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Road vehicles — Measurement of road surface friction

Véhicules routiers — Mesurage du coefficient d'adhérance

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8349 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 9, *Vehicle dynamics and road-holding ability*.

This first edition cancels and replaces the first edition of ISO/TR 8349:1986, which has been technically revised.

Annex A and B form a normative part of this International Standard. Annex C is for information only.

Introduction

During its work to establish vehicle-handling test methods, ISO/TC 22/SC 9 found it necessary to establish test methods for evaluating the friction characteristics of a test surface for handling and braking tests with non-locked wheels that considered the peak friction rather than the locked-wheel friction — until now the most commonly used measure of tyre-road friction.

The reason for this was that the tyre-road friction determining the limits of braking and handling performance is the friction obtained with wheels rolling at a longitudinal slip below 20 % and side slip angles below 20°. The maximum or peak-friction values are normally found within these ranges. Furthermore, research has shown that there is a strong correlation between these longitudinal and lateral peak values but not between such values and locked-wheel friction.

Both longitudinal and lateral friction test procedures and test equipment exist and are widely used. Different countries tend to favour either longitudinal or lateral procedures.

Because of these difficulties, the work of ISO/TC 22/SC 9 first resulted in Technical Report ISO/TR 8349, in which two basic measuring methods with four optional reference tyres were proposed for evaluation. The two measuring methods were a longitudinal friction measurement with a constant slip of 15 % and a lateral friction measurement at a constant side slip angle of 20°. Both methods are well established and traditionally used by road and airport authorities for obtaining reference friction values. As they are continuous measurements, the uniformity of the friction along the track as well as a mean value over the length of track used for the vehicle test is obtained in a single test run. For braking tests, the speed sensitivity of the friction is of interest. This can be obtained by testing at two or more speeds depending on the precision needed. In most cases two speeds will be sufficient.

In the field of automotive handling and brake testing, the use of special test vehicles has been very limited and primarily restricted to locked-wheel test trailers of ASTM (American Society for Testing and Materials) conformance, since the US Federal Motor Vehicle Safety Standard (FMVSS) referred to locked-wheel friction according to the ASTM standard.

The United Nations Economic Commission for Europe (UNECE) has established in its braking Regulation No. 13 a method for measuring the maximum friction coefficient of the test surface using the tested vehicle itself, prepared for single-axle braking. The tyres of the test vehicle are used as reference tyres. The maximum constant braking force that can be used without wheel lock is the UNECE definition of a reference friction called the peak adhesion coefficient, K. It represents the minimum peak value on the track surface in the speed interval from 40 km/h to 20 km/h.

The UNECE method is based on the assumption of a surface with uniform friction without speed sensitivity and a test vehicle whose brake force at constant brake pressure is constant. As this is normally not the case, the method provides a reference friction value lower than the actual mean peak friction along the tested track. How much lower depends on the magnitude of the speed sensitivity of the tyre–road friction and vehicle brake factor as well as the non-uniformity of the friction and its distribution along the test track.

Despite objective reasons for adopting one of the continuous-friction measuring methods proposed in ISO/TR 8349, the USA, in its latest proposed rule (FMVSS 135) for passenger car brakes, has chosen the ASTM standard E 1337-90 for determining longitudinal peak-friction measurement. This is based on the same equipment used for locked wheel friction according to ASTM standard E 274-90 but using a new standard reference test tyre, ASTM E 1136. US car manufacturers already use this method.

The UNECE has not adopted the new ASTM peak-friction measurement standard nor any of the options in ISO/TR 8349, but is striving to improve the existing UNECE K value method.

ISO/TR 8349 has been criticized in the USA and by some other SC 9 members for having too many options and for being insufficiently clear concerning the correlation between the different options.

With this background, ISO/TC 22/SC 9 decided to reconsider the approach taken by ISO/TR 8349. It was decided not to include the UNECE method, due to the above mentioned drawbacks. It was also considered too elaborate to measure both longitudinal and lateral friction and that the correlation between the two was high enough to justify measuring only one. Longitudinal friction was favoured as being the better-established in automotive legislation and for approval of original equipment tyres by automotive manufacturers.

As a result, this International Standard defines three options for measuring longitudinal friction, the choice of which depends on the available means and the application. Only two types of standard reference test tyres are used: one of passenger-car size and the other a small test tyre for low-cost equipment.