The Research of Auto Tyre Performance Grading Assessment

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Abstract. The Auto tyre is an important component of the vehicle, and its performance directly affects the vehicle performance. There is no professional testing assessment in China, this essay establishes the auto tyre performance grading assessment method, and there is advanced experience in other countries. The method could assessment item of safety, energy conservation, environmental protection. The project is aimed to guide consumption and provide data support for vehicles, and wish it could promote the rapidly development of the industry.

Introduction

In recent years, with the rapid development of the automotive industry, the market for vehicle comfort and safety requirements are getting higher and higher. As the key component of the vehicle driving system, the tire directly affects the driving safety, low carbon emissions, comfortable experience and other performance. Especially, the rapid development of new energy vehicles has put forward higher requirements for the performance of tires. China is the largest producer of tires. In 2006, China's tire output reached 285 million, more than 223 million of the United States, after 10 consecutive years to occupy the world's first. In 2015, the country's total tire output was 565 million. However, the domestic tire industry has serious structural overcapacity, and the industry needs to adjust its structure, optimize the allocation of resources and eliminate backward production capacity. According to statistics, In the current domestic production of passenger cars, radial tires and light truck radial tire, 65% of them is the low-end products. These products are characterized by low technical performance, low added value and serious homogenization, and the market competition is extremely fierce.

With the development of automotive technology towards the refinement, the performance requirements of tires are becoming higher and higher, and the trend of low carbon, green and economical development is expected. For consumers, tires are automotive consumables, and their demand is enormous. But the consumers know little about it, so it is time-consuming and difficult to choose.

Therefore, the domestic tire industry urgently needs overall supervision and consumption guidance, so as to promote the technical level of the industry and achieve high quality and rapid development.

This article from the industry development and consumption demand, to car tires as the evaluation object, the performance evaluation method of automobile tire is established, and the tires are classified according to different performance so as to promote the development of the industry and provide guidance and reference for the product consumption.

Introduction to Tire Testing and Evaluation

Tire Performance Test

Tires are auto parts and belong to the products within the scope of our CCC catalog. At present, tire testing mainly includes regulation test, R & D test and road test.

Legal test, including product CCC certification test and whole vehicle matching announcement test. Test standard is GB 9743-2015, car tire, GB 9744-2015, truck tires. Including new tire rim
size, tire strength performance, tubeless tire stripping resistance, tire durability, low pressure performance, high speed performance, tread wear mark and logo project.

R & D test is the tire product development and supporting vehicle development process testing, including tire quasi-static stiffness test (vertical and horizontal stiffness, torsional rigidity, radial stiffness, angular stiffness and coating stiffness), rolling resistance test, six component test, high-speed uniformity test, flat point test, impact test and topology scan, in addition, the tire modal test, pressure distribution and bench noise test are also the items in the R & D test.

The road test is tire matching test on vehicle, including wet grip performance test, rolling noise test, wet / dry braking performance test, road test, abrasion test, handling comfort test and so on, the tests are carried out in the professional test field which meets the standard requirements, and are the real vehicle tests of all aspects of the tire performance.

Tire Evaluation Introduction

Internationally, the United States first introduced tire grading classification regulations: The unified tire quality classification system (UTQGS) relates to the tire safety and reliability index, and three indicators are required to be engraved on the sidewall: Temperature, Traction, Treadwear. The temperature resistance rating is on the bench test, and the remaining two are road tests. The abrasion resistance index is carried out at the designated test site (near San Angelo, Texas, USA).

The EU labeling act is known to all, and regulations that from the beginning of 2012 November, all cars sold in the EU tire, light truck tire, truck tire and bus tire must be labelled, management from the tire safety and vehicle fuel economy and environmental protection. The European Union has classified the tire rolling resistance (fuel economy), the performance of wet pad (vehicle brake safety performance) and rolling noise. Among them, the rolling resistance and wet pad performance are divided into 7 grades of A to G, and the rolling noise project is displayed by the actual test value (dB), so that consumers can have a clearer understanding of the tire.

In addition, South Korea, Japan, Brazil, Gulf countries and other countries have also formulated the corresponding tire labeling system, and carried out the performance evaluation of tire safety, energy saving and environmental protection indicators. Among them, Japan is implemented by voluntary certification. At present, China has no national level of unified tire label management approach.

Evaluation Method of Tire Performance Grade

Chinese tire brand is more, the production and marketing volume is huge, and the content of the product is not high, so it is necessary to establish a unified tire performance evaluation system.

At present, the tire evaluation system in the world mainly has European Union system and American system, namely European Union tire label law and American unified tire quality classification system (UTQGS), as detailed in table 1.

<table>
<thead>
<tr>
<th>project</th>
<th>security</th>
<th>energy conservation</th>
<th>environmental protection</th>
<th>reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU labelling law</td>
<td>Wet grip properties</td>
<td>rolling resistance</td>
<td>Rolling noise</td>
<td>--</td>
</tr>
<tr>
<td>America UTQGS</td>
<td>Resistance to temperature and traction</td>
<td>--</td>
<td>--</td>
<td>Abrasion resistance index</td>
</tr>
</tbody>
</table>

In Table 1, traction tests in the US UTQGS are similar to those in the European labeling act, with slightly different test conditions. The volume of Chinese tires is large, the EU occupies a large share, and the European Union tire labeling law is enforced, which has a greater impact worldwide.
On the basis of referring to the advanced experience of foreign countries and combining with the present situation of domestic tyres, the following methods are presented (Table 2).

1) The test items include safety index (temperature resistance grade, wet land performance), energy saving index (rolling resistance project) and environmental protection index (rolling noise). Among them, the reliability test is not yet mature, not included in this evaluation method.

2) Test standard is FMVSS PART 575.104/ 2015" Uniform Tire Quality Grading Standards"(UTQGS)(temperature tolerance grade)and appendix 116, Revision 3 (rolling resistance, wet grip performance, rolling noise) of ECE R117 "uniform regulations for approval of tire rolling noise and wet pavement adhesion and / or rolling resistance".

<table>
<thead>
<tr>
<th>Evaluating indicator</th>
<th>Test item</th>
<th>Evaluation grade</th>
<th>Assessment rules</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>Temperature rating (Bench test)</td>
<td>A</td>
<td>Complete the 575 r/min stage</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>Complete the 500 r/min stage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>Not completed 500 r / min stage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wet grip performance (Road test)</td>
<td>A</td>
<td>1.55≤G</td>
<td>G is a wet scratching performance index.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>1.40≤G 1.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>1.25≤G 1.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D</td>
<td>null</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E</td>
<td>1.10≤G 1.25</td>
<td></td>
</tr>
<tr>
<td>Energy conservation</td>
<td>Rolling resistance (bench test)</td>
<td>A</td>
<td>RRC≤6.5</td>
<td>RRC is the rolling resistance coefficient.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>6.5  RRC≤7.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>7.7  RRC≤9.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D</td>
<td>null</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E</td>
<td>9.0  RRC≤10.5</td>
<td></td>
</tr>
<tr>
<td>Environmental protection</td>
<td>Rolling noise (road test)</td>
<td>A</td>
<td>N≤LV−3</td>
<td>N is the final result of tire rolling noise, and LV is the reference limit of the width of the corresponding tire section.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>LV−3 N≤LV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>LV N</td>
<td></td>
</tr>
</tbody>
</table>

3) Evaluation level reference standard, REGULATION (EC) No. 1222/2009 and its revised editionREGULATION (EU) No. 1235/2011" Tire fuel economy and other key parameter labels" carried out. Compared with the EU, wet grip performance and rolling resistance project level reduced from 7 to 5, the limit increased, more stringent.

4) When the unit type is divided, starting from the characteristics of the product itself, it takes into consideration the reference of the whole vehicle enterprises and consumers to the evaluation results, there is no use of tread patterns for tyre exports, but a more rigorous division: manufacturers and brands, product specifications, tires, speed symbols, load indices, load types, tread codes, crown / sidewall, material name and number of plies.

5) In order to eliminate the influence of the objective difference of the test site on the test results, specially designated only test site. Bench test site: Tianjin Automobile Inspection Center (component test room); road test site: Tianjin Automobile Testing Center (whole vehicle Yancheng test room).

**Project Data Analysis and Development**

In order to determine the classification of tire performance, sampling test and data analysis are carried out for the tire market. The market is now selling 1348 passenger car models used tires were statistics, a total of the tire model used for 245, and determined that 11 of them were the most

Test are performed according to ECE R117 "Uniform regulations on the approval of tire rolling noise and wet pavement adhesion and / or rolling resistance", The rolling resistance test results are the benchmark values corrected by the European Union rolling resistance benchmark laboratory. In the end, more than 200 sets of tires were tested, involving 14 brands at home and abroad. Arrange the test data as shown in Figure 1 to figure 3.

Through the data analysis, the following conclusions are drawn.

1) In the data distribution of rolling resistance and wet grab performance, the E level accounts for the largest. Percentage below E: The rolling resistance was 11.76%, and the wet grip performance was 12.50%, the end of the market is inferior tires, corresponding to the evaluation in this article grading, and gradually eliminate this part of the product.

2) In rolling noise projects, B ranks the highest, and A ranks least. The higher the level of the project, the lower the value, representing the better the performance, In view of the fact that the data distribution is not too obvious and the numerical value is not big, the evaluation method is classified according to three levels.

3) The temperature-resistant grade item is a project that is mandatory in the United States, but is self-declared on the tire sidewall. In view of the large number of Chinese tires exported to the

![Sample Distribution](image1)

Figure 1. Distribution of rolling resistance data.

![Sample Distribution](image2)

Figure 2. Distribution of performance data of wet grab.

![Sample Distribution](image3)

Figure 3. Distribution of rolling noise data.
United States, taking into account the future test data have to be recognized by foreign countries, this evaluation method to retain the project.

The evaluation method of automobile tire performance is based on the advanced experience of foreign countries, and taking into account the current situation of domestic tire products, regulate and reasonable, hoping to achieve the purpose of guiding consumption and upgrading the technical level. In addition, the performance of tires involves all aspects of the vehicle and consumers, and its performance evaluation will be upgraded with the increase of demand and the accumulation of technology. Tire wear test, low carbon index, recycling, comfort and other projects will gradually be added to the evaluation system.

Conclusion
From the point of view of actual demand, the evaluation method of automobile tire performance grade was established for the first time in China. Through a large number of experimental tests and investigations, a grading scheme suitable for domestic products is obtained, which can be used to classify product performance reasonably and effectively. The shortcomings and development of this evaluation method are summarized as follows.

1) The evaluation method is first formulated in China and lacks experience. It should be accumulated according to the effect of implementation.

2) The evaluation method should keep pace with the times, and the evaluation indexes should be "in" and "out", and constantly adapt to changes in the market at home and abroad.

3) Gradually strengthen docking with foreign countries, learn advanced experience, and promote the adoption and approval of domestic and foreign evaluation results.

References
[2] ECE R117 Uniform regulations on the approval of tire rolling noise and wet pavement adhesion and / or rolling resistance.