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Performance requirements and testing methods for automatic transmission (AT)

自动变速器（AT）技术要求与试验方法

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Performance requirements and testing methods for automatic transmission (AT)

1 Scope

This standard specifies the technical requirements and test methods for automatic transmissions (AT) for road vehicles.

This standard is applicable to road vehicles, which are equipped with automatic transmission (AT). The non-road vehicles, which are equipped with automatic transmission (AT), may make reference to this standard.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

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

GB 18352.5-2013 Limits and measurement methods for emissions from light-duty vehicles (CHINA 5)

GB/T 19233 Measurement methods of fuel consumption for light-duty vehicles

GB 34660-2017 Road vehicles - Requirements and test methods of electromagnetic compatibility

GB/T 27840-2011 Fuel consumption test methods for heavy-duty commercial vehicles

GB/T 33012.2-2016 Road vehicles-Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 2: Off-vehicle radiation sources

GB/T 33012.4-2016 Road vehicles - Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 4: Bulk current injection (BCI)

QC/T 465 Automotive mechanical transmission terminology and definition

4 Test requirements and performance requirements

4.1 Test requirements

4.1.1 Test conditions

4.1.1.1 Environment

During the test, the temperature in the test room shall be 288 K ~ 308 K (15 °C ~ 35 °C), the relative humidity shall be between 20% ~ 60%.

4.1.1.2 Transmission oil

The transmission oil, which is specified by the transmission manufacturer, shall be used; the oil quantity shall be adjusted in the manner which is specified by the manufacturer.

4.1.1.3 Bench test run-in

Before carrying out the measurement test of transmission torque capacity and steady-state efficiency, the test samples shall be subject to running in, according to the following specifications:

a) The transmission input speed is set at 1000 r/min ~ 2000 r/min; the torque is set at 50% of the transmission rated torque.

b) Run-in for 1 h in each gear.

4.1.1.4 Bench test warm-up

Before the bench test, the test sample must be warmed up, until the following conditions are met at the same time:

a) The transmission oil's temperature reaches 80 °C ± 5 °C.

b) The speed and torque of the motor are in a stable state.

4.1.1.5 Vehicle test run-in and warm-up

According to the vehicle model, the running-in and warm-up for the whole vehicle test shall be carried out, in accordance with the methods specified in Appendix C of GB 18352.5-2013 or 5.4 of GB/T 27840-2011.

4.1.2 Test equipment

4.1.2.1 Accuracy of bench test equipment

4.1.2.1.1 The error of the speed measuring device shall not exceed ±5 r/min.

Carry out the torque capacity test of the transmission, according to the test method specified in 5.1. The test result shall be within the allowable range of the manufacturer's design.

4.2.2 Transmission efficiency

Carry out the transmission efficiency test of the transmission, according to the test method specified in 5.2; the transmission efficiency of each gear shall not be lower than 60%.

4.2.3 Parking

For the transmission, which is equipped with the P gear, the parking performance test shall be carried out, according to the test method specified in 5.3. Continue to park for 5 minutes on the up and down slope, at a gradient of 20%. It shall always keep the vehicle at a standstill.

4.2.4 Air tightness

Carry out the air tightness test on the transmission, according to the test method specified in 5.4; the pressure drop shall not exceed 5 kPa.

4.2.5 Ratchet engagement

For the transmission, which is equipped with the P gear, the ratchet engagement test shall be carried out, according to the test method specified in 5.5. The ratchet engagement speed must not exceed 6 km/h.

4.2.6 Neutral gear output torque

For the transmission matched with the categories M_3 and N_3 vehicles without P gear, the neutral gear output torque test shall be carried out, according to the test method specified in 5.6. The neutral gear output torque shall not exceed 60 N·m.

4.2.7 Drag torque

Carry out the drag torque test, according to the test method specified in 5.7. The maximum value of the drag torque shall not exceed 7% of the rated torque or 60 N·m, whichever is smaller.

4.2.8 Noise

Carry out the noise test, according to the test method specified in 5.8. See Table 2, for the limit requirements of measurement results.

5.1.1.1.4 The joints shall be effectively sealed, without oil leakage.

5.1.1.2 Run-in

The transmission assembly under test shall be run-in, according to the requirements of 4.1.1.3.

5.1.2 Test procedure

5.1.2.1 The load motor is set to speed control mode.

5.1.2.2 The drive motor is set to torque control mode.

5.1.2.3 The transmission is in the D gear.

5.1.2.4 The hydraulic torque converter is locked up.

5.1.2.5 Increase the input speed of the transmission to the test speed, which is specified by the manufacturer.

5.1.2.6 Adjust the controller; test in each gear, respectively.

5.1.2.7 Gradually increase the input torque to the rated value, which is specified by the manufacturer; keep the torque stable for not less than 30 s.

5.1.3 Test result processing

During the test, the difference -- between the theoretical speed and the actual speed of the transmission load motor -- shall not exceed 5%; the input torque at this time is the torque capacity, which shall be corrected according to formula (1):

$$T_c=T_i-F_{di} \quad \cdots\cdots (1)$$

Where:

T_c - Torque capacity;

T_i - Input torque;

F_{di} - Loss of torque at the equipment input.

5.2 Transmission efficiency

5.2.1 Test preparation

The preparation before the test shall be carried out, according to the provisions of 5.1.1.

5.2.2 Test procedure

F_{di} - Lost torque of the input device, N·m.

5.3 Parking

5.3.1 Test preparation

Preparations before the test shall be carried out, in accordance with the provisions of 4.1.1.5.

The vehicle shall be fully loaded; the tires of the specified size shall be used; the tire pressure shall reach the specified value.

5.3.2 Test procedure

Drive the test vehicle to the middle of the 20% slope. Keep the longitudinal centerline of the vehicle parallel to the centerline of the slope. Step on the service brake pedal, to make the vehicle completely stationary. Shift the transmission from D to P. Then release it service brake pedal, to confirm the performance of parking on a slope. Change the parking direction of the vehicle on a slope, to confirm the performance of parking on a slope.

5.4 Air tightness

5.4.1 Test preparation

Keep the transmission in a normal installation state. Seal the breathing port of the transmission.

5.4.2 Test procedure

Connect the airtight test equipment to the transmission under test. Gently inject dry compressed air into the transmission, to gradually increase the internal pressure of the transmission to 25 kPa. Close the air supply valve, after the pressure is stable. Measure the pressure drop inside the transmission, after maintaining it for 30 s.

The above test needs to be repeated 2 more times; the maximum value is taken.

5.5 Ratchet engagement

Test on a straight road. Put the test car in D gear. Accelerate to 10 km/h. Release the accelerator, to put the vehicle in a coasting state. Shift the gear lever from D gear to P gear. Measure the vehicle speed when the ratchet is engaged. Then use the same method, to carry out the speed test of the ratchet engagement, in reverse gear.

5.6 Neutral output torque

Place the transmission in N gear. Connect the output end to the torque measuring instrument. When the input speed is 1000 r/min ± 10 r/min, measure the torque value

of the output end. The transmission oil's temperature is 80 °C ±5 °C, during the test.

5.7 Drag torque

Place the transmission in N gear. The input speed is 1000 r/min ± 10 r/min; the output speed is 0 r/min; the oil temperature is maintained at 80 °C ± 5 °C. Record the input torque value.

5.8 Noise

5.8.1 Test requirements

5.8.1.1 The test shall be carried out in a semi-anechoic room. The background noise shall be lower than 25 dB(A). The difference -- between the final measurement result and the background noise -- shall not be less than 10 dB(A).

5.8.1.2 The installation state of the transmission on the bench is consistent with that on the vehicle; the height of the axis of the input shaft from the ground shall not be less than 400 mm.

5.8.1.3 The output shaft of the transmission shall use the transmission shaft or half shaft of the original vehicle.

5.8.1.4 During the noise measurement process, fans are not allowed. The temperature of the transmission lubricating oil shall be kept at 80 °C ± 5 °C. The temperature limit can be relaxed for individual extreme conditions, but it shall not exceed 100 °C.

5.8.1.5 Carry out running-in, according to the requirements in 4.1.1.3.

5.8.1.6 The frequency range of noise measurement includes the octave band, whose center frequency is 125 Hz ~ 8000 Hz.

5.8.1.7 The microphones are installed at the four positions - upper, left, right, front - of transmission (the direction from the drive dynamometer to the transmission along the input shaft is the front); the distance from the microphone to the center point of the envelope surface of the transmission (corresponding to microphone mounting side) is 1 m. For transmissions with different arrangements, when the test bench interferes with a certain measuring point, the measuring point can be canceled, BUT at most one measuring point can be canceled.

5.8.2 Test procedure

5.8.2.1 Turn off all equipment on the test bench. Measure the background noise of the test room.

5.8.2.2 Before the transmission under test is installed on the test bench, run the test bench at the specified speed in each working condition, to test the background noise of the test bench.

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