.

A.5.1.4 All others shall be in accordance with the requirements of Section 1 of

Chapter 4 of GB/T 12534.

A.5.2 Preparation of test engine

A.5.2.1 When the engine table durability running test procedures are adopted, the engine to undergo testing must pass the inspection carried out by the manufacturer.

A.5.2.2 The test engine should be in good working order. Its engine and pollution control device should be new.

A.6 Test conditions

A.6.1 Whole vehicle on-road durability running test conditions

A.6.1.1 On-road durability running tests can be carried out on the test strip, the road or the chassis dynamometer.

A.6.1.2 When a dedicated vehicle undergoes a durability driving test, the load mass of the test vehicle should not be less than 1/2 of the maximum load fixed by the manufacturer. When an in-service vehicle undergoes the test, the load mass should meet the requirements of the manufacturer.

A.6.1.3 When the test is carried out on the chassis dynamometer, the vehicle cooling system should be similar to the vehicle temperature when driving on the road (lubricant, water, exhaust system).

A.6.1.4 The test conditions should also meet the requirements of GB/T 12678.

A.6.2 Engine table durability running test conditions

A.6.2.1 The engine dynamometer, meter and environmental conditions should meet the requirements of GB/T 19055.

A.6.2.2 During the test, the engine and all its devices, parts, electric control units, sensors and executors should be in the same condition as the original vehicle.

A.6.2.3 It is essential to ensure that the intake system of the test engine has the same standard features as the intake system of the actual vehicle.

A.6.2.4 The test engine must have the same after-treatment system as the actual vehicle. If the exhaust system is the same as that of the test room, the installation position of the after-treatment system must be the same as the one on the actual vehicle. The exhaust resistance should meet the requirements of the related exhaust standard.

A.6.2.5 Before carrying out the durability running test, the engine should undergo a running-in procedure in accordance with the requirements of the manufacturer. During the engine running-in procedure, the after-treatment device must be functioning. The time of the running-in procedure may be included in the stable-performance time of the engine after-treatment device, but not included in the test time of the engine table durability running test.

A.6.2.6 The distance between the measurement point of the input temperature of the

catalyst reducer and the front end surface of the load should be less than 30 mm.

A.6.2.7 The intercooler of an actual vehicle or otherwise a dedicated intercooler for use in the test room may be used. Under the conditions of the specified operating mode, the output temperature and the pressure of the intercooler should meet the requirements of the manufacturer.

A.7 Test equipment and instruments

A.7.1 Chassis dynamometer

A.7.1.1 When the durability running test is carried out on the chassis dynamometer, the chassis dynamometer should be able to complete the test cycle specified in Subsection A.3.1.

A.7.1.2 The chassis dynamometer should be adjusted to absorb the power that acts on the wheel at a stable vehicle speed of 80 km/h. For the methods for determining power and adjusting the brakes, please refer to the related requirements of the chassis dynamometer manufacturer.

A.7.2 Engine dynamometer

When the durability running test is carried out on the engine table, the dynamometer should be able to complete the test cycle specified in Subsection A.3.2.

A.7.3 The instruments in the engine table test room should meet the requirements of GB/T 19055-2003 and GB/T 18297-2001.

A.7.4 When the speedometer and milometer installed in the vehicle are set to measure the speed and mileage of the vehicle, error corrections must be carried out on them in accordance with GB 12548 before the test.

A.7.5 The accuracy of the test instruments and equipment should meet the requirements of the related standards.

A.8 Stable-performance running time (mileage) of engine after-treatment family

Before the durability running test starts, the performance of the engine after-treatment device should be made stable. The running method and time (mileage) required for each engine after-treatment device family to become stable should be specified by the manufacturer. In addition, relevant data and analytical information should be provided to the type approval authority.

The accumulated running of 125 hours for the engine after-treatment device family and the accumulated driving distance of 5,000 km for the vehicle can be selected as the stable-performance running time (mileage).

The driving inspection mileage specified in Subsection A.5.1.3 and the running-in procedure time specified in Subsection A.6.2.5 can be included in the stable-performance running mileage (time).

A.9 Durability running test mileage (time)

Once the performance of the engine after-treatment device family becomes stable, the durability running test can begin. The whole vehicle on-road durability driving mileage should be determined by the manufacturer, however, the test mileage should not be less than the authorised shortest test mileage stipulated in Table 1. If the engine table durability running test is selected, the test time should meet the requirements of Subsection A.3.2.

A.10 Measurement of exhaust pollutant during the durability running test

A.10.1 During the durability running test, the exhaust pollutant of the engine after-treatment device family should be measured. The measurement method should meet the requirements of the related national emission standards. After the decimal point of the measured pollutant data, one decimal place more than the standard limit should be added.

A.10.2 At the start of the durability running test (0 km), the exhaust pollutant should be measured for the first time. At 30,000 km (± 500 km), the exhaust pollutant should be measured for the second time. After 30,000 km, the exhaust pollutant is measured approximately every 500 km until the test ends.

If the manufacturer proposes the above frequency and mileage interval requirements for measuring the exhaust pollutant during the durability running test, these requirements should be reported to the type approval authority and approved by it before the test can be carried out.

The frequency at which exhaust pollutant is measured and the data collected from such measurements during the durability running test should be sufficient for carrying out the linear regression fitting and acquiring the correct results.

A.10.3 If the type approval authority decides to increase the frequency of exhaust pollutant measurements, , the manufacturer should be informed of the increase so as to revise the durability running test. The adjustment should also be reported to the type approval authority and approved by it.

A.10.4 The manufacturer may submit an application to the type approval authority for vehicles that require ESC and ETC emission tests as stipulated in GB 17691-2005. Only one of the test cycles (ESC or ETC) shall be applied to the emission tests for all the emission measurement intervals stipulated in Subsection A.10.2. The other test cycle (ETC or ESC) shall only be used to measure the emissions at the start and end of the durability running test.

When the linear regression fitting (A.11) is carried out, only the pollutant data tested from the measurement of emission cycles at all the measurement points are adopted. The determined deterioration factors are, however, also applicable to other cycles.

A.10.5 When the engine exhaust pollutant test is carried out, pressure changes in the exhaust system of the engine must also be measured and recorded.

A.11 Determination of deterioration factor ΔG_i

A.11.1 Placing the pollutants on the vertical axis and the driving mileage on the horizontal axis, draw a chart inputting all of the exhaust pollutant data tested in the exhaust test in the course of the durability running test and then match them up with their respective driving distances. Use the minimum possible squares to produce the optimum possible straight line between the data points of each exhaust pollutant.

A.11.2 Use arithmetic regression analysis to acquire the optimally fitting straight line. Identify the emission value G_{0_i} of a given type (i) of pollutant at 0 km on the straight line, and use the line to infer the pollutant emission value G_{1_i} at the mileage end of the durability requirements. G_{0_i} and G_{1_i} should be calculated to four decimal places. As a result, the figure (ΔG_i) is rounded to 3 decimal places.

The deterioration factor ΔG_i of any given type (i) of pollutant is calculated using the following equation:

$$\Delta G_i = G_{1_i} - G_{0_i}$$

A.11.3 If the deterioration factor ΔG_i of a given type of pollutant is less than 0 ($\Delta G_i < 0$), then $\Delta G_i = 0$.

A.12 Maintenance

The maintenance of the engine during the durability running test can be divided into:

- emission-related (including both critical and ordinary maintenance)
- non-emission-related

The above maintenance types can also be divided into:

- planned maintenance
- unplanned maintenance

Before the durability running test, the manufacturer must submit a list of all the maintenance interventions required during the durability running test to the type approval authority.

A.12.1 Emission-related planned maintenance

A.12.1.1 The emission-related planned maintenance carried out during the durability running test should be the same as the maintenance that users expected to be carried out by the vehicle manufacturer.

A.12.1.2 The mileage (or time) interval of the emission-related planned maintenance carried out during the durability running test should be equivalent to or the same as the maintenance requirements that users expected to be carried out by the vehicle manufacturer.

A.12.1.3 During the durability running test, any emission-related maintenance of the engine should meet the compliance requirements for in-service vehicles stipulated by the related standards. At the same time, the manufacturer should submit information to the type approval authority proving that all the emission-related planned maintenance is technically necessary.

A.12.1.4 The engine manufacturer must provide for the following maintenance (if necessary):

- Filter and cooling device in the exhaust gas recirculation (EGR) system
- Positive crankcase ventilation device (PCV valve)
- Fuel injection nozzle (only cleaning)
- Fuel injector
- Turbocharger
- Electronic control unit of the engine and its sensor and executor
- Particulate filter device (including the related parts)
- EGR device, including the related control valve and pipeline
- Exhaust after-treatment device

A.12.1.5 Emission-related critical maintenance

- Exhaust after-treatment device
- Electronic control unit of the engine and its sensor and execution device
- EGR device, including its filter, cooler, control valve and pipeline
- PCV device (PCV valve)

A.12.1.6 Any emission-related planned critical maintenance required in the test must be listed in the durability running test application submitted by the manufacturer to the type approval authority. The reasons for the maintenance and its similarity to the maintenance of in-service vehicles should be detailed.

A.12.2 Alteration of planned maintenance

A.12.2.1 During the durability running test, if the manufacturer needs to add further maintenance items, it must report this to the type approval authority promptly and obtain its approval. Users must also be informed of the new maintenance item.

A.12.2.2 The manufacturer must categorise the new planned maintenance items (e.g. emission-related, non-emission-related, critical, non-critical, etc). Of these, the emission-related items should be specified together with their practical maximum maintenance mileage (time).

A.12.2.3 At the same time, information should be submitted so that the new planned maintenance items can be detailed along with the reasons for their maintenance interval mileage (time).

A.12.3 Non-emission-related planned maintenance

A.12.3.1 During the durability running test, non-emission-related planned maintenance may be carried out, such as changing the lubricant, changing fuel filters and air filters, maintaining the cooling system, adjusting idling speed, calibrating the speed adjuster, inspecting the engine bolt tightening moment, adjusting the tyre air valve gap, adjusting the fuel injector gap, time correction, adjusting the tension of the driving belt, etc.

A.12.3.2 During the durability running test, the stipulated shortest maintenance interval mileage (time) should be the same as the users' maintenance requirements.

A.12.4 Engine maintenance during the durability running test

A.12.4.1 Equipment, instruments and tools that are not specified by the manufacturer may not be used for carrying out diagnoses, adjustment and maintenance of the engine.

A.12.4.2 During the durability running test, maintenance carried out on parts, emission control systems and the fuel system of the tested engine must be recorded.

A.12.5 Emission-related unplanned maintenance

During the durability running test, emission-related unplanned maintenance may be carried out. However this maintenance must be the same as the users' maintenance requirements.

A.12.6 Unplanned critical maintenance

During the durability running test, when the on-board diagnostic (OBD) system has clearly detected a malfunction and the malfunction indicator (MI) has consequently been activated, unplanned maintenance may be carried out on the engine and vehicle.

A.13 Malfunction records

All malfunctions affecting the parts and assembly of vehicle that occur during the durability running test must be recorded. The following must be indicated:

- (1) Name of assembly
- (2) Mileage at which malfunction occurred
- (3) Description of malfunction
- (4) Analysis of the reasons for the malfunction
- (5) Outcome of malfunction
- (6) Handling measures

A.14 Test report

After the test has ended, a report must be submitted to the type approval authority. The contents must include the following, as a minimum:

- (1) Test results for all exhaust pollutant emissions during the durability running test

- (2) Deterioration factors
- (3) Malfunction statistics for the whole of durability running test
- (4) Records of maintenance carried out on the engine during the durability running test

Annex AA
(Normative Annex)
Durability running test cycle

AA.1 Outline

The Annex stipulates the two recommended cycles for durability running tests on emission control systems for heavy-duty vehicles:

- Whole vehicle on-road durability driving test cycle
- Engine table durability running test cycle

AA.2 Whole vehicle on-road durability driving test cycle

AA.2.1 While running on the test track, road or chassis dynamometer, the durability driving test cycle should be as described in Figure AA.1. For the driving model, please refer to Subsection AA.2.2. The driving operating mode cycle comprises 10 normal driving cycles and 1 high-speed driving cycle. The mileage of a driving operating mode cycle is 23.125 km. If the top speed of the vehicle is below 100 km/h during the high-speed cycle, the vehicle should be speeded up at its maximum acceleration rate to 95% of the highest speed of the vehicle from a standing start.

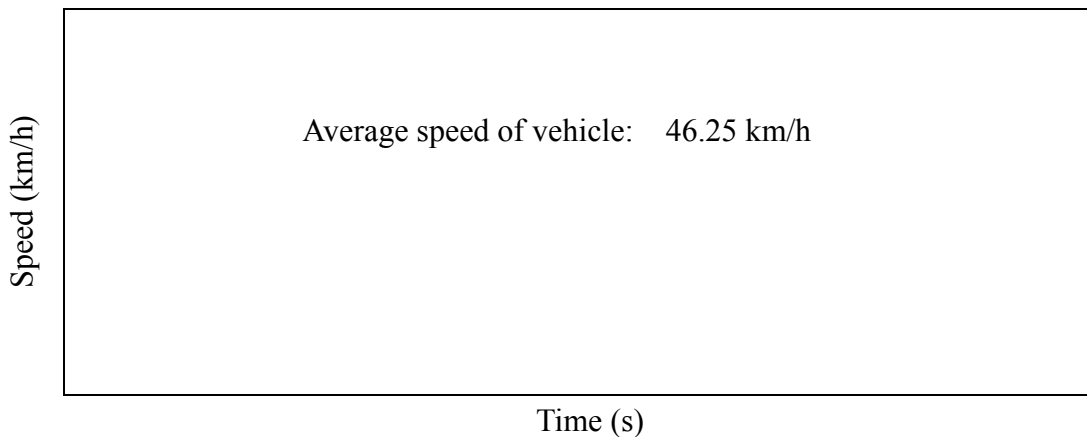


Figure AA.1 Whole vehicle on-road durability driving test cycle

AA.2.2 Driving model

AA.2.2.1 For the road driving operating mode, please refer to Table AA.1 and Table AA.2:

Table AA.1 Identifying the operating mode in normal driving

Operation No.	Operation	Driving Status (km/h)	Running Time (s)	Accumulated Time (s)
1	Idling Speed	Idling Speed	10	10
2	Acceleration	0 → 60	30	40
3	Equal Speed	60	15	55
4	Deceleration	60 → 30	15	70
5	Acceleration	30 → 60	15	85
6	Equal Speed	60	15	100
7	Deceleration	60 → 0	30	130

Table AA.2 Identifying the operating mode in high-speed driving

Operation No.	Operation	Driving Status (km/h)	Driving Time (s)	Accumulated Time (s)
1	Idling Speed	0	10	10
2	Acceleration	0 → 100	40	50
3	Equal Speed	100	200	250
4	Deceleration	100 → 0	50	300
5	Idle Speed	0	200	500

AA.2.2.2 General information

Average vehicle speed of each cycle: 46.25 km/h;
 Effective driving time: 1,800 s;
 Theoretical driving distance of each cycle: 23.125 km.

AA.3 Engine table durability running test cycle

AA.3.1 The engine table durability running test should adopt the test cycle stipulated in Table AA.3. The transition time between operating modes is 60±5s. The transition time shall be included in the running time of the next operating mode.

Table AA.3 Engine table durability running test cycle⁽¹⁾

Operating Mode No.	Rotational Speed (r/min)	Load (%)	Running Time (s)
1	Idling Speed	0	120
2	Rotational Speed at Maximum Torque	10	600
3	Rotational Speed at Maximum Torque	100 (90) ⁽²⁾	1200

4	Idling Speed	0	120
5	Specified Rotational Speed ⁽³⁾	25	600
6	Specified Rotational Speed ⁽³⁾	50	600
7	Specified Rotational Speed ⁽³⁾	75	600
8	Specified Rotational Speed ⁽³⁾	100 (90) ⁽²⁾	1200
9	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	25	600
10	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	50	600
11	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	75	600
12	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	100 (90) ⁽²⁾	1200
13	Rotational Speed at Maximum Torque	25	600
14	Rotational Speed at Maximum Torque	50	600
15	Rotational Speed at Maximum Torque	75	600
16	Rotational Speed at Maximum Torque	100 (90) ⁽²⁾	1200
17	Idling Speed	0	120
18	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	25	600
19	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	50	600
20	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	75	600
21	½ (Rotational Speed at Maximum Torque + Specified Rotational Speed) ⁽⁴⁾	100 (90) ⁽²⁾	1200
22	Specified Rotational Speed ⁽³⁾	25	600
23	Specified Rotational Speed ⁽³⁾	50	600
24	Specified Rotational Speed ⁽³⁾	75	600
25	Specified Rotational Speed ⁽³⁾	100 (90) ⁽²⁾	1200
26	Idling Speed	0	120
27	Stop the Vehicle	0	720

- (1) A cycle takes 5 hours;
- (2) The loads indicated in brackets are only applied to heavy-duty petrol engines.
- (3) The rotational speed of petrol engines is the rotational speed at maximum torque.
- (4) The rotational speed of petrol engines is the rotational speed at maximum torque.

AA.3.2 When the engine table durability running test is carried out, the manufacturer must indicate the correlation between the engine table running time and the whole vehicle on-road durability driving mileage, as well as the effective data and analytical information. The substitute method is to let the engine undergo the table durability running test for one hour in accordance with the operating mode specified in Table AA.3. It may be converted to the whole vehicle on-road durability driving mileage at 100 km.
