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White Paper

Amendment of UN/ECE Regulation No. 117

Brief Summary

The modification to UN/ECE Regulation No. 117 of the United Nations Economic Commission for Europe (UN/ECE-R117) with the amendment series 03 and 04 began in the meeting of the UNECE Working Group GRBP in January 2019. At that meeting, the experts from France discussed the introduction of limits with regard to the wet properties of worn tyres. The aim of those limits is to increase the lifespan and safety of tyres up to almost the legally defined minimum tread depth. For testing, the tyres are machined to a fixed contour and remaining tread depth. The tyre processed in this way is tested for its wet grip performance in comparison to a standard reference tyre with reduced tread depth, which has also been newly introduced. Depending on the type of use of the tyre type, the tyre must comply with certain minimum requirements compared to the reference tyre.

This amendment phases in minimum end-of-life requirements for vehicle tyre products for the first time. These requirements only take tyre tread depth into account and ignore other properties, such as ageing of the rubber compound or deterioration in structural strength. However, this singular approach gives rise to a host of requirements for the machining process used on the test specimen and for the tyre testing in practice.

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Profiles of the experts

Dipl.-Ing. (FH) Klaus Baltruschat
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Klaus Baltruschat is a specialist with over 20 years of experience in testing, tuning and characterising chassis components, especially tyres and wheels.

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Expert for Tyre and Wheel Testing
Lars Netsch is a senior tyre specialist with over 20 years of experience in the field of tyre testing, simulation, homologation and assessment and with many years of active committee experience in the development and updating of relevant standards and regulations.

Foreword and general introduction

The UN/ECE-R 117, first published in 2005 and frequently amended, has undergone fundamental revision in light of plans for improving tyre products' resilience and sustainability by extending their life without compromising on safety.

The subject matter of the amendment to UN/ECE-R117 concerns end-of-life requirements for a relevant product property. This is to ensure driving safety up to the wear limit of the chosen product while also improving sustainability.

The 02 series of amendments to UN/ECE-R117, first published in 2005, came into force in 2011. In addition to the existing limit values for tyre rolling noise and wet grip performance during braking, the amendment also includes minimum requirements for:

- Rolling resistance
- Tightening of the limit values for rolling noise, and
- Driving characteristics on snow ("snow grip")

of new tyres. This amendment marks the first time that end-of-life requirements are also addressed.

Figure 1: New tyres

Figure 2: Tyre buffing and grinding after machining steps

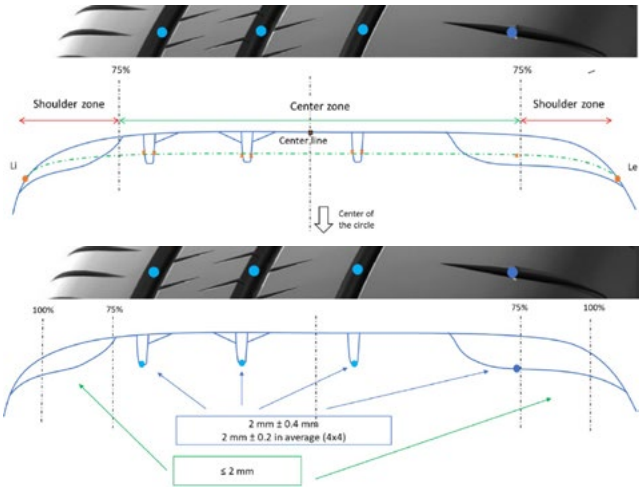
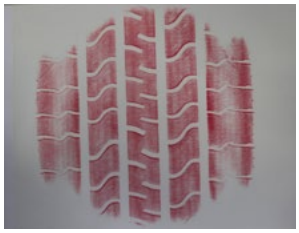


Figure 3: Prescribed tyre contour

Figure 4: Standard reference tyres NEW buffed



Footprint

Figure 5: Standard reference tyres NEW (SRTT 16")

Footprint

For this purpose, tyre wear must be artificially produced with very narrow tolerances. The objective is to reduce the tyre tread depth at the main grooves so that it is close to, but not below the minimum of 1.6 mm, taking possible measurement tolerances into account. In this context it is important to create a fixed tyre contour so that the tyre latch, i.e. the contact area of the loaded tyre, does not increase compared to a tyre in as-new condition. A buffing and grinding machine is used for this purpose. This type of machine is basically used in tyre retreading to remove the remaining tread down to the steel cord. In this type of application, the machining process is much more complex as the tyre must not be exposed to thermal stresses to avoid changes in product properties. For this reason, it makes sense to monitor and document the surface temperature during tyre machining. Continuous temperature monitoring is useful given that most manufacturers' machining processes are near-fully automated.

Figure 6: Buffing & Grinding machine

In the first step of the process, the tyre contour is determined using the laser light sectioning method and the target contour is then calculated. This can be adjusted manually depending on the manufacturer. The tyre is then cut to a proposed or self-defined tread depth using a machine-guided rotating knife. In the last step, it is ground to the specified dimensions with a grinding stone. The laser light sectioning method is then used again for automatic measurement of the final tyre contour and the result compared and evaluated with the specifications from the guideline. Due to the procedural weakness of the measurement method, validation of the measurement using a suitable second method and, where necessary, initiation of a further work step to exactly fulfil the requirement are urgently recommended. As part of quality assurance, the surface roughness of the tyre tread is then measured using a suitable measuring device and documented in the machining protocol. Various technologies can be applied to measure surface roughness. The technical literature describes various methods. For example, tactile methods use a measuring probe to determine surface roughness. The probe scans a certain path at a fixed speed to produce a two-dimensional micro-contour plot. In practice, this method uses a diamond tip to scan the surface. However, as diamond is the hardest known mineral in the world, the measuring tip may penetrate the surface and thereby influence and falsify the measurement result. Given this, it is important in this initial phase to gather experience and evaluate the method. We recommend giving particular consideration to innovative non-contact optical methods of surface roughness measurement. These methods might be particularly suitable for elastomer surfaces such as tyre compounds. The choice of measuring equipment should therefore focus on suitability. Where necessary, the method shall be compared with a known reference surface. RMA tables, which list definitions and tolerances for roughness specifications can be applied for this purpose.

Figure 7: Wet-grip measurement - trailer method

Figure 8: Wet grip measurement - vehicle method

The tyres thus prepared undergo the same testing as new tyres; only the validation standard is different. While new tyres have to compare to a “new to no wear” standard reference tyre, the artificially worn tyres are compared to a newly introduced standard reference tyre (“SRTT”) with a tread depth of 2 mm (content of the 04 series of amendments). The SRTT is already manufactured with the reduced tread depth, precisely specified according to a new standard. Until enough such tyres are available, new SRTTs can be processed accordingly with the buffing and grinding process and used for testing (03 series of amendments). Two methods are accepted for determining braking performance on wet surfaces:

- vehicle method
- trailer method

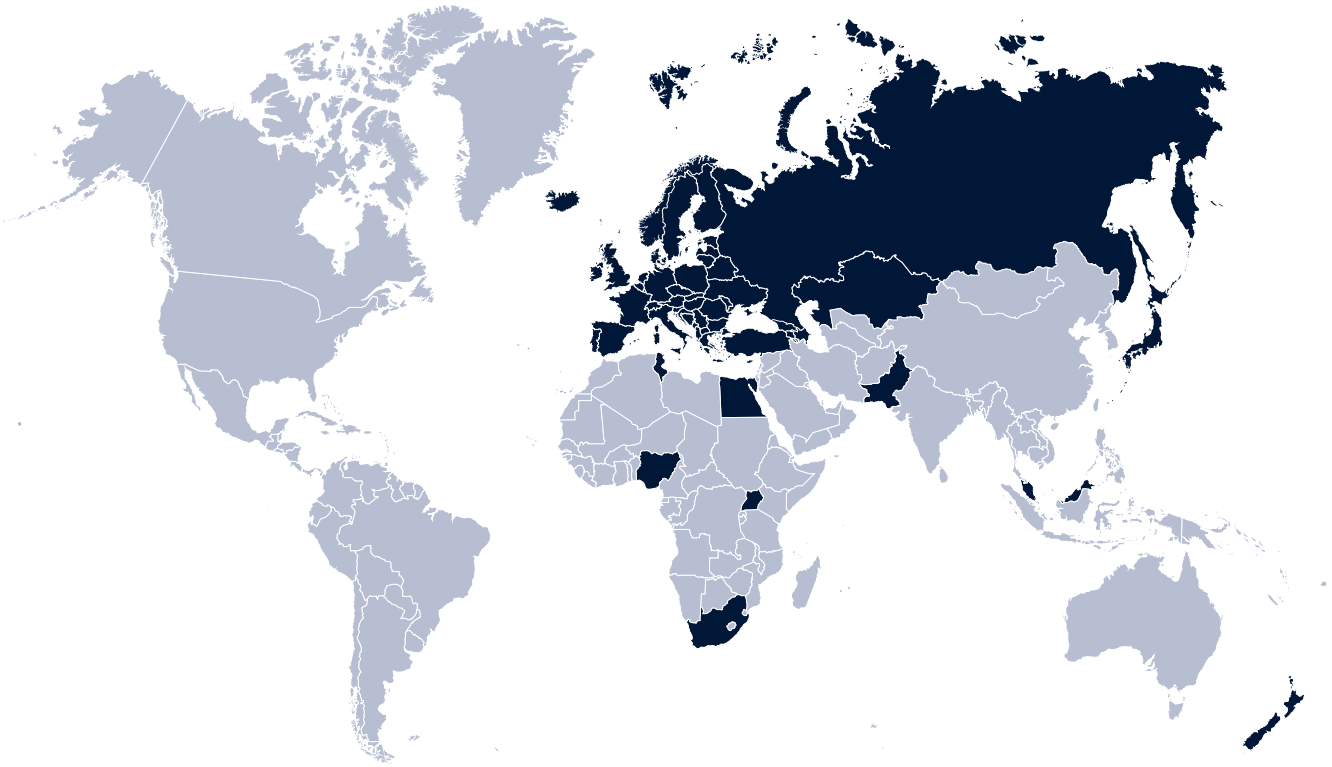
However, in our experience the trailer method is preferable. This is because the water depth may strongly influence the test result. In the case of a trailer with self-irrigation within the tolerances of the volume measurement, this influence may be less pronounced. The UNECE working group for wet grip of (artificially) worn tyres is currently investigating the influence of road surface water depth.

Another advantage of the trailer method is that the finely tuned vehicle dynamics control systems (ESP) of the test vehicles often react sensitively to wet road surfaces and reduce power from the powertrain in an attempt to regain driving stability.

Tyres that meet the minimum requirements for both conditions - new and with artificially reduced tread depth - receive a positive result in these partial UN/ECE-R117 tests (Annex 5 and Annex 9).

The testing team from the Tyre Outdoor Testing department has many years of experience in testing artificially worn tyres. Objective wet grip performance tests were carried out not only on these “worn” tyres as described in the current guideline, but also on tyres undergoing wear tests in parallel at different performance levels. Extreme thoroughness and meticulous observation and evaluation of influencing parameters are paramount in these tests.

Overview of UNECE contracting states



Countries using UN/ECE R117

Germany	Norway	Republic of Moldova	Cyprus
France	Finland	Bosnia and Herzegovina	Malta
Italy	Denmark	Latvia	Malaysia
Netherlands	Romania	Bulgaria	Albania
Sweden	Poland	Kazakhstan	Armenia
Belgium	Portugal	Lithuania	Montenegro
Hungary	Russian Federation	Türkiye	San Marino
Czech Republic	Greece	Azerbaijan	Tunisia
Spain	Ireland	North Macedonia	Georgia
Serbia	Croatia	European Union	Egypt
United Kingdom	Slovenia	Japan	Nigeria
Austria	Slovakia	Ukraine	Pakistan
Luxembourg	Belarus	South Africa	Uganda
Switzerland	Estonia	New Zealand	

Latest version:
https://unece.org/transport/documents/2023/03/contracting-parties-agreement-their-date-application-un-regulations-and

Relevant standards and regulations

Annex 5 to the UN/ECE-R117 is to be used for tyre testing involving braking on wet surface. It has the same content as the requirements of the international standard ISO 23671. The amendment has added the new Annex 9 to the UN/ECE-R117, governing production of artificially worn tread and specifying both the quality of the machined tread and the calculation formulas deviating from the original specification to determine the performance of the worn tyre compared to the SRTT. The various SRTT specifications are standardised in line with an array of ASTM standards applicable in the USA.

Required tests

Figure 9: Illustration – vehicle method

The vehicle test measures the performance of artificially worn tyres during ABS emergency braking from 85 km/h to a standstill on an irrigated road surface with water depth of approx. 1 mm, and compares it to the average maximum deceleration of the SRTT, also with reduced tread depth.

In testing with the Skid trailer, the maximum braking force of the tyre is measured on the irrigated road surface in a full braking manoeuvre from a travel speed of 65 km/h within a short timespan of approx. 0.5 second, and compared with that of the SRTT.

After quality assurance checks, the measured values go through further calculations and are converted into the respective performance parameters; these are then compared with the minimum values set out in the regulations. Within the test method tolerances, the performance characteristics are independent of environmental variables such as the precise water depth and the ambient and road temperatures. This requires appropriate expertise on the part of the executing experts and many years of test experience with the relevant test standards. TÜV SÜD can provide all this specialist expertise to deliver the highest-quality results for its customers.

Preparation and organisation of testing

Customers provide TÜV SÜD with a set of single-brand tyres, consisting of a maximum of 4 identical test specimens (a single test specimen is sufficient for the trailer method). The customer may supply the tyres already cut to the required remaining tread depth or as new tyres with full tread depth. The tyres are then inspected for compliance with the standards before testing commences. In the case of new tyres, TÜV SÜD prepares the specimens to give the correct tread depth and roughness.

An appropriate test vehicle is then selected and the tyres are mounted on the wheels with the specified dimensions. All other aspects of testing, from providing the test vehicles, test drivers and SRTTs to booking the test tracks and verifying the suitability and conformity of the test surfaces, are also organised by TÜV SÜD. This testing service also includes preparation of compliant test reports and collaboration with official authorities.

Benefits of working with TÜV SÜD

TÜV SÜD is an accredited testing laboratory and a technical service recognised, notified or designated by many European and international type approval authorities. Furthermore, TÜV SÜD has an extensive network of proving grounds in Europe and has its own certification body operating in areas of certification including well-balanced, high-performance tyre brands that go beyond the legal requirements (“value-added certification”).

As a result, TÜV SÜD is able to offer testing services comprising all the necessary services from a single source.

In addition to the formal and technical requirements of customers and standards, we focus on the interests and needs of our customers and are always available to answer questions.

Further information about the services provided by TÜV SÜD in the field of tyre testing can be found or requested here:

www.tuvsud.com/tyre-testing
myrequest@tuvsud.com

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