TECHNICAL SPECIFICATION

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Rubber — Generation and collection of tyre and road wear particles (TRWP) — Road simulator laboratory method

Caoutchouc — Génération et collecte des particules émises par l'usure des pneumatiques et de la route (TRWP) — Méthode de simulation routière en laboratoire

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Contents

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 45, *Rubber and Rubber Products.*

Introduction

Tyre and road wear particles (TRWP) are formed from the friction between a tyre and roadway surface. The particles are subsequently released into nearby soil and sediment ecosystems. As such, there is interest in studying the composition and effects of TRWP on the environment (Kreider et al. 2010; Unice et al. 2015). This document provides guidelines for the generation of TRWP using a road simulator in a laboratory setting. The guidelines describe the method, apparatus and equipment, TRWP collection procedures, monitoring measures, and test report. An informative case study is also provided.

Generation of TRWP with a road simulator eliminates interferences from other roadway surface contaminants such as brake dust, oil and grease, soil, and vegetation (Kreider et al. 2010). This method allows for a more accurate characterization of the physical and chemical properties of TRWP than other generation methods including on-road collection and cryogenic breaking of rubber tread. In addition, a greater mass of TRWP can be collected using the road simulator laboratory method. Other laboratory generation methods (e.g., steel brush and grit paper) are not representative of actual driving conditions and may introduce additional interferences to the generated TRWP. Furthermore, previous analysis has shown that the particle morphology and size distribution of TRWP generated using on-road and road simulator methods are similar, with the on-road TRWP slightly smaller in size (Kreider et al. 2010).

Annex A gives information on a case study of TRWP generation.

Rubber — Generation and collection of tyre and road wear particles (TRWP) — Road simulator laboratory method

1 Scope

This document specifies a method for the generation of tyre and road wear particles (TRWP) in a road simulator laboratory that is representative of actual driving conditions. Guidance is provided for the road simulator system, test pavement and tyres, vacuum collection system, monitoring, and reporting.

This method is applicable for the collection of TRWP from a known pavement and tyre type under realistic driving conditions without the inference of road surface contaminants (i.e. brake dust, exhaust, grease, etc.).

There is a possibility that this method is not relevant for studded tyres.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
monitoring
repeated measurement to follow changes over a period of time

3.2
particle
small discrete mass of solid or liquid matter

3.3
tyre and road wear particles
TRWP
discrete mass of elongated particles generated at the frictional interface between the road and the pavement surface during the service life of a tyre

Note 1 to entry: The particles consist of tyre tread enriched with mineral encrustations from the roadway surface.

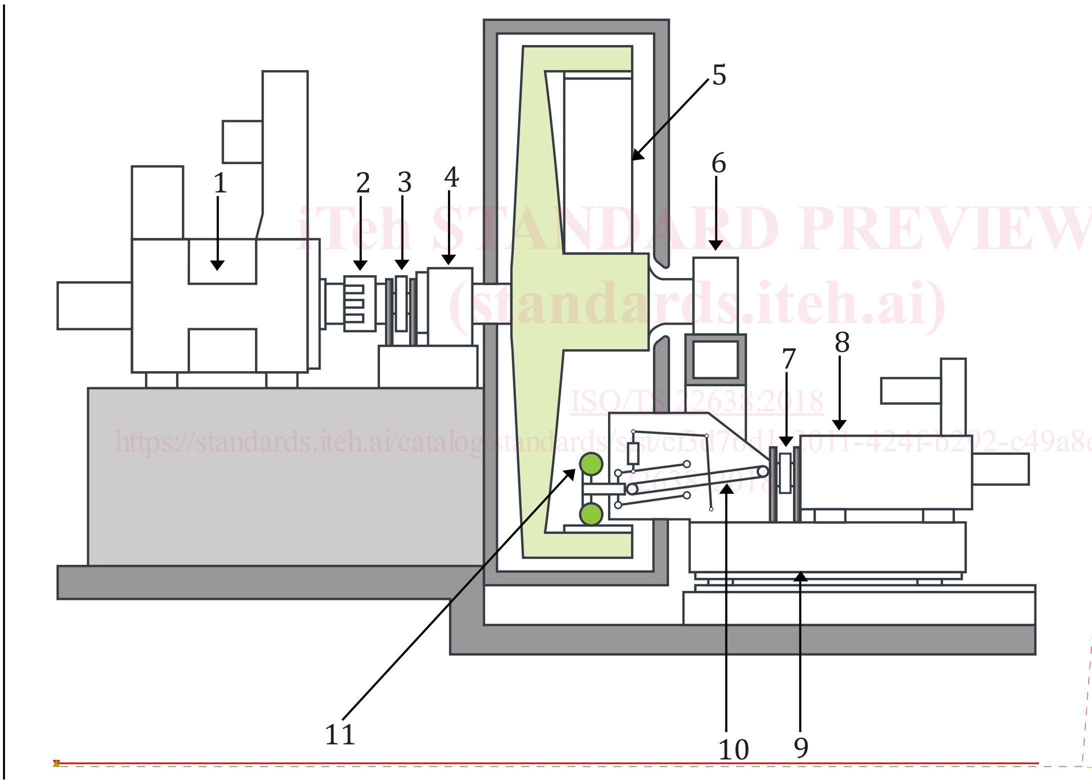
4 Apparatus and equipment

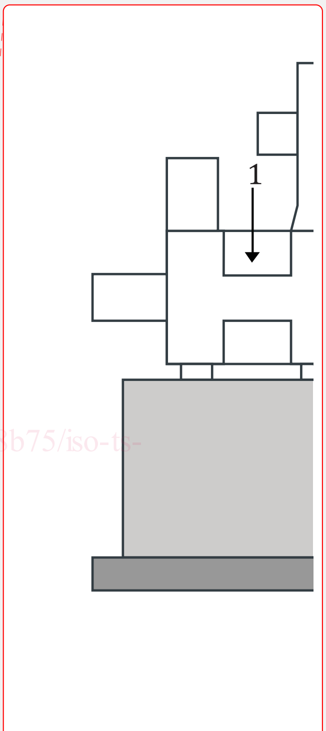
TRWP are generated from a tyre and pavement of known composition using a road simulator system used for TRWP generation, with an aspiration collection system. A precision balance is used to weigh collected TRWP, and collected TRWP shall be stored in amber glass jars.

4.1 Generation System

4.1.1 Characteristics, a testing facility consisting of a road simulation system fitted with road pavement cassettes is required for the TRWP generation. The system shall permit housing of at least one tyre in a manner such that the tyre interfaces the pavement cassettes similar to normal tyre operation. Systems such as the interior drum testing system (see Figure 1) or rotating tabletop systems can be considered for this application.

The generation system should be electronically programmable to mimic realistic driving parameters including speed, acceleration, loading, braking, and steering. The system shall be capable of a maximum test speed of at least 150 km/h. The drive capabilities should include adjustable camber angle between −2° and 8°, adjustable slip at the test wheel between 0 % and 100 %, and steering angle adjustable during operation of −15° to 15°. The radial force should be adjustable between −5 kN and 5 kN, and the normal force should be adjustable between 0 kN and 10 kN.





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Key

1 drum drive engine, 200 kW, 200 rpm
2 clutch
3 brake (for casket mounting only)
4 bearing
5 surface of inner drum (filled caskets)
6 bearing
7 free-wheeling hub with disk brake
8 tyre drive engine, 200 kW, 200 U/min
9 wheel slide
10 tyre load
11 tyre wheel

Figure 1 — Conceptual schematic of interior drum testing facility

4.1.2 Monitoring, during operation, the system shall allow for monitoring of tyre speed, system temperature, and tyre forces and torques. Ventilation in the collection system (e.g. in ductwork of a drum rotator or within the enclosure for a tabletop generator) shall be measured and recorded.

4.2 Test pavement

The test pavement shall be contained in exchangeable cassettes. Test pavement shall be unweathered and mimic actual road pavement to generate representative TRWP. Pavement type may vary, but one suggestion is an asphalt-based pavement specified in ISO 10844. The surface area of the test pavement should be large enough to simulate actual rolling tyre movements.

4.3 Test tyres

Test tyres shall represent those typically found on the market to generate representative TRWP. Specific tyres may vary by vehicle type (truck or passenger car), performance (seasonal tyres), composition, and age. Test tyres should be maintained within manufacturer specified optimal pressure ranges.

4.4 Collection system

The collection of TRWP shall be through an aspiration system attached to a capture hood at the test tyre hub located behind the rolling tyre. The collection system shall consist of a stainless steel capture hood connected to a vacuum via a stainless steel tube.

5 Procedures

5.1 General

The instruments used in this procedure shall be operated in accordance with the manufacturer's instructions.

5.2 Simulated driving parameters

Programmable driving parameters may vary, but shall be representative of actual driving conditions (i.e., city and/or highway driving). The test tyre should be operated at the maximum tyre load and the manufacturer-recommended tyre inflation pressure. An operational cycle that may be used includes:

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— 2,6 % of total drive time between 0 km/h and 30 km/h;

— 7,4 % of total drive time between 30 km/h and 50 km/h;

— 25,2 % of total drive time between 50 km/h and 80 km/h;

— 34,2 % of total drive time between 80 km/h and 120 km/h;

— 30,6 % of total drive time between 120 km/h and 150 km/h.

Acceleration or deceleration between speeds can be conducted at 1 m/s^2 to 2 m/s^2. This cycle can be repeated until the desired mass is collected. Special attention should be paid to the tyre-pavement interface. Depletion of TRWP generation and collection may occur if there is observed smearing on the pavement.

5.3 Particle collection

A single composition sample shall be collected in an environment free of contamination. All accessible areas shall be cleaned prior to testing. Following collection, the sample shall be removed from the

vacuum by gently tapping and scraping with a stainless steel mini-scoopula and sieved at 150 µm to remove larger debris. TRWP should then be weighed and placed in a pre-weighed amber glass container, which can be used for storage.

6 Test report

The test report shall include at least the following information:

a) all information necessary for identifying the sample collected;

b) reference to this document (i.e ISO/TS 22638);

c) Generation system characteristics;

d) test pavement;

e) test tyre(s);

f) date of the simulation;

g) time and duration of the simulation;

h) simulation conditions and parameters, including velocity, temperature, tyre forces, and enclosure ventilation rate;

i) particle collection and measurement equipment;

j) monitoring measures;

k) mass of sample collected;

l) any anomalies that occurred during the simulation;

