

Additional guidelines for the execution of tyre-road noise measurements with a CPX (Close Proximity) measurement trailer

version 2012

The additional guidelines for the execution of CPX measurements were drawn up under the responsibility and assignment of the CROW working group ‘Protocol for CPX measurements’. At the time of delivery of this version of the guidelines the CROW working group consisted of the following members:

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Introduction

The Dutch practice of assessment of the noise reducing properties of pavements according to the CPX (Close Proximity) Method has revealed that relatively large differences may occur between test results produced by different CPX operators. Due to these differences road authorities are facing questions and uncertainties about the acoustical quality of the pavements tested.

In order to obtain a reliable picture of the actually existing differences between the test results of the various CPX trailers and the causes for these differences a comparison test between all CPX trailers in operation in The Netherlands was executed in autumn 2008 under assignment of CROW. According to the operators and / or producers all participating trailers satisfied the requirements and specifications of the current version of ISO/CD 11819-2 at that time.

The results of this comparison test were analysed statistically and evaluated from the perspectives of acoustics and measuring technique [2].

In autumn 2011 the comparison test was repeated [3] with the aim to update the research findings and to broaden the scope by inviting three participants from outside The Netherlands.

Based on the combined results and conclusions of both investigations the CROW working group Protocol for CPX measurements has drawn up the guidelines presented hereafter. The guidelines are aimed to achieve a further uniformity of the measurement methodology, supplementary to the specifications of ISO/CD 11819-2 [1], and to realize a smaller measurement uncertainty of the CPX method.

1 Guidelines

1.1 Basic principles

These guidelines are complementary to the international standard ISO 11819-2 under development. This standard has not yet been published as a final document. For the drafting of the guidelines at hand the fourth committee draft version of ISO/CD 11819-2 dated 23 March 2011 was used. The basic principle behind these guidelines is the assumption that the requirements for the execution of measurements according to this ISO document will be observed fully, except for the items where these guidelines expressly deviate from the ISO methodology.

The current version of the guidelines will be updated when a new version of ISO 11819-2 has been published. The current version will lose its validity after the update.

1.2 General construction requirements for CPX measurement trailers

Measurement trailers shall be constructed as two-wheeled trailers. The test wheels shall roll in the left and right wheel tracks of the traffic lane. The axle track of the test wheels shall correspond as close as possible to the distance between the wheel tracks on the lane and shall measure $1,90 \pm 0,10$ m between the centre lines.

1.3 Application of an enclosure around the test wheels and correction for sound reflections within such enclosure

The CPX trailers may be designed according to two enclosure options:

- a) open trailer without enclosure;
- b) trailer with enclosure lined with sound absorbing material.

As sound reflections do not occur for option a), no corrections for the effect of sound reflections are necessary for this trailer type. For option b) the effects of sound reflections shall be assessed and corrected for in the following manner:

- The raw test results of a trailer with an enclosure according to option b) shall be corrected with the frequency dependent device correction term Cd_f according to equation (2) or (9) of ISO/CD 11819-2 .
- The device-dependent correction term shall be determined using a mock-up calibration sound source placed at the position of the test wheel in accordance with the method described in ISO/CD 11819-2 (Annex A; section A.2). This calibration test shall be executed on a reflective road surface.
- The frequency dependent device correction terms applied for option b) type trailers shall be reported in an unambiguous way in the test report and on the data sheets.

1.4 Properties of test tyres

Variations in the properties of the test tyres and the decay of these properties over time are an important cause for differences between CPX trailers. Therefore measures shall be taken to safeguard the equality of the properties of the test tyres of different operators as far as possible. The measures are:

- Joint purchase and selection of tyres in conformity with the requirements and specifications for test tyres as given in ISO/TS 11819-3 [4] or future versions of this international technical specification.
- Well conditioned cold storage of test tyres aimed at slowing down the aging process and decay of properties of tyres. The storage conditions shall be in conformity with ISO/TS 11819-3. The requirement with respect to the storage temperature of test tyres shall be narrowed down to a temperature interval of $0 - 5$ °C.
- Regular execution of comparison tests as described in 2.3 in order to detect differences between test tyres and to correct for it. When executing comparison tests the tyres belonging to one trailer

shall be exchanged with the tyres of other trailers in order to be able to separate the effects of tyre differences and of trailer differences in a statistical analysis;

1.5 Influence of the mounting side of the test tyre

As the influence of the mounting side of the tyre (and of side of the measured wheel track) on the final test result is significant all measurements shall be executed with test tyres of the same type mounted on either side of the trailer. The results of the test tyres shall be averaged in order to characterise the road surface properties with the smallest measurement uncertainty achievable.

1.6 Measurement of distances and speeds

The instruments used for the measurement of the distance and the driving speed shall have a measurement uncertainty of at most ± 1 % of the measuring range (expressed as a 95 % confidence interval).

The instruments shall be calibrated at least once a year. If the measurement of distance or driving speed is based on detection of the rotational speed of the test wheel or of one of the wheels of the towing vehicle the calibration shall be updated after putting into use of new test tyres or new vehicle tyres.

1.7 Selection and registration of test sections

In many cases the CPX measurement of a test section will be repeated at a later time in order to monitor the changes of the acoustical road surface characteristics over time. It is imperative to execute a repeated measurement on exactly the same test segment as the original measurement. If this procedure is not executed with the highest possible accuracy variations of the tested object will occur, which will increase the measurement uncertainty.

Therefore it is recommended to choose the starting and end points of the test segment already at the first measurement such that it can be reproduced easily at a later time. In addition to this the length and the location of the tested segments shall be registered accurately at all measurements, preferably referring to the hectometre sign along the road as well as to an independent co-ordinate system.

1.8 Recommendation for regular participation in a comparison test

In order to monitor the acoustical and measurement technical properties of a CPX trailer it is recommended that CPX test operators participate on a regular basis in a comparison test. With the results of a comparison test a clear view can be obtained of the individual deviations of one's own instrument from the group average test results and the spread of these deviations. Also a comparison test will deliver actual values of the measurement uncertainty of the CPX method.

Recommendations for the set-up and execution of CPX comparison tests are given in the reports of the investigations conducted in 2008 [2] and 2011 [3].

References

- [1] Fourth ISO/CD 11819-2 Acoustics – Measurement of the influence of road surfaces on traffic noise – Part 2: The close-proximity (CPX) method, ISO document TC 43/SC 1 N1847, Geneva, 23-03-2011.
- [2] Roo, F. de, J. Telman, Ringonderzoek CPX-meetaanhangers – Analyse van de resultaten, TNO report nr. MON-RPT-033-DTS-2009-00414, TNO Science and Industry, Delft, 22 June 2009.
- [3] Roo, F. de, G.B. Derksen, CPX trailer comparison – Round Robin test data analysis, CROW report D12-02, May 2012.
- [4] ISO/TS 11819-3 Acoustics – Measurement of the influence of road surfaces on traffic noise – Part 3: Reference tyres – under development; not yet published.