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**Full scale automotive aerodynamic wind tunnel test - The
method of automotive aerodynamic performance test
(English Translation)**

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Table of Contents

Foreword	
1 Scope	
2 Normative references	
3 Terms and definitions	
4 Aerodynamic wind tunnel requirements	
5 The basic test procedure and method of the experiment	
5.1 Vehicle inspection	
5.2 Wheel running requirements	
5.3 Vehicle installation	
5.4 Vehicle attitude adjustment	
5.5 Running and debugging	
5.6 Wind tunnel settings	
5.7 Test and working conditions	
6 Validity Evaluation of Test Data	
7 Test report	
Appendix A (normative appendix) Pneumatic wind tunnel performance and test equipment requirements	
Appendix B (Normative Appendix) Calculation Method of Arithmetic Mean Deviation	
Appendix C (informative appendix) Reference sample of aerodynamic test report	

1 Scope

This standard specifies the requirements for the flow field quality, test equipment and instruments for the aerodynamic wind tunnel test of the whole vehicle, and recommends the aerodynamic test Standard operating conditions and test methods and procedures give an evaluation method for the validity of the test data, and the results obtained can be used as the aerodynamics of the whole vehicle the basis for evaluating and optimizing the design.

This standard applies to real vehicles, namely passenger cars and light pickups with less than seven seats (including seven seats), and also applicable to vehicle models of corresponding sizes (Clay model, hard model, etc.), the weight and size are determined according to the wind tunnel scale and test capacity.

2 Normative references

The following documents are indispensable for the application of this document. For dated reference documents, only the dated version applies to this article. For undated reference documents, the latest version (including all amendments) is applicable to this document.

GB/T 3730.2-1996 Road Vehicle Quality Vocabulary and Code GB/T 19234-2003 Passenger car size code JJF 1059-1999 Evaluation and Expression of Uncertainty in Measurement T/CSAE 111-2019 Passenger car aerodynamic performance terminology

3 Terms and definitions

The following terms and definitions apply to this document.

Automotive aerodynamic wind tunnel A test device that simulates the action of airflow during the course of a car driving on the road. The measuring system equipped with this device can measure vehicle aerodynamic force and aerodynamic torque, local flow field display, pressure at characteristic points or characteristic areas, etc. In the vehicle development process, it is used for phased gas dynamic performance inspection, optimization, and finally verification of the car's aerodynamic performance level.

3.1.1

Full-scale automotive wind tunnel A wind tunnel that can test real vehicles or 1:1 car models.

3.1.2

Automotive aerodynamic wind tunnel coordinate system In the automobile aerodynamic wind tunnel, the coordinate origin is at the center of the turntable, and the coordinate system conforms to the right-hand rule, as shown in Figure 1.

3.2.6

Boundary layer thickness The thin layer of fluid attached to the solid wall caused by the viscous force between the fluid and the solid wall is defined by the flow velocity of 0 to 99% the directional thickness is taken as the thickness of the boundary layer, in meters, m.

3.2.7

Dynamic pressure correction coefficient in the wind tunnel It is used to correct the dynamic pressure of the nozzle to obtain the coefficient of the reference dynamic pressure value at the front end of the test vehicle or the model. The reference position is cut off from the middle of the nozzle outlet.

In the direction of surface X, 1.5 m away from the outlet section of the nozzle and 1 m away

from the ground, it is also called the drop coefficient, which is represented by the symbol K .

3.2.8

Nozzle method

A measurement method used to monitor the wind speed at the outlet of a wind tunnel. Usually the static pressure at the inner wall of the steady flow section of the wind tunnel and the straight section of the nozzle outlet are selected.

The difference in static pressure at the inner wall surface is used as the reference pressure of the nozzle outlet.

3.2.9

Plenum method

A method used to monitor the wind speed at the outlet of a wind tunnel. Usually, the static pressure at the inner wall of the steady flow section of the wind tunnel and the static pressure in the no-wind zone of the wind tunnel are selected.

The difference is used as the reference pressure of the nozzle outlet.

3.2.10

Longitudinal static pressure gradient the static pressure gradient within the effective length of the model area on the center line of the wind tunnel test section in the X direction to characterize the large horizontal buoyancy of the wind tunnel along the X direction small.

Wind tunnel atmosphere parameters Environmental parameters in the test section of the wind tunnel, including atmospheric pressure, temperature, and humidity.

3.3.1

Atmospheric pressure the atmosphere is composed of dry air and water vapor. The sum of the corresponding dry air pressure and water vapor pressure is the atmospheric pressure. The symbol is P_{atm} .

Unit. Pascal, Pa.

3.3.2

Temperature of test section Usually refers to the temperature T_S in the flow field of the test section of the 3/4 opening recirculation wind tunnel, the unit. Celsius, $^{\circ}C$.

3.3.3

Relative humidity

Indicates the ratio of the water vapor pressure of the humid air to the water vapor pressure of the saturated humid air at the same temperature, the symbol is, the unit. %.

3.3.4

Air density

The mass of air per unit volume, symbol, unit. kg/m³, the aerodynamic measurement test uses the airflow density in the test section of the wind tunnel, 3.4 Automotive aerodynamic parameters Characterize vehicle aerodynamic performance, including vehicle aerodynamic force, aerodynamic torque and corresponding aerodynamic coefficients, see T/CSAE 111 for details-2019.

Wind tunnel equipment and system Usually refers to wind tunnel measuring devices and other auxiliary equipment systems.

3.5.1

Aerodynamic six-component balance Measuring equipment used to measure the force and moment of airflow acting on a vehicle or model, including aerodynamic forces in X, Y, and Z directions and related Moment.

3.5.2

Turn table

A device used to simulate the steering or yaw angle of a vehicle or model.

3.5.3

Wheel rotating unit

A device for rolling simulation of vehicle wheels, abbreviated as WRU, is also called wheel driving unit (WDU).

3.5.4

Rolling road system

Used to simulate ground movement, abbreviated as RRS, also called center belt (CB) in automobile aerodynamic wind tunnels.

3.5.5

Rocker panel restraint it is used to limit and fix the wind tunnel test vehicle or model. Its structure is connected with the measuring platform of the wind tunnel six-component balance, which is also the transmission of force One of the devices.

4 Aerodynamic wind tunnel requirements

According to the basic requirements of aerodynamic test, this standard specifies the flow field quality requirements of aerodynamic wind tunnels and the functions and performance requirements of main test equipment.