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Test methods for the rolling resistance of industrial tyres

工业车辆轮胎滚动阻力试验方法

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1 Scope

China's national test methods for the rolling resistance of industrial tyres. Rolling resistance is well established as a measurement for car and truck tyres, where it drives fuel consumption and is regulated and labelled. Industrial tyres - the solid and cushion tyres of forklifts, and the tyres of other materials handling equipment - had no equivalent, and the case for measuring them has been made by electrification. A diesel forklift's fuel cost was a minor line; a battery forklift's rolling resistance directly determines how long it runs between charges, and therefore whether a fleet needs a spare battery per truck. Measuring it is different from the car case because these tyres are solid or nearly so, they run at low speed under high load, and much of their loss is hysteresis in a thick rubber section rather than in a flexing carcass - so the test conditions have to reflect the duty rather than being borrowed.

This document describes the test methods for rolling resistance of industrial tyres, including test equipment and accuracy, test conditions, test procedures, additional loss measurement, data processing and repeatability testing of rolling resistance testing machine. This document is applicable to the testing of rolling resistance of pneumatic and solid tyres for industrial vehicles.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 2982 Designation, Dimensions, Inflation Pressure and Load Capacity of Pneumatic Tyres for Industrial Vehicles

GB/T 6326 Tyre Terms and Definitions

GB/T 10823 Size Designation, Dimensions and Load Capacity of Solid Tyres for Pneumatic Tyres Rims

GB/T 12939 Rims Series for Industrial Vehicles

GB/T 16622 Size Designation, Dimensions and Load Capacity for Pressed-on Solid Tyres

GB/T 16623 Technical Specification of Pressed-on Solid Tyres

GB/T 29040 Test Methods of Rolling Resistance for Motor Vehicle Tyres - Single Point Test and Correlation of Measurement Results

3 Terms and Definitions

The terms and definitions defined in GB/T 6326 and GB/T 29040 are applicable to this document.

4 Measurement Methods

This document provides four measurement methods. The tester can choose to use any measurement method. No matter which method is chosen, the measurement results shall be converted into rolling resistance values between the tyre / drum contact surface. The four measurement methods are:

- a) Tyre axonometric method: measure or convert into the counter-acting force on the axle of the tyre;
- b) Drum shaft torque method: measure the input torque of the drum;
- c) Power method: measure the energy input to the drum;

d) Deceleration method: measure the deceleration of the drum and the tyre rim assembly.

NOTE 1: in the tyre axonometric method, the measured values include the bearing losses and aerodynamic losses of the tyre rim assembly, which are taken into account in further data processing. NOTE 2: in the drum shaft torque method, power method and deceleration method, the measured values also include the bearing losses and aerodynamic losses of the tyre rim assembly and the drum.

5.1 Technical Requirements for Test Drum

5.1.1 The diameter of the drum of the testing machine shall not be less than

1.7 m, the diameter tolerance shall be 1%, and the values of rolling resistance and rolling resistance coefficient shall be expressed as the value of the

1.7 m drum. The rolling resistance results of different drum diameters are different, and the conversion of different drum diameters can be carried out in accordance with the stipulations of 9.6.

5.1.2 The surface of the drum of the testing machine shall be a smooth steel drum surface. Sometimes, in order to improve the accuracy of separated measurements, textured drum surfaces can also be used. The surface of the drum shall be kept clean. The measured rolling resistance (F_r), rolling resistance coefficient (C_r) and rolling resistance coefficient percentage (dC_r) shall be expressed as the value of a smooth drum surface. When a textured drum surface is adopted, it shall comply with the stipulations of A.7.

5.1.3 The surface width of the drum of the testing machine shall be greater than the width of the tread surface of the tyre.

5.2 Test Rims The test rims shall be steel or light alloy rims, and shall comply with A.2 and the following stipulations:

---For solid tyres with pneumatic tyre rims, the test rims shall be the allowable rims specified in GB/T 10823 or related industry technical documents;

---For pressed-on solid tyres, the test rims shall be the rims specified in GB/T 16622 and GB/T 16623, or related industry technical documents;

---For pneumatic tyres for industrial vehicles, the test rims shall be the measurement rims specified in GB/T 2982 or related industry technical documents. NOTE: the related industry technical documents mentioned in this document are only applicable to tyre specifications beyond the scope of the corresponding national standards.

5.3 Load, Positioning, Control and Instrument Accuracy The load, positioning, control and instrument accuracy shall be accurate, and shall comply with the stipulations of Appendix A.

6 Test Conditions

6.1 General Rule The inflated pneumatic tyres for industrial vehicles are subjected to a rolling resistance test, and the air pressure is allowed to be raised, that is, the "capped inflation test".

6.2 Ambient Temperature The reference ambient temperature shall be 25 C. The measurement position shall be within the range of 150 mm ~ 1,000 mm from the sidewall of

the tyre. When the reference temperature cannot be reached, then, it shall be corrected to the value under the reference temperature conditions in accordance with the stipulations of 9.5.

6.3 Drum Surface Temperature At the beginning of the test, the drum surface temperature shall be the same as the ambient temperature.

6.4 Test Air Pressure After the rims are installed, the pneumatic tyres for industrial vehicles shall be inflated in accordance with the requirements. The test air pressure shall be the air pressure specified in GB/T 2982 or related industry technical documents; the inflation pressure shall be closed and shall comply with the tolerance range specified in A.4.

7 Test Procedures

7.1 General Rule Each stage of the test procedures shall be carried out in accordance with the sequence provided in 7.2 ~ 7.4.

7.2 Thermal Equilibrium After the pneumatic tyres for industrial vehicles are inflated, after parking at ambient temperature for 24 h, the air pressure shall be adjusted to the test air pressure, and then, verified after adjustment for 10 min. The solid tyres for industrial vehicles shall be parked for 24 h at ambient temperature.

7.3 Heating-up Carry out heating-up driving of the test tyres in accordance with Table 1, Table 2 and the following stipulations:

- a) Solid tyres for industrial vehicles: heat up for 15 min;
- b) Pneumatic tyres for industrial vehicles: heat up for 3 h.

7.4 Measurement and Record The following data shall be measured and recorded during the test:

- a) Test speed (U_n);
- b) Tyre test load (L_m) perpendicular to the drum surface;
- c) Initial test air pressure;
- d) Measured rolling resistance coefficient (C_r), rolling resistance coefficient percentage (dC_r), and its corrected value ($dC_{r,corrected}$) under the conditions of 25 C and
- e) Ambient temperature (t_{amb});
- f) Drum radius (R);
- g) Tyre load perpendicular to the drum surface when the additional loss is measured by the separation method;
- h) The selected test method;