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**Performance requirements and test methods for automobile
active noise cancellation system**

汽车主动降噪系统性能要求和试验方法

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1 Scope

This document specifies the performance requirements for active noise cancellation systems in automobiles and describes the test conditions and methods.

This document applies to the production and inspection of M1 and N1 category vehicles equipped with active engine noise cancellation systems or active road noise cancellation systems. Other vehicles shall refer to this document for compliance.

2 Normative references

GB/T 3730.2
GB/T 3785.1
GB/T 6326
GB/T 15173
GB/T 18697
GB/T 28046
GB 34660
GB/T 38146.1

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 6326 and GB/T 38146.1 as well as the followings apply.

3.1 Automobile active noise cancellation; ANC

Noise cancellation technology that uses loudspeakers or other sound sources to emit anti-phase sound waves to cancel out noise in the passenger cabin.

3.2 Engine noise cancellation; ENC

Automobile active noise cancellation that aims to suppress engine noise in the passenger compartment.

3.3 Road noise cancellation; RNC

Automobile active noise cancellation that aims to suppress road noise inside the passenger compartment.

3.4 Engine order frequency

The frequency that has a fixed harmonic relationship (either an integer or a non-integer) with the engine rotation frequency.

3.5 Automobile active noise cancellation stability

The ability that the automobile active noise cancellation system can maintain noise cancellation performance or prevent the generation of additional noises under different automotive operating environments and conditions.

NOTE. Hereinafter referred to as "stability".

3.6 Noise reduction

The A-weighted noise attenuation of in-vehicle noise at a specific frequency point or within a specific frequency band before and after the vehicle's active noise cancellation system is turned on.

NOTE. The unit is weighted decibels [dB(A)].

3.7 Primary noise

The noise generated by a car when active noise cancellation is not used.

3.8 Secondary sound source

The sound source that is used by the automobile active noise cancellation system to generate sound waves that cancel out primary noise.

NOTE. In automobile active noise cancellation, the most commonly used secondary sound source is the vehicle's speakers.

3.9 Reference transducer

A sensor used to collect acoustic or vibration signals as a reference signal for a feedforward controller.

NOTE 1. In automobile active noise cancellation, a feedforward controller is a control technology that uses sensors placed near the noise source to predict the noise in the passenger compartment as early as possible to improve the noise cancellation effect.

NOTE 2. In an active noise cancellation system with a feedforward controller, the reference signal is the feedforward controller input signal that is highly coherent with the primary noise. In active noise cancellation systems for engine noise, commonly used reference signals include sine/cosine signals generated from the engine speed order frequency, engine vibration signals, or engine noise signals from within the engine compartment. In active noise cancellation systems for road noise, a commonly used reference signal is the chassis vibration signal.

NOTE 3. Commonly used reference sensors include microphones, accelerometers, and speed sensors.

3.10 Error transducer

A sensor used to acquire error signals.

NOTE. An error signal is a monitoring signal. As one of the input signals to a controller, it is used to adjust the controller parameters, thereby changing its output. A commonly used error sensor is a microphone located near the occupant's ear.

4.1.1 The vehicle active noise cancellation system's resistance to high and low

temperatures, corrosion resistance, waterproofing, and aging resistance shall meet the requirements of GB/T 28046 (all parts).

4.1.2 The electromagnetic compatibility of the vehicle active noise cancellation system

shall comply with the requirements of GB 34660.

4.1.3 The design of the vehicle active noise cancellation system shall ensure that the failure does not affect other vehicle performance and operational safety.

4.2.1 The noise cancellation frequency range of the active noise cancellation system for

engine noise shall be at least 40 Hz~200 Hz. If the active noise cancellation system for engine noise of the test vehicle has a wider noise cancellation frequency range, then the noise cancellation target in 4.3.1 can be applied to a wider noise cancellation frequency range.

4.2.2 The noise cancellation frequency range of the active road noise cancellation

Under extreme evaluation conditions, the active noise cancellation system shall not produce any clearly perceptible abnormal noises. Under special evaluation conditions, the active noise cancellation system shall not produce any serious abnormal noises.

According to 4.4.1, if the test vehicle still has operating conditions not listed in Table B.4 that affect stability, these operating conditions can be added during the stability test.

In this case, the active noise cancellation system shall not produce any noticeable abnormal noises.

NOTE. Serious abnormal noises refer to annoying noises or noises that affect driving safety, such as sudden noises that may startle the driver, or intermittent or continuous noises that are loud enough to affect the driver's perception of the surrounding environment.

5.1.1 Acoustic measurement instruments

The microphone used for measurement shall meet the requirements of a Class 1 sound level meter as specified in GB/T 3785.1. A random field microphone is preferred. A free field microphone may be used if a random field microphone is unavailable.

5.1.2 Calibration of acoustic measurement instruments

Before and after measurement, the acoustic measurement instrument shall be calibrated using a Class 1 acoustic calibrator conforming to GB/T 15173. If, without any adjustments, the difference between the later calibration reading and the previous calibration reading exceeds 0.5 dB(A), the measurement result after the previous calibration is considered invalid.

5.1.3 Data acquisition equipment

The equipment shall be able to simultaneously record time-domain data and process or post-process frequency-domain and order-domain data online. The data processing methods of the data acquisition equipment shall meet the following requirements.

- a) The analysis frequency is not less than 11200 Hz;
- b) The frequency resolution of the spectrum analysis is 1 Hz;
- c) The Hanning window is used as the window function;