

FINAL SUMMARY REPORT 2016



ROSANNE





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TABLE OF CONTENTS

EXECUTIVE SUMMARY	5
1 BACKGROUND & OBJECTIVES OF THE PROJECT	6
2 WORK PERFORMED AND RESULTS	7
2.1 Measurement methods for the skid resistance of road surfaces	7
2.1.1 Definition of boundaries and requirements for the Common Scale for harmonisation of skid resistance measurements	7
2.1.2 Analysis of data from the first round of tests and initial development of the common scale	7
2.1.3 Analysis of data from the second round of tests and further development of the common scale	8
2.1.4 Quality assurance procedures to accompany proposed common scales	9
2.1.5 Draft prEN for harmonised skid resistance measurement	9
2.2 Measurement methods for the noise emission properties of road surfaces	9
2.2.1 Background	9
2.2.2 Developing a new procedure for characterising acoustic properties of road surfaces in Europe	10
2.2.3 Improvements of the relation between the Statistical Pass-By method (SPB) and Close-Proximity Method (CPX)	11
2.2.4 Defining corrections for temperature influence on noise measurement results	11
2.2.5 Compatibility with the new European noise calculation method CNOSSOS-EU	11
2.3 Measurement methods for rolling resistance properties of road surfaces	12
2.3.1 Parameters influencing rolling resistance	13
2.3.2 Certification	13
2.3.3 Validation	13
2.4 Texture, reference tyres and reference surfaces	13
2.4.1 Pavement texture effects and descriptors	13
2.4.2 Reference tyres	15
2.4.3 Reference surfaces (noise)	16
2.4.4 Reference surfaces (rolling resistance)	16
2.4.5 Pavement surface variations across the road	17
3 DISSEMINATION ACTIVITIES	19
4 CONCLUSIONS AND RESULTS	23

FIGURES

Figure 1: Views of the test track at IFSTTAR, Nantes	7
Figure 2: Views of some of the devices that took part in the testing	8
Figure 3: Equipment for CPX measurements: left an example of an enclosed trailer (AIT); right an example of an open trailer (DRD)	10
Figure 4: Averaged measured CPX spectra at 80 km/h on DAC 0/11 and SMA 0/11 to serve as a first proposal for a ROSANNE virtual reference spectrum (IFSTTAR)	12
Figure 5: Trailer-based rolling resistance measurement method; an example of the force-based trailer (BRRC) performing measurements during the round robin test in Nantes	12
Figure 6: Two of the five texture measuring devices used in the 2014 measurements: The ElaTextur (left) and T3Dg (right). The former is a simple device measuring MPD in a small circle, the latter is a 3D device measuring a 0.4 x 0.5 m area	14
Figure 7: Example of raw and enveloped profiles; the latter using the indentation method	14
Figure 8: The tread patterns of the two reference tyres specified in ISO/DTS 11819-3	15
Figure 9: Example of raw and enveloped profiles; the latter using the indentation method	18

TABLES

Table 1: List of dissemination activities carried out	19
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EXECUTIVE SUMMARY

The main objective of the ROSANNE project was to advance the harmonisation of measurement methods for skid resistance, noise emission and rolling resistance of road pavements and prepare for standardisation. The project aimed to perform pre-normative research to enable the creation or improvement of European standards, mainly in the field of the working group CEN/TC 227/WG 5 "Road Surface Characteristics". Due to the different status of standardisation at the project start for the three properties, four adapted strategies were followed:

1. For **skid resistance**, the main objective was to advance the harmonisation of skid resistance measurements following the previous TYROSAFE project's Roadmap due to the substantial number of different procedures and devices currently in use. The key activity was to derive conversion factors for different skid resistance indices within the separate groups of longitudinal and sideways skid resistance measurement devices.
2. For **noise emission**, the strategy was to select from or combine the existing pass-by and trailer measurement methods for the pavement influence on road traffic noise emission into a standardised pavement noise emission characterisation method and demonstrate its viability for acceptance testing, monitoring and noise propagation calculations.
3. For **rolling resistance**, the aim was to create a technical basis for a possible new standard for assessing the pavement contribution to rolling resistance by trailer measurements.
4. For **texture, reference tyres and reference surfaces**, one aim was to explore the commonly used descriptors and compare with newer ones. Another aim was to define reference tyres for use in noise and rolling resistance measurements. Furthermore, reference surfaces were to be defined in order to facilitate reproducible comparisons of both noise and rolling resistance measurement results.

For all four parameters, substantial progress has been made towards reliable measurement methods. Besides the scientific reports, the key outputs of the project are draft documents which can be used as starting points for the standardisation process by CEN and ISO. Already during the lifetime of the project, the work in CEN and ISO has benefitted from the technical output of ROSANNE.

Making key road surface parameters accessible to harmonised assessment and management enables the creation of products and services that can bring about considerable cost reductions for road authorities and industries with European-wide application due to the possibility to rely on common assessment methods. The guidelines and standards that will be created based on the results of ROSANNE are expected to further support the application and adoption of cost-effective innovation in the road infrastructure sector.

1 BACKGROUND & OBJECTIVES OF THE PROJECT

The major challenge of the European road networks is to provide efficient transportation, while maintaining high standards with regard to road safety, public health and environmental impact. Road administrations have to achieve cost-effective management of their networks while facing requirements to contribute to a reduction in accident rates, noise pollution of residential areas and greenhouse gas emissions of road vehicles. Road surface parameters play a key role in the options available on a national and international level to achieve these desirable results. Previous research, especially in the TYROSAFE project (see <http://tyrosafe.fehrl.org>), has shown that controlling skid resistance, noise emission and rolling resistance of pavements enables road administrations to make a beneficial contribution to making road transport safer and greener. The same research also shows that assessment methods and policies for these three road surface parameters vary greatly across Europe; if at all available. This leads to the situation that, while their importance is recognised, the exchange of expertise and good practice among EU countries faces considerable barriers. Ultimately this leads to barriers facing companies that wish to trade in more than one country due to the difficulties in interpreting the technical requirements for the provision of goods and services, which in this case are the supply of road surfacing materials and the provision of road survey services, and the inefficiency of requiring different physical equipment for making measurements. This is due to the fact that, for example in the case of skid resistance, not even the physical property that is measured is exactly the same. In the case of the rolling resistance contribution of pavements, there is currently no standardised measurement method available. For this reason, any steps forward in developing and harmonising the assessment of skid resistance, noise emission and rolling resistance will contribute to the reduction of accidents, noise pollution and greenhouse gas emission. Additionally, it will reduce trade barriers and foster innovation in the road construction sector. Standardisation of these methods could prove even more beneficial, provided the necessary pre-normative research is carried out.

The ROSANNE project was intended as a direct successor to the TYROSAFE coordination action and answered specifically to the first subject in the description of topic SST.2013.5-3. "Innovative, cost-effective construction and maintenance for safer, greener roads" calling for:

- The development of standards and guidelines supporting the objectives on European network development and related EC priorities in terms of safety, noise, environment and energy consumption
- The provision of harmonised measurement tools to enable consistent assessment of road surface properties and tyres

The main objective of this project was to develop and/or harmonise measurement methods for skid resistance, noise emission and rolling resistance of road pavements as a preparation for standardisation. To achieve this, the project followed the recommendations of key predecessor projects like TYROSAFE, HERMES, SILVIA, SILENCE and MIRIAM, as well as considering ongoing work in CEN and ISO. The project results will help to develop and improve standards in the field of working group CEN/TC 227/WG 5 and in ISO standardisation working groups with which CEN cooperates.

The specific objectives of ROSANNE for the different road surface properties were:

- 1 Skid resistance:** ROSANNE aimed at the harmonisation of skid resistance measurement following the TYROSAFE Roadmap, by deriving conversion factors for friction indices based on similar groups of devices, namely longitudinal and sideways skid resistance measurement devices.
- 2 Noise emission:** The ROSANNE team evaluated the existing measurement methods (SPB and CPX) for use in a harmonised pavement noise emission characterisation method. An evaluation of its viability for acceptance testing, monitoring and compatibility with environmental noise calculation methods like CNOSSOS-EU was carried out. The remaining problems with the method, such as the influence of temperature, were also addressed.
- 3 Rolling resistance:** This project built on the results obtained in the MIRIAM project to prepare for standardising trailer measurements of rolling resistance coefficients of road surfaces. To this end, it was also necessary to study the influencing road surface parameters and factors which disturb such measurements and develop correction procedures for such influences.
- 4 Texture:** The project explored the potential for recent developments in the measurement of surface texture to deliver parameters that better reflect the physical process of tyre/road interaction and that may improve our understanding of how the texture influences skid resistance, noise emission and rolling resistance.
- 5 Reference tyres and pavements:** The project investigated the performance of reference tyres and pavements which are necessary for the measurement of road surface properties.

ROSANNE carried out pre-normative research towards all the above-mentioned objectives.

The actual standards will mainly be developed by the following standardisation working groups based on the ROSANNE results:

- CEN Technical Committee 227, Working Group 5: "Surface characteristics" (CEN/TC 227/WG 5) and
- ISO Technical Committee 43, Subcommittee 1, Working Group 33: "Measuring method for comparing traffic noise on different road surfaces" (ISO/TC 43/SC 1/WG 33).

The successful adoption of the proposed draft standards as European standards will be subject to a voting in the standardisation committee composed of national stakeholders and experts and was beyond the scope of this project. However, providing a validated and well-documented method substantially increases the chances of making well-informed decisions and successfully progressing with standardisation work.

2 WORK PERFORMED AND RESULTS

2.1 Measurement methods for the skid resistance of road surfaces

For skid resistance, many European countries have established thresholds for pavement acceptance and routine monitoring that are linked to devices that originated from national development and many years' experience of the performance of pavement materials. Past work has led to proposals for harmonisation of measurements from European skid resistance devices, but it has not been possible to establish an algorithm that brings the measurements from all the different devices into a common scale with sufficient accuracy. The lack of accuracy is a particular concern for the control and acceptance of newly constructed pavements against contractual specifications and warranty terms.

The TYROSAFE project (Roe et al, 2009) concluded that, with the large number of different devices operating on various principles and different responses to the variation in road and test conditions, it would be difficult to achieve a common scale that accommodates all devices in all conditions and still obtains a sufficient accuracy. However, an acceptable accuracy might be achievable if restrictions are placed on the range and types of devices in combination with their operating principles and conditions. TYROSAFE produced a roadmap that described different approaches to achieving this.

2.1.1 Definition of boundaries and requirements for the Common Scale for harmonisation of skid resistance measurements

Building on the earlier work of TYROSAFE, a review of the purpose of skid resistance measurements and requirements, an analysis of skid resistance devices available and a review of national thresholds for acceptance testing and routine monitoring surveys was completed. It was found out that the 15 devices with Technical Specifications prepared by CEN/TC 227/WG5 fall into three groups that are each important because they represent different aspects of road user experience: steering and cornering under normal conditions, braking under normal conditions and sliding following loss of control.

It was therefore recommended that these groups form the basis for the harmonisation exercise to be executed in the ROSANNE project, with a Common Scale to be established within each group:

1. Side-force measurement (devices with 20 degree wheel angle, 34 % slip)
2. Longitudinal force measurement with low slip ratios (devices with 15-25 % slip, close to peak friction)
3. Longitudinal force measurement with high slip ratios (devices with over 60 % slip)

Moreover, it was proposed to organise round robin tests between some European friction devices to develop this friction index. Two experimental campaigns were proposed: the first one to build the common scale and the second one to check its stability with other friction devices.

For technical reasons associated with reducing the errors due to speed correction, it was proposed to adopt a defini-

tion of vehicle operating speed rather than tyre slip speed within the harmonisation procedure. It is believed that this will considerably improve the chances of achieving a reliable harmonisation of devices within each of the device groups. The selection of this reference speed is significant because speed correction errors reduce at the reference speed, so the chances of a device being able to provide the most accurate measurements are maximised at this speed. A reference speed of 60km/h was recommended as this was closely aligned with the recommended survey speeds of most of the devices.

A review was also made of a range of factors that influence skid resistance measurements and identified opportunities for some degree of standardisation where it could be possible to reduce the variations in test tyre, vertical load, and water depth. Whilst this is not generally within the scope of the ROSANNE project it is something that CEN may wish to consider in the future.

This stage of the project was reported in Deliverable D1.1: Definition of boundaries and requirements for the common scale for harmonisation of skid resistance measurements.

2.1.2 Analysis of data from the first round of tests and initial development of the common scale

The first test campaign was held in May 2014 in Nantes, France on project partner IFSTTAR's test tracks and trafficked roads around the IFSTTAR facility. To limit the differences due to seasonal variations, the tests were carried out on two consecutive weeks; one week for devices measuring side-force friction coefficient and another week for devices measuring longitudinal friction coefficient.

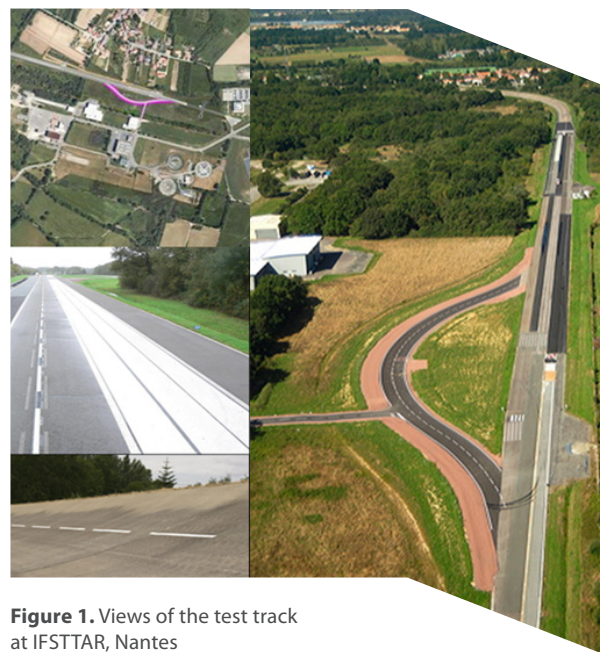


Figure 1. Views of the test track at IFSTTAR, Nantes

A total of five side-force and six longitudinal devices took part in this 2014 test programme; the devices were available to the consortium and included a reasonable number of the 15 different device types available in Europe, particularly those that are in common use. The complete test pro-

programme allowed for calibration of the common scale over a range of skid resistance levels and a test of its robustness on surface types and measurement conditions that are representative of the roads in Europe.

Analysis of the data from the first round of tests showed that measurements made by different devices can be converted to a common scale based on the SRI principles outlined in CEN TS 13035-2 (CEN, 2010). In addition the assumptions made in developing the TYROSAFE roadmap were proved correct in that the precision of the common scale is improved by developing a common scale for different groups of devices based on their operating principle.

The precision of the common scale for each device group was assessed by calculation of the reproducibility standard deviation, σ_{Rt} , which produced values of around 0.04 to 0.05; these values appeared to be achievable on live trafficked roads as well as on the more controlled environment of the test track. The values obtained were somewhat higher than is found for the best controlled fleets of devices of the same

type, where values of about 0.03 have been reported. However the results were a significant improvement of those obtained from previous harmonisation exercises.

Full details of the test programme, the data analysis and results can be found in Deliverable 1.2: Analysis of data from the first round of tests and initial development of the common scale.

2.1.3 Analysis of data from the second round of tests and further development of the common scale

The second test campaign was held in April 2015, again at the IFSTTAR facility in Nantes, France and followed the same general methodology as the first trial. The second trial was opened up to new devices which resulted in 8 side-force friction devices and 10 longitudinal devices taking part. (For operational reasons, the number of devices participating each week had to be restricted to a maximum of 10). Some of the devices that took part are shown in Figure 2.



Figure 2. Views of some of the devices that took part in the testing

The results from the second trial were broadly comparable to those from the first, with reproducibility standard deviation, σ_{Rt} , values of around 0.045 for the three groups of devices, even though an increased number of devices took part. As with the first trial, analysis of data from tests on local roads close to the IFSTTAR test track showed that the precision of the common scale was not affected by this potentially less controlled environment, e.g. increased variability in test line and speed, compared to the test track measurements.

An assessment of the stability of the common scales over time was also made and this showed that while some devices remained relatively stable between the two trials, the different calibration factors derived for other devices produce very different SRI values for some combinations of surface

characteristics and test speed. The cause of these fluctuations would need to be identified and resolved in order for to allow practical implementation of the common scale.

The concept of applying a precision classification to individual device types was explored. The approach taken was to determine the standard deviation of the SRI measurements produced by each device for each surface. Bands of standard deviation were then defined and individual devices assigned to the appropriate band.

Full details of the test programme, the data analysis and results can be found in Deliverable 1.2: Analysis of data from the first round of tests and initial development of the common scale.

2.1.4 Quality assurance procedures to accompany proposed common scales

Within the scope of the ROSANNE project, quality assurance procedures are necessary to maintain the reliability of the Common Scale over time and its application in various member states. QA procedures are also necessary to maintain the reliability of individual devices as well as the measured results themselves.

Existing QA procedures were reviewed for the measurement of skid resistance and the control of fleets of devices within Europe. Several components to providing a successful QA procedure were identified and the role of each component discussed. The components broadly relate to:

- Operator checks of the device to ensure components and measurements are within specification
- Independent checks of the device to verify operator checks
- Correlation trials between fleets of the same device type to maintain precision of the fleet
- Correlation trials between different device types to maintain conversion parameters used for the common scale.

The report produced within the framework of the project (Deliverable 1.4: Quality Assurance Procedures to accompany proposed Common Scale(s)) assessed the advantages and disadvantages of combining the different components into an overall quality assurance procedure and identified where responsibility for implementing the different components of the QA procedure would lie.

2.1.5 Draft prEN for harmonised skid resistance measurement

The final output of the skid resistance work package in ROSANNE is a draft standard for harmonised skid resistance measurement that can be presented to CEN/TC 227/WG 5 for discussion and further development.

The draft standard follows the principles of the existing CEN TS 13035-2 (CEN, 2010) to derive a Skid Resistance Index (SRI) for each of the three groups of devices identified within ROSANNE; i.e. the standard will consist of three parts. In calculating the SRI, the reference speed is based on operating speed rather than slip speed, for the reasons outlined in the Deliverable 1.1: Definition of boundaries and requirements for the common scale for harmonisation of skid resistance measurements). It should be noted that the SRI values obtained from the different parts of the standard are independent of each other and are not comparable

The essential characteristics of the device types covered by each part of the draft standard will be defined using the existing CEN Technical Specifications for the individual devices.

The standard will include the a, b and B parameters, required to enable conversion of measurements to an SRI, for the devices that took part in the test programmes conducted as part of the project. Limits on the validity of these values in terms of the device types and individual devices that are eligible to use these calibration constants, and the period of time for which they remain valid will be defined.

The draft standard will also draw on the recommendations of Deliverable 1.4: Quality Assurance Procedures to accompany proposed Common Scale(s) to provide a mechanism for maintaining the common scales and the device specific parameters over time.

2.2 Measurement methods for the noise emission properties of road surfaces

2.2.1 Background

Road surface characteristics have a significant influence on the emission and propagation of road traffic noise. The generation of tyre/road noise is dependent on pavement texture and pavement porosity. Additionally, porosity leads to sound absorption properties of the pavement that may also reduce the sound propagation of the overall vehicle noise. In certain cases also the elasticity of the pavement may play a role. Pavement influence can lead to substantial differences in sound levels, associated with a given traffic flow and composition, from different road surfaces.

In order to successfully use low-noise pavements as noise abatement measures it is essential to accurately evaluate the acoustic performance of such pavements using a standardised procedure such as those detailed in ISO 11819 series (the Statistical Pass-By and the Close-Proximity method). Noise characterisation methods for classification, approval testing, monitoring or the determination of input values for noise calculation procedures are currently available in some European countries at the national level. However, they use a variety of methodologies, based on several measurement methods and different references. Input road data for environmental noise calculations are currently often linked to the various national noise calculation schemes, and exhibit other national specifics, which makes results in general incomparable.

Within the European FP5 project SILVIA, a first proposal for such a common European noise characterisation methodology was proposed. The project however came to an end before any validation of the characterisation methodology was performed and there has only been, at best, a very limited adoption of the principles of the methodology. It was then felt necessary to reconsider the features in the SILVIA procedure, in particular the combined use of two measurement standards with the basic SPB (Statistical Pass-By) method and the CPX (Close-Proximity) method in order to increase the accuracy of the whole system and to facilitate its implementation. With the common noise calculation method envisaged in the END (Directive 2015/996/EC of 19 May 2015) and developed within the CNOSSOS-EU project, a common European method was established; among others, to determine road surface effect on environmental noise based on a consistent set of input parameters for any type of road surface. Therefore, the main scope of this ROSANNE work was to analyse more closely the technical aspects mentioned before in order to develop a practical procedure for characterising the acoustic properties of road surfaces in Europe.

2.2.2 Developing a new procedure for characterising acoustic properties of road surfaces in Europe

The procedure drafted in the project relies on the application of the CPX measurement method (according to ISO/FDIS 11819-2:2016) and specifies the detailed conditions for its use to allow the determination of characteristic values for the acoustic performance of road surfaces with a given accuracy. The values derived from this procedure are suitable for the following purposes:

1. To characterise the initial acoustic properties of a road surface type (the acoustic label) using a common procedure across Europe. Such an acoustic label will serve as a baseline for COP (Conformity-Of-Production) assessments and monitoring over the working lifetime of the surface. The label permits the comparison of different road surface types in an unbiased manner.
2. To verify the acoustic quality and homogeneity of a newly laid road surface (COP).
3. To determine the acoustic quality and homogeneity of a road surface at a given point during its working lifetime; the collation of sufficient data on the same surface over time will allow predictions of acoustic behaviour and may help to drive surface design/development.

In addition, the procedure developed in ROSANNE is expected to allow:

- The establishment of reference values for wider road surface "families" or categories of surface types;
- The derivation of input parameters for road surface corrections within environmental noise calculation methods (in particular for the harmonised CNOSSOS-EU method).

A first draft of the ROSANNE procedure was produced during the second year of the project and described in deliverable report D2.4 "Draft standard for a procedure for the characterisation of noise properties of road surfaces". This document was the basis for internal discussions and in particular for the validation of the procedure performed during the last months of the project. The validation was mainly based on statistical analysis of the data collected amongst the partners and on additional analyses of new measurement results performed for some particular road surfaces. The work included deeper analyses of the uncertainties related to the whole procedure and an exemplary validation performed for an ideal road surface. The details related to the statistical analysis and the experimental validation of the ROSANNE procedure are shown in the first part of Deliverable 2.6: Report on the experimental validation of the procedure for characterisation of noise properties of road surfaces including an updated draft standard; while the updated version of the ROSANNE procedure is presented in the second part of this report.



Figure 3. Equipment for CPX measurements: **top** – an example of an enclosed trailer (AIT); **bottom** – an example of an open trailer (DRD)

2.2.3 Improvements of the relation between the Statistical Pass-By method (SPB) and Close-Proximity Method (CPX)

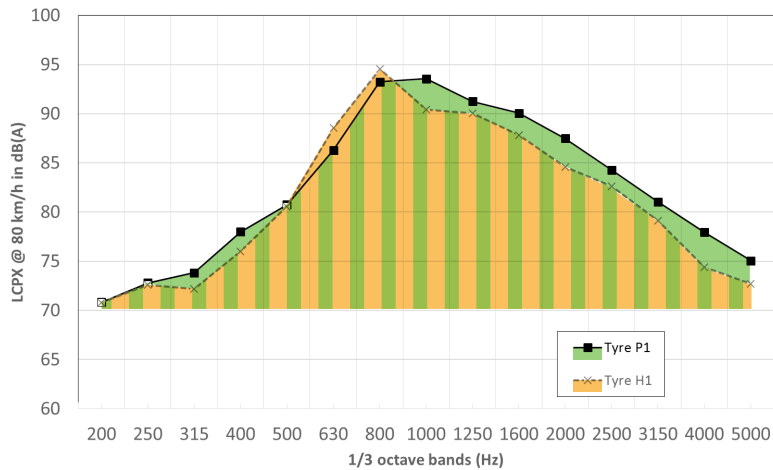
As one of the main objectives was to study the relationships between measurements of the acoustic properties of road surfaces made with different methods, particularly those in EN ISO 11819-1 and ISO/DIS 11819-2, the main activity was the collection of data on CPX noise levels and vehicle pass-by noise levels measured on the same pavements at approximately the same time. The data were pre-processed and grouped into two main groups: those where both types of noise levels had been recorded at the same reference speed, and those where CPX noise levels had been recorded at 80 km/h while vehicle pass-by noise levels had been measured at reference speeds 110 – 120 km/h. Report D2.3 on the correlation between SPB and CPX method summarised the results of the analyses performed in this task. There seems to be a reasonable 1:1 relationship between CPX noise levels measured with tyre P1 (the standard reference test tyre, SRTT), and SPB noise levels from passenger cars given by a linear relation, as long as both types of noise level are measured at the same reference speed. The average relationship found in the data collected for ROSANNE at a microphone height of 1.2 m is described in detail in the report D2.3 and shows a 20.5 dB average difference between the two measured quantities and with almost 90 % of all data being within ± 1 dB around this trend line. On dense pavements an average 9.5 dB difference was found between the CPX noise level measured with reference tyre H1 (Avon AV4) and the pass-by noise level from multi-axle heavy trucks measured at 1.2 m height. This implies a 12.0 dB average difference between $CPXH^{80}$ and LAF^{max} from two-axle trucks, based on average observed differences between pass-by levels for two-axle and multi-axle trucks. The agreement between the CPX noise levels measured with reference tyre P1 (SRTT) and the pass-by noise levels for heavy vehicles was not as good. The measurements carried out in the ROSANNE project show good correlation between maximum noise levels and sound exposure levels.

2.2.4 Defining corrections for temperature influence on noise measurement results

The second task of this WP was focused on temperature and aimed at defining its influence on noise measurement results. Temperature may be measured as ambient air, road surface and/or tyre temperature; although in the ROSANNE procedure, air temperature is used for normalisation purposes. For the CPX method the temperature influence is defined for the chosen reference tyres (and as influenced by the type of road surface); while for the SPB method the temperature influence is of interest for all tyres in the traffic mix. In addition, temperature influence on power unit noise may have a marginal effect in the SPB method. For this purpose, it has been necessary to collect more data regarding the influence of temperature in the SPB and CPX methods for various surface types, since existing data were sometimes inconsistent, inaccurate or simply just missing. Final data are used to determine a correction procedure to noise levels for temperature, referenced to a normalised air temperature (20°C). In this way, noise levels measured are normalised to the reference temperature. The corrections range between 0.03 and 0.1 dB per degree C. The data collection was performed in cooperation with the ISO working group TC 43/SC 1/WG 27 (in which some ROSANNE members take part) and the results of this work form the basis for the ISO technical specifications (TS) ISO/TS 13471-1 (on temperature correction for the CPX method) and ISO/TS 13471-2 (on temperature correction for the SPB method). At the time of publication of this final report, the draft ISO/TS 13471-1 had just been approved by the ISO noise committee and is expected to be published by the end of 2016. Deliverable 2.2: Report on temperature influence and possible corrections for measurement of noise properties of road surfaces explains in detail the work performed as well as conclusions and recommendations for further standardisation activities.

2.2.5 Compatibility with the new European noise calculation method CNOSSOS-EU

The last objective of the work on noise measurements was to check the consistency of the ROSANNE characterisation procedure with CNOSSOS-EU. Deliverable report D2.5 (Report on the compatibility of the proposed noise characterisation procedure with CNOSSOS-EU and national calculation methods) investigates whether the characterisation procedure developed in ROSANNE can provide road surface input data applicable to the European model for road traffic noise emission, and more generally to the existing national prediction methods, if there is a request for it. The report presents briefly the European harmonised model for road traffic noise emission. The draft guidelines for the implementation of this model are also presented. They suggest how to convert existing road source data used in national database, including road surface data, for using them in the harmonised model. Then an analytical comparison is made, of the main features of the respective systems, ROSANNE characterisation method and CNOSSOS-EU road traffic noise model. The comparison reviews indicators, frequency range, pavement definition, reference conditions and measurement conditions, etc. It appears that both systems are fairly but not fully consistent at the moment. However, a consistent connection is realistic. The report draws some recommendations on how the ROSANNE characterisation procedure could provide valuable and compatible input to the European calculation method for road noise prediction. Some of them can still be addressed before the final publication of the procedure, such as the systematic inclusion of spectral results in the labelling procedure and in the monitoring procedure, a systematic determination of the speed coefficient in the labelling procedure, or the introduction of a "label-type" procedure for "mid-life" road surface performance. Other issues probably need more investigation, such as the validation of a "virtual reference spectrum" in ROSANNE (see Figure 4) or the evaluation of the ground effect difference between dense and porous road surfaces. The main remaining issue at the moment is linked to the different measure-



ment methods, CPX in the case of the ROSANNE procedure and SPB in the case of the CNOSSOS-EU model. Significant progress has been made on the relation between these two methods but some issues are still to be further investigated. In particular, it will be necessary to extend the investigation on the relation CPX/SPB with regard to the frequency domain and to the category of heavy vehicles.

Figure 4. Averaged measured CPX spectra at 80 km/h on DAC 0/11 and SMA 0/11 to serve as a first proposal for a ROSANNE virtual reference spectrum (IFSTTAR).

2.3 Measurement methods for rolling resistance properties of road surfaces

Environmental questions have become an important part of the decision-making processes for highway projects in many countries. Advantages of different road pavements from environmental viewpoint and their effects to the energy consumption for different types of vehicles using these roads are therefore an important part of the planning progress.

Numerous requirements are made for modern vehicle tyres. Besides properties such as comfort, low noise level, lateral traction, stopping power, useful life span, etc., the property of “rolling resistance” has been gaining in significance recently, both from the point of view of (fuel) consumption reasons and ecological reasons (CO₂ reduction). There are many factors that impact the energy/fuel consumption of a vehicle. Amongst others rolling resistance plays a major role. The type of road pavement and its surface influence the rolling resistance of the tyre-road unit.

The ROSANNE work on rolling resistance has been concerned with the measurement methods for rolling resistance properties of road surfaces. A large Round Robin test was made and the results of the test has been used as an input to the draft standard and used for an experimental validation of the rolling resistance measurements method.

Measurement of road surface properties using the method enables comparison to be made between the rolling resistance of road surfaces by using reference tyres when they are free-rolling straight ahead, in a position perpendicular to the road surface, and in steady state conditions. For that a self-propelled vehicle or a towed trailer driving at a constant speed can be used. When measuring tyre-road rolling resistance, it is necessary to measure small forces or angles. It is, therefore, essential that equipment and instrumentation of appropriate accuracy are used.



Figure 5. Trailer-based rolling resistance measurement method; an example of the force-based trailer (BRRC) performing measurements during the round robin test in Nantes

2.3.1 Parameters influencing rolling resistance

The influence of several parameters on rolling resistance has been investigated:

- Speed influence on rolling resistance (as measured on the drum facilities at the speed range 30 - 100 km/h) is negligible.
- Tyre load increase leads to increase in rolling resistance force at constant inflation pressure. Changes of the rolling resistance are, however, specific to the tyre and pavement combination thus the resistance may decrease, increase or stay fairly constant. Changes of the resistance due to load changes may be very substantial.
- If inflation pressure increases, the rolling resistance decreases, but the rate of decrease is very much dependent on "absolute level" of rolling resistance.
- Temperature increase leads to decrease of rolling resistance. The magnitude of this decrease is however very much dependant on tyre and pavement combination.
- During measurements of rolling resistance tyre load, inflation, ambient temperature and road wetness are important factors and must be precisely controlled.

2.3.2 Certification

Certification procedures and calibration guidelines of the different kinds of test methods have been described in the draft standard. The test vehicle and measurement system performance will be certified prior to the initial use of the system. Subsequent certification of the influence of parasitic losses and tyre and wheel alignment will be repeated at least annually. This may require replacement of aged or damaged components prior to re-certification.

2.3.3 Validation

An experimental validation was organised in September 2015, and performed as a Round Robin Test in which five test trailers were compared when using the draft standard method. The test programme was performed in Nantes, France, at the IFSTTAR's reference test track, an outdoor facility offering 12 different road surfaces of various texture characteristics that can be tested in optimal conditions (no traffic disturbance, road sections in ideal condition, a great number of data available). It was completed with tests on a trafficked road circuit in the vicinity of IFSTTAR, in order to check the applicability of the procedure in realistic road conditions, and its sensitivity to road characteristics not available on the test track (unevenness, slopes). Furthermore, trailer-based direct measurements of rolling resistance coefficients were compared with alternative indirect measurement methods: coast-down method and measurements of fuel consumption.

The results showed that the proposed methodology is ready to be applied without ambiguity. However on-site measurements are difficult to perform. In particular, the results suggest that the control of the test tyre temperature and warm-in procedure is critical. Despite sporadic and still unexplained deviations measured by some devices, the overall repeatability is acceptable. The discrepancies between the coefficients measured by the different devices are still high with regard to the sensitivity to pavement characteristics. This explains why the correlation between rolling resistance and different surface descriptors varied in quality. However, the progress made in a better control of measurement quality has been improved upon compared to previous projects. The energy-method showed surprisingly good comparability to the coast-downs tests and the method seems promising. The huge amount of data collected during the experiment will be of interest for further developments far beyond the ROSANNE project.

2.4 Texture, reference tyres and reference surfaces

2.4.1 Pavement texture effects and descriptors

An important road surface property, influencing skid resistance, rolling resistance and noise, is pavement surface texture. The starting point in this task of ROSANNE was to produce a state-of-the-art report (Deliverable 4.1: State-of-the-art concerning texture influence on skid resistance, noise emission and rolling resistance) presenting the latest knowledge about the influence of pavement surface texture on the three performance parameters (skid resistance, noise and rolling resistance), and how these influences may be described by relevant descriptors.

The major experiments related to pavement texture were measurements made in conjunction with the skid resistance tests of various devices on the IFSTTAR test track in Nantes in the spring of 2014. Texture measurements were then made with four different stationary devices (by BAST in Germany) and supplemented with a mobile fifth device by BRRC in Belgium. Eleven very different tracks were measured, using two three-dimensional (3D) profilometers (i.e. measuring an area) and three 2D profilometers (i.e. measuring along a line).

The aim of these measurements was to compare various texture descriptors and to find potentially useful new measures that can replace or supplement the existing ones, such as mean profile depth (MPD). They also provided an assessment of the capabilities of 3D measuring devices compared with traditional 2D systems, to see if 3D measurement and descriptors derived from them provide a significant advantage over traditional 2D profilometers and their measures. Further, the profilometers had different sensitivity and resolutions, which made it possible to see how important this property is. The team was also interested to compare two measures designed to be sensitive to the asymmetry of the profile (whether profile peaks are directed mostly upwards or downwards), namely skewness (defined by ISO) and the G Factor (defined in some German studies).



Figure 6. Two of the five texture measuring devices used in the 2014 measurements: The ElaTextur (left) and T3Dg (right). The former is a simple device measuring MPD in a small circle, the latter is a 3D device measuring a 0.4 x 0.5 m area.

Further texture testing was conducted in conjunction with the rolling resistance round robin test (RRT) in Nantes in September 2015. Then also megatexture and unevenness (IRI) were tested, and measurements on the test track sections were supplemented by some test sections on trafficked roads. At this occasion, equipment from VTI, BRRC and IFSTTAR provided measurement results. The focus was then on comparing MPD measurements by the three devices, and by studying the correlation between texture and rolling resistance coefficients.

A special activity of this work has been to try to find a way to describe the profile curve in a way which is closer to the actually tyre/surface contact than the raw profile. This is called enveloping; i.e. the profile is modified to represent how the tyre tread rubber is able to “envelope” (be in touch with) the texture. A couple of enveloping attempts in earlier projects have been compared with a new enveloping procedure worked out in ROSANNE, named the “indentation” method. It is believed that the enveloped profile is a better description of texture impact on rolling resistance and noise emission, and to some extent also on skid resistance. In the latter case, the inverse to the enveloped profile may be a good drainage descriptor.

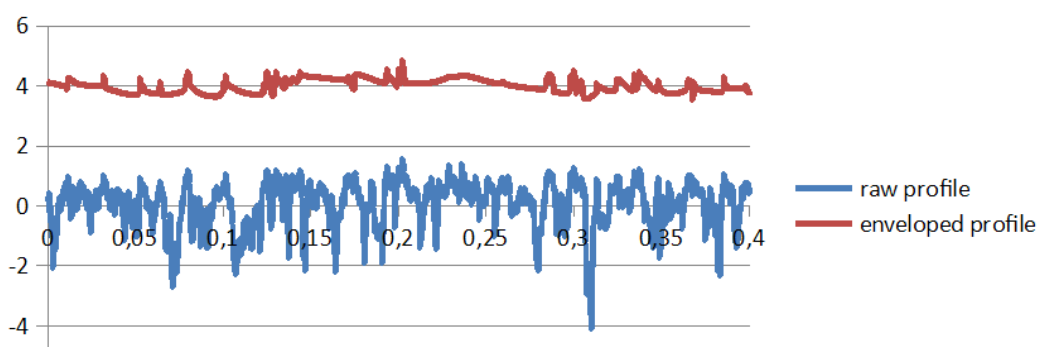


Figure 7. Example of raw and enveloped profiles; the latter using the indentation method.

The results are reported in Deliverable 4.2. Among the results one may note especially the following:

- There is relatively good correlation between the relevant texture descriptors determined by all five measuring devices
- The device with improved resolution (0.02 mm horizontally) appeared to have improved correlation with some wet skid resistance measures
- For the surfaces tested, no special advantages by 3D vs 2D measurements could be observed. However, for surfaces with directional textures (not tested in ROSANNE) there might be some advantages by 3D measurement
- The MPD and megatexture values appeared to have good correlation with rolling resistance
- Enveloping further improved the correlation of MPD with rolling resistance; best of all when using the indentation method
- The comparison between the three texture measuring systems taking part in the 2015 measurements showed almost perfect correlations of MPD values between them; especially when all three used the new data processing procedures proposed in the revised ISO/CD 13473-1

Detailed results are presented in deliverable report D4.2.

This work has been carried out in close coordination with ISO/TC 43/SC 1/WG 39, the group that develops ISO standards regarding texture, and is also followed with interest by CEN/TC 227/WG 5, which is responsible for European standards in the subject area.

2.4.2 Reference tyres

The CPX method for measuring noise properties of road pavements, and the method for measuring rolling resistance are useful only with certain reference tyres. Also skid resistance measurements rely on reference tyres. Therefore, in parallel to the work on the CPX method, work in ISO/TC 43/SC 1/WG 33 on reference tyres has been intensive [3]. This aims at producing an ISO Technical Specification (TS) with the final designation ISO/TS 11819-3, specifying two reference tyres. The work done in ROSANNE has provided valuable extra resources to determine the properties of such tyres. The two tyres selected as references, and already widely used, are the following:

Tyre P1

A steel-belted radial tyre for relatively large passenger cars or vans, specified in ASTM standard F2493-14, having the dimensional code P225/60R16 and referred to as a Standard Reference Test Tyre (SRTT). Both the text "Standard Reference Test Tyre" and the dimensional code P225/60R16 are displayed on the sidewall.

Tyre H1

A steel-belted reinforced radial tyre for light trucks and vans, manufactured by Cooper Tire & Rubber Co. in the United Kingdom under the product name "Avon Supervan AV4", having the dimensional code 195R14C. The Avon Supervan AV4 has a reinforced carcass construction to enable the carriage of heavy loads, and has a very robust rubber compound on the sidewall.

P stands for passenger cars, and H stands for heavy vehicles. The number 1 (in P1 and H1) indicates that this is the first generation of reference tyres; as it is likely that in 5-15 years one would select tyres that are more in line with the tyre market at that time. Although the widths of these tyres are quite different, the outer diameters are quite similar, which is practical when changing tyres on the trailers or other vehicles. The tread patterns of the two reference tyres are illustrated in Figure 5.

Figure 8. The tread patterns of the two reference tyres specified in ISO/DTS 11819-3



It was noticed already in the 1980's that road surfaces influence tyre/road noise in different ways depending on whether one is testing with passenger car or truck tyres. In general, truck tyres are much less sensitive to the texture of the surface than car tyres are. Truck tyre/road noise is often the worst on the smoothest surfaces, while it may be almost the contrary for car tyres. Therefore, in order to characterise the road surface "noisiness" for a blend of light and heavy vehicles, one must make measurements with both a car and a truck tyre. But a test vehicle with one or two heavy truck test tyres will be very heavy, impractical to maneuver, and very expensive. Therefore, the decision was taken to search for a light tyre that can act as a proxy for the heavier bus and truck tyres, but still be so small that one can use it together with a car tyre. WG 33 has identified such a tyre, which actually is one of the smallest light truck tyres one can get, but it appears to do its job to simulate the sensitivity to noise properties of heavy truck tyres. This is the H1 tyre mentioned above. As also this one will not be available for a long time, the intention is to build up a significant supply of such tyres and store them well for subsequent use during the next few years.

Tyres are "fresh produce", since it is inevitable that rubber deteriorates with use and time. It is mainly the rubber hardness which increases and thus causes an increase in noise (but a decrease in rolling resistance). Therefore, ROSANNE has had to assign limits to rubber hardness, and even produced a correction for the hardness influence (on noise) over the allowed hardness range, to a reference hardness. The main work on this was made by AIT (but also work of TUG and DRD must be acknowledged).

Further, the rubber is sensitive to temperature. Therefore, it has been necessary to do research on the relations between noise and temperature and between rolling resistance and temperature. After determining acceptably robust relationships, correction procedures for correcting measured values to a reference air temperature of 20°C have been worked out. Such work was made in noise measurements (see Deliverable 4.2) and rolling resistance measurements (see Deliverable 3.5?), but it is uniquely related to these reference tyres, hence its relation to this part of ROSANNE.

2.4.3 Reference surfaces (noise)

Often, noise measurements are reported as "noise reductions". Noise reduction is a term meaningless without a reference situation. It is important that the reference surface is properly identified and described; else any "noise reduction" is meaningless. In the EU project HARMONOISE, a virtual reference surface was first proposed, something which has later been taken up by the CNOSSOS-EU project; recently resulting in a reference surface being specified roughly in Directive (EU) 2015:996, where the concept of a Virtual Reference Surface is used, which is a mix of DAC 11 and SMA 11 having been exposed to traffic for at least two years. Note that this is described in Deliverable report D2.5.

The concept needs some further specifications to provide a more stable and well-defined reference, and this is a subject of Deliverable 4.3, part b.

2.4.4 Reference surfaces (rolling resistance)

It has turned out that the calibration of rolling resistance measurement equipment (in this project trailers) is complicated and does not always result in reproducible results. Therefore, a need for a reference surface has emerged – a pavement surface for which the rolling resistance coefficient can be determined with relatively low uncertainty and thus constitute a simple reference for day-to-day calibration checks.

Such a virtual reference surface has been defined within ROSANNE. The procedure is as follows:

1. The relevant proxy parameters are chosen, which are known to influence the rolling resistance, such as texture, unevenness, elasticity, and slope. For each proxy parameter a suitable descriptor is chosen, e.g. MPD for texture and IRI for unevenness, and to each descriptor a reference value is attributed. Examples are shown below.
2. Fixing the boundaries for the real test tracks. The measurements are carried out on real road sections which may deviate from the virtual rolling resistance reference surface. The deviations are, however, limited and the boundaries of the descriptors of the relevant parameters are fixed.
3. By means of a simple equation, derived from experiments in the past and in the RRT conducted in September 2015 in ROSANNE, calculation of the rolling resistance coefficient (C_r) on the virtual rolling resistance reference test surface (indicated hereafter as $C_{r,ref}$) is made. This may then be used to adjust the settings of the rolling resistance measuring device to indicate a C_r fitting the theoretical one.

The reference surface and the boundaries within which the actual test section shall be is described by the following parameters and values (only the most important examples):

- MPD shall be between 0.6 and 1.0 mm (reference value = 0.80 mm)
- The skewness of the texture shall be between -0.5 and +0.5 (reference value = 0.0)
- Unevenness expressed as IRI shall be no greater than 1.5 mm/m
- The test surface shall be an asphalt pavement without any other elastic ingredient (such as rubber granulates) than bitumen modifier
- The longitudinal slope of the real test surface shall be no higher than 2.0 %
- The length of the measurement surface shall be at least 100 m and the width at least 3.5 m

If the pavement properties are within the boundaries given above (and a few more, see Deliverable 4.3), one can calculate what $C_{r,ref}$ would be if the MPD were the reference value of 0.80 mm, by applying this formula:

$$C_{r,ref} = C_{r,meas} - k \Delta MPD$$

where MPD = MPD measured on the tested surface, expressed in mm

k = a constant factor, equalling 0,00019

ΔMPD = difference of measured MPD to the reference value 0.80 mm = $MPD - 0.80$ mm

If this $C_{r,ref}$ varies from a nominal value from day to day, one may either consider the measurements as biased or even invalid, or (probably more commonly) use the differences to correct the C_r scale to a common one.

It is of great importance that air temperatures during the measurements are stable, that the test tyre has reached an equilibrium temperature, so that one can correct C_r to a reference temperature of 20°C; otherwise the observed differences in C_r may be due to temperature. The temperature influence is studied in the rolling resistance measurement part of the project (see section 3.3).

As mentioned above, attempts have been made to find a better descriptor than MPD for this purpose, namely an enveloped profile from which an "enveloped MPD" is determined. These attempts have been successful. Therefore, the "raw" MPD as used above can be replaced by an "enveloped MPD" by the indentation method, by a special procedure described in D4.2. The k factor in the equation above will then have another value, but the effect is that the determination of the $C_{r,ref}$ will be more precise than if using the "raw" MPD. The exact value of k in this case is currently being discussed.

The k factors vary depending on the reference tyre (P1 or H1). Test speeds may nominally be 50 or 80 km/h.

The parameters have been chosen so that the virtual reference surface is similar to a very common type of road or test track pavement. Actual pavements that may fulfil the requirements would be found among DAC 11, DAC 16, SMA 8, SMA 11 and SMA 16. Also some thin asphalt layers may qualify, if they do not have too different skewness. This procedure allows one to make a simple calibration of the equipment to a nominal value of $C_{r,ref}$; or to report rolling resistance coefficients compared to the virtual reference surface. It is the intention to propose the procedure as a CEN technical specification.

2.4.5 Pavement surface variations across the road

It is obvious that road surface characteristics change and not the least that variations in the lateral direction occur when a road is in use. This is essential information when standards and measurement methods shall be specified. As support for the classification and measurement methods for road surface properties, investigation was made on how much typical roads differ in texture properties across the road (in typical ruts and difference between left and right wheel tracks, also considering lane-to-lane variations).

This issue was studied by conducting an extensive road tour through four countries in northern Europe, operating the Road Surface Tester (RST) vehicle owned by VTI. By means of a multifunction profilometer able to measure at traffic speeds, the RST was setup to measure MPD and megatexture in five parallel paths and IRI and transversal profile calculated from the output of all 18 laser sensors. For practical reasons only the slow lane was measured in all countries. The route started in Linköping in Sweden, went over the bridge to Denmark, then through Denmark (landway) to Germany continuing through northern Germany and Poland, and after a ferry tour it ended in Linköping, Sweden. See Figure 4. In total, 2063 km were evaluated.

The results were divided into separate datasets using road width, whether safety barrier existed to separate the on-coming traffic and by country. The condition parameters evaluated were general unevenness (using the IRI indicator), megatexture using an RMS value and macrotexture using the MPD. As an optional analysis, the theoretical water depth in rutted wheel tracks was also evaluated.

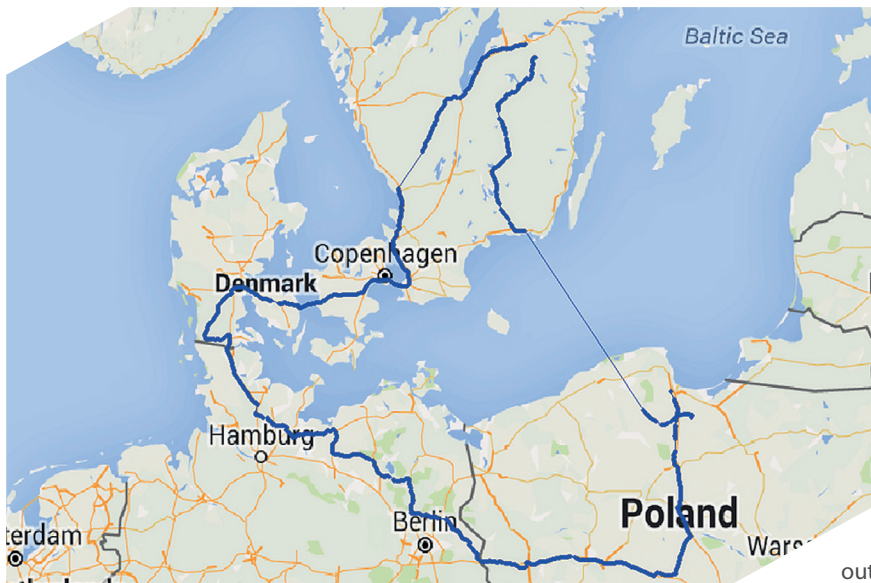


Figure 9. The route run by the RST vehicle for the measurements of pavement lateral properties in WP 4

The result regarding MPD and the influence of lateral position showed only small differences, as long as measurements were within the wheel tracks. It was generally lower differences than 0.05 mm. However, MPD of the area between the wheel tracks; i.e. in the middle of the road, in general, has a greater value than in the wheel tracks. Megatexture showed the same pattern as MPD. On the contrary, IRI seems to be more sensitive to position, which needs to be considered. Regarding wider roads, barrier separated roads and motorways, there is no difference of IRI between the wheel tracks but in the positions outside the wheel tracks the IRI value increases.

observed closer to the road edge with weak road shoulders. The evaluation of theoretical water depth showed decreasing depth when traffic volume increases. This is mainly due to a more solid construction and tougher maintenance standard.

An important result is that where there is a mix of light and heavy traffic, after traffic has resulted in some changed macrotexture and the creation of wheel tracks, the right wheel track is significantly wider than the left wheel track, since the greater width of the heavy trucks result in the right wheels running closer to the right edge of the lane than the wheels of light vehicles do. This is important for example when driving with two-wheeled CPX trailers; implying that they shall preferably be run so that the left test tyre is aimed at running in the left wheel track, and the right test tyre will be in some position within the wider right wheel track, depending on the width of the CPX trailer. This is also important for lateral positioning of rolling resistance measurements. For one-wheel rolling resistance measuring devices, in order to avoid running over edges of ruts it would be the best to measure in the right wheel track which is wider.

It should be pointed out that the mention of left and right here, assumes driving on the right side of the road. The conditions would be reverse in countries where driving is on the left side.

The work is described in the Deliverable 4.4: Variation of road surface texture and other geometric properties in transverse direction.

3 DISSEMINATION ACTIVITIES

The following range of activities (Table 1) were carried out during the project to raise awareness, communicate progress of the project and disseminate the results.

NAME	DATE AND PLACE	WEBPAGE	ACTION	PARTNER	BRIEF DESCRIPTION OF THE ACTIVITY
ERPUG Forum 2013	10-12 th September 2013, Copenhagen, Denmark	www.erpug.org	Presentation	VTI Ramböll	European Road Profile User's Group, ERPUG
ROSANNE website	Since February 2014	www.rosanne-project.eu	Basic information on ROSANNE	FEHRL	Basic information on the project for key stakeholders
ROSANNE flyer	March 2014	www.fehrl.org/?m=32&mode=download&id_file=16351	Basic information on ROSANNE	FEHRL	Basic information on the project for key stakeholders
ROSANNE Linked In group	March 2014	www.linkedin.com/groups/Infraction-ERANET-Plus-7437466?trk=my_groups-b-grp-v	Latest information on ROSANNE	FEHRL	Latest information on the project for key stakeholders
FEHRL Infrastructure Research Magazine	June 2014	www.fehrl.org/index.hp?m=33&a=content&id=900	Article on ROSANNE	FEHRL	FIRM is distributed to 2000 key transport infrastructure research stakeholders across Europe and beyond.
Publication of article on Horizon 2020 website	June 2014	ec.europa.eu/programmes/horizon2020/en/news/where-tyre-contacts-road-blueprint-better-interaction	Overview of ROSANNE in context of Tyrosafe	FEHRL	Information on ROSANNE in context of Tyrosafe
ERPUG conference 2014	24 th October 2014	www.erpug.org	Brief ROSANNE information	VTI FEHRL TRIMM project	ROSANNE work on texture mentioned in presentation by Sandberg
INTER-NOISE 2014 Melbourne	16-19 th November 2014	www.internoise2014.org/	Presentation of ROSANNE	AIT TUG	Focus on WP2 by Manfred Haider, Marco Conter, Reinhard Wehr, Ulf Sandberg. Temperature influence on tyre/road noise of selected tyres by Piotr Mioduszewski, Stanisław Taryma, Ryszard Wozniak. Inhomogeneity of low-noise wearing courses evaluated by tyre/road noise measurements using the close-proximity method by Piotr Mioduszewski, Wladyslaw Gardziejczyk
COOEEE conference	27-28 th November 2014	cooee-co2.dk/Workshop/Workshops.htm	papers and presentations	DRD	Focus on WP2 by Manfred Haider, Marco Conter, Reinhard Wehr, Ulf Sandberg
FEHRL Infrastructure Research Magazine	December 2014	www.fehrl.org/index.hp?m=33&a=content&id=900	Article on ROSANNE	FEHRL	FIRM is distributed to 2000 key transport infrastructure research stakeholders across Europe and beyond.

NAME	DATE AND PLACE	WEBPAGE	ACTION	PARTNER	BRIEF DESCRIPTION OF THE ACTIVITY
TRB session, Washington DC, USA	Sunday 11 th January 2015	pressamp.trb.org/conferences/programs/session.asp?event=766&session=31682	Presentations by Ulf Sandberg and Luc Goubert	BRRC VTI	Presentations entitled "New and Improved ISO Standards for Texture Measurements" and "EU project ROSANNE – Rolling resistance, Skid resistance, And Noise Emission measurement standards for road surfaces"
TRB session, Washington DC, USA	Sunday 11 th January 2015	onlinepubs.trb.org/onlinepubs/sp/DAWG_082813_announcement.pdf	Bojan Leben presented at DAWG meeting, discussion forum	ZAG	Bojan finished with asking about similar harmonisation trials in the U.S. and potential experience, about methods they (would) use in such trials to correlate or harmonise measurement results, etc.
Journées Techniques Routes 2015 (French national road conference)	5 th February 2015		Veronique Cerezo made presentation	IFSTTAR	ROSANNE presentation
Danish Road and Traffic Magazine (Traffic and Roads)	April 2015		Article	DRD	Harmonisation of measuring equipment for friction, noise and rolling resistance by Bjarne Schmidt and Jens Oddershede
12 th Slovenian Road Congress	22 nd -23 rd April 2015		Darko Kokot submitted paper	ZAG	Paper
FEHRL Infrastructure Research Meeting 2015 (FIRM15)	22 nd April 2015		Manfred Haider	AIT	Presentation
Euronoise conference, Maastricht, Netherlands	31 st May – 3 rd June 2015	www.euro-noise2015.eu	Manfred Haider and Marco Conter	AIT	Manfred Haider chaired session on Tyre/road noise measurements, standards and classification Marco Conter presented article on acoustic long-term performance of asphalt and concrete road surfaces on Austrian motorways related to ROSANNE WP2
FEHRL Infrastructure Research Magazine	June 2015	www.fehrl.org/index.php?m=33&a=content&id=900	Article on ROSANNE	FEHRL	FIRM is distributed to 2000 key transport infrastructure research stakeholders across Europe and beyond.
Seminar at PolyU (Polytechnic University), Hong Kong	31 st July 2015		Presentation on ROSANNE	TUG	Paper
INTER-NOISE 2015, San Francisco	9-12 th August 2015		3 papers and presentations	VTI TUG	Presentations and posters on WP2 work by; Ulf Sandberg: "Standardised corrections for temperature influence on tire/road noise" Piotr Mioduszewski, Jerzy Ejsmont, Stanislaw Taryma, and Ryszard Wozniak: "Temperature influence on the tire/

NAME	DATE AND PLACE	WEBPAGE	ACTION	PARTNER	BRIEF DESCRIPTION OF THE ACTIVITY
					/road noise evaluation by the drum method" Beata Swieczko-Zurek, Jerzy Ejsmont, Piotr Mioduszewski, Grzegorz Ronowski, and Stanislaw Taryma: "The effect of tire aging on acoustic performance of CPX reference tires" Erik Buhlmann, Ulf Sandberg, and Piotr Mioduszewski: "Speed dependency of temperature effects on tyre/road noise measurements"
ERPUG conference	14-16 th October 2015	www.erpug.org	Presentation	VTI Ramböll	European Road Profile User's Group, ERPUG
FEHRL Infrastructure Research Magazine	January 2016	www.fehrl.org/index.php?m=33&a=content&id=900	Article on ROSANNE	FEHRL	FIRM is distributed to 2000 key transport infrastructure research stakeholders across Europe and beyond.
Journées Techniques Routes 2016 (French national road conference)	10 th February 2016	jtr.ifsttar.fr/programme/	Two ROSANNE presentations in "Harmonisation des méthodes de mesure de caractéristiques de surface des chaussées, et gestion de leur qualité" session	IFSTTAR	« Projet européen ROSANNE: harmonisation des mesures d'adhérence, définition d'une échelle commune » Minh Tan Do and Veronique Cerezo - Projet Européen ROSANNE: Bruit de roulement J. Lelong and Fabienne Anfosso
DCAG Runway Surface Conditions Assessment and Reporting Symposium, Paris	1 st April 2016	www.stac.aviation-civile.gouv.fr/manifestation/friction_symposium_2016.php	Two presentations	TRL IFSTTAR	"The ROSANNE Project: Harmonisation of Skid Resistance Measurements on Roads" - Martin Greene Macrotexture assessment methods and their correlation - Véronique Cerezo and Minh Tan Do
6 th Transport Research Arena	18 th -21 st April 2016		Manfred Haider	AIT DRD TRL VTI	ROSANNE poster (by Marco Conter, Martin Greene, Bjarne Schmidt, Ulf Sandberg) and presentation
MIRIAM Workshop -, Rolling Resistance in Road Infrastructure Asset Management	19 th May 2016		Presentations	BRRC TUG	Round Robin Test for rolling resistance & draft standard preparation - Anneleen Bergiers, Johan Maeck. Road texture influence on tyre rolling resistance - Jurek Ejsmont
6 th Euroasphalt and Eurobitumen congress	1-3 rd June 2016		Bjarne Schmidt	DRD	Presentation on CO ₂ reduction with Low Rolling Resistance Stone Mastic Asphalt
LEO International Seminar, Oslo, Norway	2 nd June 2016		Ulf Sandberg	VTI	Presentation

NAME	DATE AND PLACE	WEBPAGE	ACTION	PARTNER	BRIEF DESCRIPTION OF THE ACTIVITY
INTER-NOISE 2016, Hamburg, Germany	21 st –24 th August 2016		Presentations and posters on WP2	AIT BRRC TUG	Marco Conter et al.: "ROSANNE project: new procedure for noise characterisation of road surfaces in Europe" Anneleen Bergiers, Johan Maeck: "Validation of reference tyres and temperature correction for Close-ProXimity (CPX) method". Rasmus Stahlfest Holck SKOV: "Analysis and comparison of methods, CPX and SPB, for measuring noise properties of road surfaces" Piotr Mioduszewski; Stanisław Taryma; Ryszard Woźniak: "Temperature influence on tyre/road noise frequency spectra" Reinhard Wehr, Andreas Fuchs: "A combined approach for CPX tyre hardness and temperature correction" Fabienne Anfosso, Guillaume Dutilleux, Marco Conter: "Compatibility of the ROSANNE noise characterisation procedure for road surfaces with CNOSSOS-EU model" Ulf Sandberg; Erik Buehlmann, Marco Conter, Piotr Mioduszewski, Reinhard Wehr: "Improving the CPX method by specifying reference tyres and including corrections for rubber hardness and temperature"
Transportation Research Procedia 14 (2016) 2946 – 2955			Paper	AIT DRD TRL VTI	Manfred Haider, Marco Conter, Martin Greene, Bjarne Schmidt, Ulf Sandberg: "Status of the EU-Project ROSANNE"
ROSANNE final conference	11 th October 2016	www.rosanne-project.eu/	Presentations and demonstration	All partners	
13th Slovenian Congress on Roads and Traffic	19-20 th October 2016		Darko Kokot submitted paper	ZAG	Paper
FEHRL Infrastructure Research Magazine	January 2017	To come	Article on ROSANNE	FEHRL	FIRM is distributed to 2000 key transport infrastructure research stakeholders across Europe and beyond.

Table 1. List of dissemination activities carried out

In addition to the above activities, regular presentations were given to the CEN TC227/WG5, ISO groups and the Stakeholder Reference Group, as well as internal communication to the project Consortium at six-monthly Project Management Group meetings.

4 CONCLUSION AND RESULTS

The objective of the ROSANNE project was the harmonisation and/or development of measurement methods for skid resistance, noise emission and rolling resistance of road pavements and using these for classification of the pavements. Within ROSANNE, a lot of findings were gathered and new decisions according to strategies and measuring devices are made which can be suggested to the various Standardisation committees – mainly CEN/TC 227/WG 5. Based on these findings, several standards were drafted which can be the basis for future standards, including both ISO and CEN standards. These drafts have been or will be discussed in the standardisation committees.

All Work Packages related to surface properties gathered findings based on the evaluation of the results of several measurements and internal workshops which can directly feed into various standardisation projects; in either CEN or ISO committees. Beside the preparation of draft standards the dissemination of the project results to the scientific community, road industry, road administrations, policy makers and other relevant stakeholders is another important component to distribute the achieved knowledge within the project to a wider community.

The main targeted standardisation body of the project is Working Group 5 of the CEN Technical Committee 227 for “Road materials” with the title “Road surface characteristics”, which supports CEN/TC 227 developing European standards on road surface characteristics. ROSANNE project partners have developed drafts for standardisation which are distributed to WG 5 as a possible basis for standards.

CEN as well as ISO are offered a wide set of deliverables – differing in the levels of consensus and approval required before issue – offering flexible means to meet market needs for technical requirements and information. Amongst these, in the CEN structure the European Standard (EN) is the major deliverable, besides which CEN produces other publications with different status, such as the Technical Specification (CEN/TS) or the Technical Report (CEN/TR) that are of interest for ROSANNE. The deliverables within the ISO structure are comparable to the ones of the CEN structure.

Based on the findings in ROSANNE, the results provide input for several standardisation documents. Some examples are listed below:

WP1 “Skid resistance”: The findings will be used directly in CEN/TC 227/WG 5. The start of the revision of CEN/TS 13036-2:2010-09 was planned for 2016. It was decided to divide the devices in two groups – SFC devices and LFC devices, while LFC devices are additionally divided in low slip ratio and high slip ratio.

- The CEN/TS 15901 series and CEN/TS 13036-2 are planned to be substituted by one full EN standard with different parts according to the groups mentioned above, if the Technical Specifications are no longer needed.
- At the moment, there exists a very detailed draft of the standard but only for the SFC devices which includes the description of the device, how to proceed with measurements, possible corrections, calibration procedures and of course the calculation of a Common scale, in this case the SRI (Skid resistance index). For the draft about the LFC devices (low slip ratio and high slip ratio) there is no timeline defined yet.

WP2 “Noise emission”: In the consortium it was decided that CPX will be the primary method for noise characterisation of pavements. There is also a liaison with several ISO committees (e.g. liaison with WG 27, 33 and 39 of ISO/TC 43/SC 1 “Noise”) so the findings of ROSANNE have provided input directly for the following standards and technical specifications:

- ISO 11819-1: Some ROSANNE findings may be implemented in the next revision period
- ISO 11819-2: Final draft (FDIS) subject to ballot (ISO & CEN), some results from ROSANNE are incorporated in the final version
- ISO/TS 11819-3: Final draft approved in ISO ballot, ROSANNE findings are implemented in this
- ISO/TS 13471-1: Final draft approved in ISO ballot; temperature correction largely developed in ROSANNE is part of this

WP3 “Rolling resistance”: Research in ROSANNE was focussed on trailer measurements and explored the different factors affecting the measurements. The basis for future activities in this field within the CEN group could be the establishment of a Task Group in WG5 which focus on Rolling Resistance. Based on the gathered results in ROSANNE and other projects this TG could develop a Technical Report about Rolling Resistance measurements as a first step.

WP4 “Texture”, “reference tyres and reference surfaces”: While there is a direct link between texture and the other surface properties, the findings related to texture will feed directly into the standardisation documents mentioned above. Also the findings of the reference tyres and reference surfaces are in-cooperated in the documents of the other Work packages.

All the Deliverables from the project can be found on the ROSANNE project website at www.rosanne-project.eu.

ROSANNE PARTNERS



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"ROLLING resistance, Skid Resistance ANd Noise Emission measurement standards for road surfaces"

