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# CPX trailer comparison
# round robin test data analysis

Report D12-02

*Field: Infrastructure*

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**CROW**

Galvanistraat 1, NL-6716 BA Ede
P.O. Box 37, NL-6710 BA Ede
The Netherlands
Telephone: +31 381 69 53 00
Fax: +31 318 62 11 12
E-mail: crow@crow.nl
Web site: www.crow.nl

**At the date of issue of this report, the CROW working group'Protocol for CPX measurements'consisted of the following members:**

- A.A.M. (Rien) Bakker, *provincie Utrecht*
- G.J. (Gijsjan) van Blokland, *M+P*
- E. (Berry) Bobbink, *provincie Gelderland*
- G.F.C. (Gerald) van Grunsven, *provincie Noord-Brabant*
- P.E. (Peter) van Hinthem, *Breijn B.V.*
- J.J.A. (Hans) van Leeuwen, *DGMR*
- G.N.M. (Gerard) van Mulken, *gemeente Eindhoven*
- F.(Fred) Reinink, *M+P*
- J.(Jos) Reubsaet, *Adviesburo Jos Reubsaet*
- W.J. (Willem Jan) van Vliet, *RWS/DVS*

On behalf of CROW the working group was chaired by Mr. J. (Jan) Knol. The data analysis and reporting tasks were performed by Mr. G.B. (Giljam) Derksen and Mr. F. (Foort) de Roo of TNO Technical Sciences, under responsibility of the working group.

# Contents

# Summary

One of the methods to determine the influence of the road surfaces characteristics on the emission of noise by road traffic is the so-called Close Proximity (CPX) method, which measures the noise emission of the tyre-road contact in the near field of a sound radiating tyre. These measurements are executed with CPX measurement trailers.
Experience in the Netherlands and in other European countries has shown that CPX measurements may suffer from a relatively large measurement uncertainty. In order to quantify the actual measurement uncertainty for the Dutch CPX trailers and to develop guidelines for further reduction of the measurement uncertainty a round robin test was held in the Netherlands in 2008.
In 2011 this investigation was repeated and enlarged by the participation of three CPXtrailers from other European countries.

The agreed procedures for the execution of the comparison tests in 2011 offered more freedom of interpretation to the participants than in 2008. As a result of this an unexpected contribution to the measurement uncertainty occurred in the form of a variation of the length and the position of the road segments tested by the different trailer operators. This resulted in somewhat larger standard deviations of the measured CPXlevels than observed in 2008, although several other aspects of the test procedure were defined more strictly than in the previous comparison test.

It is concluded that the data from this recent comparison test probably give a realistic view of the measurement uncertainty that will occur in uncontrolled situations. If, however, the inherent uncertainty of the CPXmethod is to be assessed, a stricter specification of the comparison test procedures is advisable.
Presumably the data obtained from the 2011 round robin test give an overestimation of the basic measurement uncertainty of the CPX test method.

# Samenvatting

Een van de methoden voor het bepalen van de invloed van wegdekken op de geluidsemissie door wegverkeer is de zogenaamde CPX (Close Proximity) methode, waarbij de geluidsemissie ten gevolge van het band-wegdekcontact wordt gemeten met een tweetal meetmicrofoons in het nabijheidsveld van een geluid afstralende band. Deze metingen worden uitgevoerd met een CPX-meetaanhanger.
Ervaring in Nederland en in andere Europese landen heeft geleerd dat tussen CPX-meetresultaten van verschillende uitvoerders relatief grote verschillen kunnen bestaan ten gevolge van de meetonzekerheid van de methode.
In 2008 is een vergelijkend ringonderzoek van de op dat moment in Nederland in gebruik zijnde meetaanhangers uitgevoerd om de actuele meetonzekerheid te bepalen en om te komen tot richtlijnen voor verdere vermindering van de meetonzekerheid van de CPX-methode.
In 2011 is dit ringonderzoek herhaald en uitgebreid door deelname van drie deelnemers uit andere Europese landen.

De afgesproken procedures voor de uitvoering van het ringonderzoek in 2011 boden meer interpretatievrijheid aan de deelnemers dan in 2008. Ten gevolge daarvan is een onvoorziene bijdrage aan de meetonzekerheid opgetreden in de vorm van een variatie van de lengte en de ligging van de door de verschillende deelnemers gemeten wegsegmenten. Dit heeft geresulteerd in enigszins hogere standaarddeviaties van de gemeten CPX-niveaus dan in 2008 het geval was, hoewel diverse andere aspecten van de meetprocedure strikter waren geformuleerd dan in het vorige ringonderzoek.

Geconcludeerd is dat de resultaten van het meest recente ringonderzoek waarschijnlijk een realistisch beeld geven van de meetonzekerheid die zal optreden in prakrijksituaties zonder verdere aanwijzingen voor de lengte en ligging van het te meten wegsegment. Indien echter de inherente meetonzekerheid van de CPX-methode moet worden bepaald, is een striktere omschrijving van de meetprocedures aan te bevelen.
Waarschijnlijk geven de resultaten van het in 2011 gehouden ringonderzoek een te hoge schatting van de fundamentele meetonzekerheid van de CPX-meetmethode.

# Introduction

The influence of the road surfaces characteristics on the emission of noise by road traffic can be measured in two ways: with the Statistical Pass-By (SPB) method [1], which measures the average emission of a large number of vehicles, and with the Close Proximity (CPX) method [2], which measures the noise emission of the tyre-road contact in the near field of the sound radiating tyre.

Experience in the Netherlands and in other European countries has shown that measurements according to the CPX method may suffer from a relatively large measurement uncertainty. This fact causes interpretation problems for road authorities, when comparing test results from different operators of CPX-trailers, even when all trailers are in conformity to the applicable ISO standard [2].

In order to quantify the actual measurement uncertainty that occurs for the Dutch CPX trailers in 2008 a round robin test was held, in which all Dutch operators of that time participated. The test results were analysed and interpreted by TNO.
In the report of this investigation [3], [7] also the different sources of uncertainty were identified and possibilities for reduction of the uncertainties were discussed.

In 2010 an initiative was taken by Rijkswaterstaat/DVS and CROW to repeat the round robin test and, if possible, to extend its significance, by including CPX trailer operators from other European countries.

Under assignment of Rijkswaterstaat/DVS and CROW, TNO elaborated an experimental plan that was discussed in a newly formed CROW working group ‘Protocol for CPX measurements’.
After incorporation of the comments from the working group members the final version of the experimental plan [4] constituted the basis for the execution of a comparison test that took place on 29 September 2011.

TNO was commissioned by Rijkswaterstaat/DVS and CROW to analyse the test results in a statistical and acoustical sense and to investigate the factors that influence the observed measurement uncertainty and the possibilities to reduce this uncertainty.
This report presents the results of the comparison test and the findings from the analyses and investigations.

# 1 Experimental plan of the comparison test

## 1.1 General principles of the experimental plan

The comparison test was executed with seven CPX trailers in six or sevenmeasurement laps over a test circuit that consisted of five road sections with different pavement types. Each CPX trailer used two different tyre sets belonging to the trailer and one reference tyre set that was rotated amongst the trailers. Four trailers were used by Dutch operators and three trailers by operators from other countries. The tests were executed in full conformity with the most recent version of ISO/CD 11819-2 [2 ]. For certain aspects of the test procedure additional instructions were given. These will be discussed in later sections of this chapter.

## 1.2 Description of the participating trailers / operators

### 1.2.1 DGMR / Reubsaet - NL

This trailer was used by two different operators, who shared the measurement laps, but did the data processing and analysis separately. The trailer is fully open (without a hood) . The twotest wheels are mounted with the flanges pointing inward. The axle track of the test wheels is 1,84 m.

Figure 1. CPX Trailer operated by DGMR / Reubsaet (NL)

### 1.2.2 Danish Road Institute (DRI) – Denmark

The trailer is of the same design as the trailer of DGMR / Reubsaet and is fully open. The test wheels are mounted with the flanges pointing inward and have an axle track of 1,84 m.


Figure 2. CPX trailer operated by Danish Road Institute (DRI – Denmark)

### 1.2.3 M+P - NL

This operator participated with two identical trailers, indicated as MP02 and MP03. Both trailers are equipped with a hood lined with sound absorbent material consisting of flat sheets of plastic foam. The test wheels are mounted with the flanges pointing outward. The axle track of the test wheels is 1,88 m.


Figure 3. CPX trailer MP02operated by M+P consulting engineers (NL)

### 1.2.4 Bundesanstalt für Straβenwesen (BASt) – Germany

The trailer is of the same design as the trailers of M+P and is equipped with a sound absorbing hood. The test wheels are mounted with the flanges pointing outward and have an axle track of 1,88 m.


Figure 4. CPX trailer operated by the Bundesanstalt für Straβenwesen (BASt – Germany)

### 1.2.5 Vlaamse overheid (Flemish government) – Belgium

The trailer is of the same design as the trailers of M+P and is also equipped with a sound absorbing hood. The test wheels are mounted with the flanges pointing outward and have an axle track of 1,88 m.

### 1.2.6 Province Noord-Brabant – Bureau Milieumetingen – Netherlands

The trailer is equipped with a hood lined with sound absorbent material (Sirex S-20/30 NOP lining). The test wheels are mounted with the flanges pointing outward. The axle track is 1,95 m.


Figure 5. CPX trailer operated by Province of Noord-Brabant – Bureau Milieumetingen (NL)

## 1.3 Measured road sections

The comparison tests are executed on a circuit of connected road sections, situated east of the city of Zutphen in the province of Gelderland in the Netherlands (see map in annex I).
The test circuit started at the service and storage station of the provincial road authority, situated along the road N319 and indicated on the map with a black dot within a grey square. The test circuit started in south-easterly direction towards the roundabout, where the N314 in south-westerly direction was taken. This section of the N319 was driven until the next roundabout and was used to bring the tyres at working temperature. At the roundabout a turn was made and the N314 was driven back as test section 1 in north-easterly direction until the roundabout. Then the circuit was followed in northerly direction along the N314. This section was split in two test sections 2 and 3 with different road surfaces. The fourth test section followed after a left turn at the next roundabout along the N346 in westerly direction. The fifth section followed after a left turn into the N319 in south-easterly direction until the service station. Table 1 gives a specification of the five test sections.

**Table 1. Specification of the tested road sections.**

| Section number | Road number | Length of the section (m) | Pavement type | Type indication in this report |
|---|---|---|---|---|
| 1 | N314 | 1644 | 2 layer porous asphalt concrete – grading 2/6 mm | 2 layer ZOAB 2/6 |
| 2 | N314 | 292 | Porous asphalt concrete – grading0/16 mm | ZOAB 0/16 |
| 3 | N314 | 416 | Low energy porous asphalt concrete – grading 0/16 mm | LEAB ZOAB 0/16 |
| 4 | N346 | approx. 950 | Stone Mastic Asphalt – grading 0/11 mm | SMA 0/11 |
| 5 | N319 | approx. 1200 | Dense asphalt concrete – grading 0/16 mm | DAB 0/16 |

## 1.4 Tyres used for the comparison test

In accordance with the latest version of ISO 11819-2 all participating operators used two types of tyres, both of which are specified in ISO/TS 11819-3 [5]:

*a. Tyre type SRTT*

This tyre was originally defined in American Standard ATM F2493-06 [6] as a Standard Reference Test Tyre. In fact it is a tyre of the brand Uniroyal, type Tigerpaw, size 225/60 R16 (see figures 6 and 7). This tyre is used in the CPX tests as reference tyre P1, being representative of passenger car tyres.

Figure 6. Picture of tyre type SRTT

Figure 7. Tread pattern of the SRTT tyre

*b. Tyre type Avon AV 4*

This is a tyre of the brand Avon, type Supervan AV4, size 195 R14 (see figures 8 and 9). This tyre is used in the CPX tests as reference tyre H1, being representative of heavy vehicle tyres.

Figure 8. Picture of tyre type Avon AV4

Figure 9. Tread pattern of tyre type Avon AV 4

## 1.5 Measurement schedule

In the measurement schedule the following objectives were pursued:

1. Each measurement trailer should make at least one measurement run with the reference tyre set.
2. Per measurement run as many trailers as possible should use the same type of tyre.
3. The number of tyre changes should be kept to a minimum.
4. M+P should start and finish with the reference tyre set because they delivered this tyre set.
5. Emphasis should be on the measurement runs with 80 km/h.

These objectives resulted in the schedule given in table 2.

Due to practical considerations during the execution of the CPX tests several deviations from the original schedule occurred. All intended runs were carried out, but not always in the order originally planned. As a result runs with similar tyres were in some cases spread outover the day.
In a number of cases (6) the file names and the information contained in the file were not consistent with respect to the tyre and / or the speed used during the test. In these cases it was assumed that the file name expressed the proper tyre/speed combination used at a specific test section.

**Table 2. Proposed measurement schedule.**

| TEST RUN | OPEN TEST WHEEL | | ABSORBENT ENCLOSURE | | | | |
|---|---|---|---|---|---|---|---|
| | Design DGMR/Reubsaet | | Design M+P | | | | Design infrageluid |
| | DGMR/Reubsaat | DRI | M+P 1 | M+P 2 | BAST | Vlaamse overheid | Noord-Brabant |
| | | | | | | | |
| 1 | 2 | 2 | 1 | 2 | 2 | 2 | 2 |
| 2 | 1 | 4 | 4 | 4 | 4 | 4 | 4 |
| 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| 4 | 4 | 1 | 4 | 4 | 4 | 3 | 4 |
| 5 | 4 | 4 | 2 | 2 | 1 | 4 | 5 |
| 6 | 5 | 5 | 5 | 5 | 5 | 5 | 1 |
| 7(optional) | | | | 1 | | | |
| | | | | | | | |
| 1 | SRRT-ref 80km/u | | | | | | |
| 2 | AVON AV4 80 km/u | | | | | | |
| 3 | SRTT 50 km/u | | | | | | |
| 4 | SRTT 80 km/u | | | | | | |
| 5 | AVON AV4 50 km/u | | | | | | |

## 1.6 Details of the test procedure

### 1.6.1 Test speed

Both types of test tyres were used at speeds of 50 and 80 km/h on all trailers.
The SRTT reference tyre set was used on all trailers at a speed of 80 km/h.

The noise emission test results were corrected for the average speed during the test drive. Therefore the speed was recorded with a calibrated speedometer or a GPS receiver.

The average speed over all runs and over a test section for a given tyre was not allowed to deviate more than + 5 % from the reference speed; the actual test speed on each road segment (of 20 m) was not allowed to deviate from the reference speed by no more than + 20 %.
The driving speed of the trailer and the distance travelled during the measurements were determined with instruments with an accuracy of 1 % or better.

### 1.6.2 Temperature measurements

*a. Air temperature*

According to ISO 11819-2 the CPX test results were corrected for air temperature. This air temperature was measured by each operator in accordance with the sub-clauses 11.10.1 and 11.10.2 of ISO 4CD 11819-2 with his own temperature measurement equipment.
All temperature measurement data were time stamped and the measurement method, continuously or intermittently, was reported.
The temperature measurement sets were calibrated in order to minimize the contribution of the temperature correction to the measurement uncertainty and were in conformity with the requirements of sub-clause 6.5 ISO 4th CD 11819-2. This sub-clause was interpreted such that the required measurement accuracy of + 1 °C was considered to be a 95 % confidence interval.

*b. Road surface temperature*

After each test round the contact temperature of the road surface was measured by each operator in accordance with the sub-clauses 11.10.1 and 11.10.3 of ISO 4th CD 11819-2 with his own temperature measurement equipment. This temperature reading was not used in the data processing, but was recorded as additional information.
The road surface temperature measurement equipment was calibrated and should have a measurement accuracy of + 1 °C, to be interpreted as a 95 % confidence interval.

*c. Tyre tread surface temperature*

After each test round the contact temperature of the tyre tread surface was measured in accordance with the sub-clauses 11.10.1 ofISO 4CD 11819-2 with the temperature measurement equipment belonging to each trailer. The measurement(s) were carried out on a part of the tread surface that was not directly exposed to sun radiation.
This temperature reading was not used in the data processing, but was recorded as additional information.
The tyre tread surface temperature measurement equipment was calibrated and should have a measurement accuracy of + 1 °C, to be interpreted as a 95 % confidence interval.

## 1.7 Registration of location and length of the testedroad segments

It was intended to record the exact position of the beginning and end of the tested segments with a calibrated positioning device and to measure the length of the tested segment with a calibrated odometer.
During the preparatory discussions several options for marking of the intended test sections were discussed. Most test sections started immediately after a roundabout or a crossing, so the vehicles had to accelerate from low speed to the prescribed test speed. Therefore the actual starting point for a vehicle-trailer combination would be dependent of its achievable acceleration. This would cause a certain spread in the actual starting points and lengths of the tested segments. During the previous CPXtrailer comparison test the series of test results per 20 m segments had been synchronised prior to the statistical analysis. According to the current instructions the results would be averaged and would be reported for 100m segments. This did not offer the possibility for a synchronisation correction as part of the analysis.
Moreover, a certain spread in the location of the starting points and the lengths of the tested segments was considered to be representative of normal practice. It was decided that the effects of such spreads should be included in the results of this CPXcomparison and in the reported measurement uncertainty. As a consequence of this approach no exact markings of the starting and end points of the test sections were used, except for the transition between test sections 2 and 3, where one type of pavement

changed into another without a clearly visible indication of the exact location of the transition. This transition was marked with traffic cones at the roadside.

This procedure did not work out in the way it was intended. After the first inspection of the submitted test results it appeared that a large spread of the locations and the lengths of the tested segments had occurred, especially for the test runs with a speed of 80 km/h. In particular for the shorter road sections (2 and 3) this resulted in a very poor overlap between the series of test results of the different operators. (See annex V). For several tyre / pavement / speed combinations only one segment of 100 m was common in all submitted series of test results, while for section 2no overlap existed at all for some of the combinations. An additional complication was that not all operators had used the hectometre signs at the road side to record the location of their tested 100 segments. Some operators had used GPS coordinates (M+P and BASt) or GPS distance readings from the start of the test circuit (DRI) to register the locations of the tested 100 m segments. The GPS coordinate data could be converted into hectometre readings afterwards using Google maps. This procedure introduced some uncertainty about the location of the tested segments. The GPS distance measurements could not be transferred easily into hectometre readings. Therefore the location data for the DRI series are given as distances relative to the starting point of section 1, while the other location data are given as hectometre readings based of the road side indications.

As the number of reported 100 m segment results per test section varied considerably between the different operators, and the locations of the tested segments did not coincide to a sufficient degree, it was decided to execute the statistical analysis not on the data of the 100 m segments, but only on the overall averages of the whole test sections.
A consequence of this decision was that the results of the current CPXcomparison will not be directly comparable to the results of the previous comparison in 2008.
Furthermore only one average result per test section will be included in the statistical analysis instead of a series of data for each 100m segment. Therefore the analysis of variance within one test section cannot be executed in a similar way as in the previous CPX comparison. See chapter3 for further information about the statistical analysis methods used.

# 2 Test results

## 2.1 Results of CPX measurements

The measured data were processed by the participating operators in conformity with sub-clauses 11.1 and 11.2 of ISO/4$^{th}$ CD 11819-2 [2]. For each test run, test section, test tyre type and wheel track the A-weighted CPX levels of 20 m segments in 1/3-octave bands with mid-band frequencies from 315 to 5000 Hz were determined. For the CPX trailers with an absorbent enclosure the trailer dependent spectral corrections for sound reflections were applied to the 1/3-octave band levels. Next the overall A-weighted CPX levels in dB(A) were obtained by energy based summation of the 1/3-octave band levels. Then temperature and speed corrections were applied to these overall levels.
The 20 m overall CPX levels were averaged arithmetically to 100 m segment values. These 100 m segment CPX levels (dB(A) and 1/3-octave)were reported to TNO by the participating operators. Due to differences in start and end points of the measured sections the total number of 100 m CPX values delivered by the different operators showed a considerable variation (see annex II; table II-1)

## 2.2 Comparison of acoustic calibration sound sources

In order to assess the influence of possibly existing deviations of the calibration of the sound level measurement chains of the trailers the sound levels produced by the sound calibrators of the participants were checked with the same measurement system. These verification measurements were executed by M+P. The results of the checks are presented in table 3. All calibrators, except one,are of Class 1 and show average deviations from the nominal value of 94 dB of 0,04 dB or less. The stability of the calibrators was good, with a highest standard deviation of the measurement series of 0,011 dB. The Class 2 calibrator of Reubsaet showed a larger deviation of 0,27 dB. This fact is known to the operator and compensated for in the data processing.

*Note The nominal value for all three calibrators is only valid for microphones of the pressure sensitive type. For free field types of microphones a correction of -0,15 or -0,20 dB should be taken into account. As no information on the microphones used was available, it is assumed that all microphones were of the pressure sensitive type*

**Table 3. Results of verification measurements of the sound levels produced by the sound calibrators of the participants.**

| Description | Brand and type | Class | Date of latest annual verification | Sound level - Average value [dB] | Duration of verification measurement [s] | Standard deviation of the measurement series [dB] |
|---|---|---|---|---|---|---|
| DGMR | RION NC-74 | 1 | 03-11 | 94,002 | 13,375 | 0,005 |
| Reubsaet | B&K 4230 | 2 | ? | 94,272 | 22,875 | 0,004 |
| DRI | B&K 4231 | 1 | 22-08-2011 | 94,042 | 15,875 | 0,005 |
| M+P nr. 4 | B&K 4231 | 1 | 17-03-2011 | 94,027 | 12,000 | 0,004 |
| BASt | B&K 4231 | 1 | 25-02-2011 | 93,995 | 13,750 | 0,004 |
| Vlaamse overheid | RION NC-74 | 1 | 11-03-2011 | 93,958 | 17,625 | 0,005 |
| Noord-Brabant | B&K 4231 | 1 | 08-06-2011 | 93,963 | 14,875 | 0,011 |

## 2.3 Shore-hardness of test tyres

The shore-hardness of the rubber of the tyre tread is known to influence the noise generation of the tyre-road interaction. Therefore the hardness of the rubber is specified in ISO 11819-3. The required value is 64+2. Normally the shore-hardness of the rubber increases during the lifetime of the tyres due to the influences of higher temperatures and ultraviolet light.
The hardness of all tyres used during the comparison was measured by M+P; the results are presented in tables 4a and 4b.
For the SRTT tyres it may be noticed that the hardness of the circulation reference set is the lowest of all tyres and also lower thanthe tolerance range of the hardness requirements. This may be caused by the fact that this tyre set was produced more recently than the other SRTT sets (except the set of the Vlaamse overheid) The set had not been in normal operation until this comparison test and had not been subjected to the hardening effects of outdoor conditions, because it was kept in a cold store.

**Table 4a – Shore-hardness of the SRTT test tyres.**

| Tyre type SRTT | Date of production [week-year] | Temperature of tyre surfaceduring test [°C] | Left | Right |
|---|---|---|---|---|
| **Operator / tyre set** | | | | |
| DGMR / ReubsaetSRTT,nr. 8, set 4 | 06 – 2006 | 26 | 69.8 | 69.6 |
| DRI SRTT | 46 – 2008 | 24 | 68.8 | 68.2 |
| M+P SRTT set 2 | 09 – 2006 | 23 | 68.8 | 69.8 |
| M+P SRTT set 7 | 42 – 2006 | 23 | 68.0 | 68.8 |
| BASt SRTT; L = nr. 15; R = nr. 14 | 43 – 2005 | 23 | 67.8 | 68.6 |
| Vlaamse overheid SRTT | | 30 | 62.4 | 62.8 |
| Noord-Brabant SRTT | 16 – 2009 | 23 | 66.8 | 66.6 |
| M+P SRTT reference circulation set | 18 – 2011 | 26/27 | 60.6 | 61.0 |

**Table 4b – Shore-hardness of the Avon AV4 test tyres.**

| Tyre type AVON AV4 | Date of production [week-year] | Temperature of tyre surface during test [°C] | Left | Right |
|---|---|---|---|---|
| **Operator / tyre set** | | | | |
| | | | | |
| DGMR / Reubsaet AV4 | 22 – 2005 | 25 | 66.2 | 68.6 |
| DRI AV4, set 8 | 05 – 2007 | 23 | 65.0 | 64.0 |
| M+P AV4 set 2 | 06 – 2007 | 25 | 65.0 | 65.0 |
| M+P AV4 set 4 | 06 – 2007 | 25 | 64.4 | 66.2 |
| BASt AV4 | 33/35 – 2007 | 25 | 65.8 | 66.0 |
| Vlaamse overheid AV4 | | 25 | 60.8 | 60.0 |
| Noord-Brabant AV4 | 46 – 2009 | 24 | 64.6 | 64.0 |

## 2.4 Tyre pressure of test tyres

According to sub-clause 10.8 of ISO/4th CD 11819-2 the inflation pressure of the test tyres shall be 200 kPa ± 10 kPa. All operators inflated their test tyres to a pressure of 200 kPa.
According to sub-clause 6.7 the equipment used to determine the inflation pressure shall have an overall accuracy of at least ± 4 %.
In order to check the variability of the tyres pressures that occurred during the CPX comparison a comparative check of the tyre pressure measuring devices was organised. A tyre was set to 200 kPa by M+P according to their tyre pressure measuring device. Then the other participants measured the same tyre with their own measurement devices. This gave the results presented in table 5.

**Table 5. Results of comparative check of tyre inflation measurement devices.**

| Tyre pressure measured by M+P [kPa] | Tyre pressure measured by participant | [kPa] | Difference [%] |
|---|---|---|---|
| 200 | DGMR / Reubsaet | 225 | + 13% |
| 200 | DRI | 225 | + 13% |
| 200 | BASt | 215 | + 8% |
| 200 | Vlaamse overheid | 215 | + 8% |
| 200 | Noord-Brabant | 215 | + 8% |

From these results it can be observed that the tyre pressure measurement device of M+P gives the lowest results. This measurement device is not traceably calibrated to an absolute standard, so its readings may exhibit a systematic deviation. The maximum difference between the readings of the measurement devices is 25 kPa or 13 %. This is larger than the allowed margin of 2 x 10 kPa for the actual inflation pressure, and also larger than 2 x 4% allowed measurement uncertainty.
However, no correlation between the tyre pressure differences and the reported CPX levels was observed in the comparison.

## 2.5 Certification data of the CPX trailers

The sound reflection effect of the vehicle body, the enclosureand supporting structures of CPX trailers must meet the requirements in given in annex A of ISO/CD 11819-2 [2].
If the trailer is covered with an enclosure that screens the test tyre(s) and the microphones from unwanted noise sources, the effect of sound reflections against the enclosure and / or wheel alignment must be determined during certification measurements prior to the initial use of the system. Subsequent certification of the enclosure and wheel alignment must be repeated at least every two years. The description and the results of the tests performed shall be reported in a publicly available report.

The trailers described under 1.2.3 until 1.2.6 are equipped with an enclosure and have been subjected to certification measurements in the period before the comparison test. The results of these measurements are expressed as a ‘device correction for sound reflections” ($C_{df}$).
The reports of the certification measurements were submitted by the participants and the $C_{df}$ values have been extracted from the reports and are presented in table 6.

**Table 6. Results of trailer certification measurements.**

| Trailer | Date of test | Tyre side | Device correction for sound reflections ($C_{df}$) in dB per 1/3-octave band | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 |
| M+P 02 | 2011 | Left | -1,2 | 0,6 | -0,4 | 1,5 | 0,3 | -0,1 | -0,3 | -0,3 | 1,1 | -0,7 | -0,3 | 0,3 |
| | | Right | -0,9 | 0,2 | -0,9 | 1,6 | 0,4 | 0,2 | -0,2 | 0,2 | 0,8 | -0,4 | -0,6 | 0,5 |
| M+P 03 | 2011 | Left | -1,5 | 0,9 | 0,1 | 0,3 | -0,5 | -0,7 | -0,4 | 0,2 | 0,9 | -0,9 | -0,4 | 0,2 |
| | | Right | -0,7 | -0,1 | -0,1 | 0,7 | 0,1 | -0,1 | -0,2 | 0,6 | 0,3 | -0,6 | -0,3 | 0,3 |
| BASt | 13-04-2011 | Left | -1,4 | 0,4 | -0,7 | 1,6 | 0,2 | -0,6 | 0,0 | -0,1 | 1,5 | -1,0 | -0,3 | 0,4 |
| | | Right | -1,7 | 0,3 | -1,0 | 1,7 | 0,2 | -0,4 | -0,2 | 0,2 | 1,1 | -0,9 | -0,4 | 0,3 |
| Vlaamse overheid | 11-05-2011 | Left | -0,2 | -0,9 | -1,8 | 0,3 | 1,0 | -0,4 | 0,0 | 0,5 | 0,4 | -0,6 | -0,5 | -0,6 |
| | | Right | -0,2 | -1,1 | -1,7 | 0,1 | 0,8 | -1,1 | 0,0 | 0,2 | 0,1 | -0,5 | 0,0 | -1,0 |
| Noord-Brabant *) | 26-05-2010 | -- | 3,1 | -1,3 | 0,2 | 1,4 | 1,8 | 2,1 | 0,9 | 2,0 | 3,0 | 2,6 | 2,6 | 1,8 |

*) Recently (on 29 March 2012) a new certification measurement of the device correction of the Noord-Brabant trailer was carried out. This measurement gave results that are approximately 1 dB lower than the data given in the table (which were still valid at the time of the comparison test).

# 3 Statistical analysis of test results

The man aim of the statistical analyses is to estimate the standard deviations during repeatability[1] and reproducibility[2] conditions. The measurement error within a trailer can be called the repeatability. The reproducibility is the combination of variations between trailers and measurement error.
To be in compliance with ISO 3534 the following definitions should be used:

- atest item is a road segment of 100 m;
- a test result is the average ofthe left and right microphone;
- a laboratory is a trailer.

In general the following procedure is used to estimate the repeatability and reproducibility standard deviations:

- Repeatability: use repeated test results of identical test items to estimate the average trailer measurement error, this is called the repeatability
- Reproducibility: the standard deviation (based on the test results as defined) between the trailers is called the reproducibility. The standard deviation between trailers is a biased estimator for the between trailer variance, it has to be corrected for measurement error. Themeasurements in this experiment (like many others) do not correspond completely with the definition of a test result, making it necessary to apply some correction factors such as the number of repetitions.

Moreover the layout of the performed experiment was such that it was not possible to estimate these standard deviations directly

- Only for the SRTT80 the experiment is repeated twice by each trailer making it possible to estimate the repeatability. This lack of replicated runs for the other tyre speed combinations makes it not possibly to calculate the repeatabilityfor test results
- The number of segments are not always the same; moreover it is sometimes not even known which segments are measured. The result of this that it is not possible to analyse the data on test item (= segment of 100m) level but only at section level.

In paragraph 3.2 the method that is used to estimate the standard deviations is described in more detail.

## 3.1 Preparation of delivered test data

It is assumed that all data delivered by the participants are:

- properly averaged octave values;
- corrected for speed and temperature;
- 100 m values.

To be sure that there were no obvious mistakes some additional test were performed. It turned out that there were some copy/paste errors. These were reported to and corrected by the participants.
No tests were performed to check whether the temperature and speed corrections were performed correctly.
The participants delivered 100m section values, before analysing them they were averaged (arithmetically) over the 100m segments within a test section by TNO resulting in to 2 values for the whole test section (one for each tyre mounting side) .

[1]Repeatable conditions (ISO 3534-1): conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time.
[2]Reproducibility conditions (ISO 3534-1): conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment.

## 3.2 Analysis of average CPX values per test section – see annex II

Due to the lack of repetitions is it is not possible to estimate directly the repeatability for the average of left+right side test results. For that reason the individual left, right values (averages for the whole section) are used in the analyses. With this setup the variation can be partitioned into the following parts:

- trailer
- mounting side
- interaction trailer*mounting side.

Two different models are elaborated:

- One source of variation: trailer. By definition the unexplained variation is the combination of mounting side and the interaction. The unexplained variation is due to inhomogeneity of the track, differences between sides, tyres and so on. The residual variation of this model correspond with the repeatability of a measurement at a single mounting side (left or right). It is not important which side is used to report a CPX value.
- Two sources of variation: trailer and side. The interaction is by definition the unexplained variation and is due to inhomogeneity of the track, tyres and so on. The residual variation of this model estimates the standard deviation of measurement at the left or right side of the trailer. This variation is used to calculate the repeatability of the mean of the left and right side measurement.

Both models give estimates of the variation between the trailers (the trailer components for the two models are not always the same; this is due to the variations in the number of segments in a section.) By summation of the trailer component and the residual component the reproducibility is obtained which will be found for repeated measurements with different trailers but under different repeating conditions. The most important difference is that the first model correspond with a measurement at single side, the second model is used for the average of the left and right mounting side. These two approaches are used for the five different road surfaces; the results are given in annex II. For the second model also the estimated reproducibility (test result is average of left and right) is given.

For the interpretation of the results the following should be realised:

- The source of variance ‘trailer’ represents the variation between the CPX values that is due to systematic differences between the trailers. Trailer specific tyre properties of the same tyre type are also part of this source.
- The source of variance ‘residual’ corresponds to variation that can not be explained. For both models the interaction is part of the residual. This means that the residual is a combination of a number of specific trailer related effects such as differences between left and right side of the trailer, differences between the two copies of the same type of tyre, measurement errors related to the measurement equipment, to variations of the position of the driving line on the traffic lane.

There are two additional topics related with a proper interpretation of the trailer and residual component:

- In section 2 it was observed that the realised length of the test sections depends on the trailer / operator. However as can be seen from table II-inannex II the length also depends on the test run and therefore on the tyre/speed combination. These dependencies are not important if there is no relation between the CPX values and the exact location. However, Figure 10 gives the 100 m values of the CPX levels for section 1 with the 2-layer porous asphalt surface. This graph shows clearly that there is a gradient of the measured values along the length of the section. So, differences between trailer results are not only differences between trailers but also differences between the actually measured sections and measurement errors. Similar figures for the other sections are given in annex II.

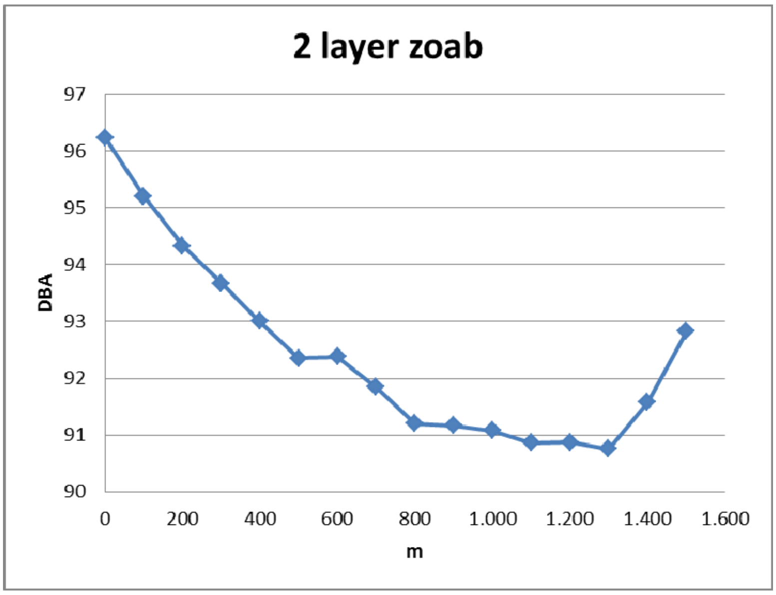



Figure 10. CPX values of test section 1 per hectometre (100 m segment) as a function of the location along the section (in dB(A))

- As said, the analyses are based on averaged (over the 100 m segments) values. This is an important fact for the analyses and the interpretation of the results. Ignoring this would result in too optimistic values for the repeatability due to the 'square root of n' rule. Therefore weighted analyses of variances are performed, the weights being the number of 100m segments per section. With such analyses the residual variance corresponds to the variance of one measurement of one 100m segment.

## 3.3 Standard deviation of 100 m segments within a test section – see Annex II

The standard deviations of 100 m segments within a test section are calculated and presented in annex II.

## 3.4 Analysis of average values per test tyre – see annex III

In annex III separate graphs are given for each tyre, showing the CPX values in relation to the different sections. Also graphs are given showing the deviations from the overall mean.

# 4 Acoustical interpretation of analysis results

## 4.1 Average CPX values per test section – see annex II

In this analysis the overall A-weighted CPX levels per test tyre, per 100 m test segment and per participant were averaged over the full length of the test section. The number of averaged 100 m segments varied between the participants.Therefore only the full length average values were analysed with analysis of variance. In the following sub-sections the results will be discussed per test section.

### 4.1.1 Section 1: 2-layer porous asphalt concrete – 2/6 mm

This section with its 2-layer porous road surface shows the largest differences between the different tyres and speeds, specifically between the SRTT and Avon AV4 tyres. This is probably due to the fine graded top layer (2-6 mm), which enhances the differences between smooth and rougher tyre treads. At 80 km/h the SRTT reference set shows the lowest CPX levels, which may be caused by the low shore-hardness of this tyre set.

The smallest mean difference between the left and the right mounted tyres (0,10 dB) occurs for the SRTT reference tyre set. In Figure 11 the difference between left and right is shown for each of the participants and for the five test sections. The left-hand graphs show the average difference for the SRTT references tyre set and the right-hand graphs for the individual SRTT tyres sets of the participants, both at a speed of 80 km/h. From these graphs the differences between the road surfaces and between the tyre sets can be observed clearly.

The analysis results for the SRTT Reference set demonstrate the influences of the trailer related factors and of the tyre mounting side without influences of differences in the tyre characteristics. These results will therefore describe the most favourable conditions with respect to measurement uncertainty.

For this reference tyre set the overall standard deviation between the participants for measurements with a single tyre (mounted left or right) on 100 m segments amounts to 0,99 dB.0,40 dB of this total standard deviation can be attributed to trailer related factors. Due to a lack of data the standard deviation due to influences of mounting side cannot be determined. The remaining 0,90 dB can be considered as the standard deviation under repeatability conditions, while the overall value of 0,99 dB represents the reproducibility conditions.

The smallest overall standard deviation of 0,99 dB was realised with the reference SRTT tyre set, while the individual SRTT sets of the participants at 80 km/h gave a slightly larger standard deviation of 1,26 dB. These values are larger than the values of the other road sections (except for section 3), which may be caused by the fact that section 1 is strongly inhomogeneous and shows a decrease of the CPX levels of 3 dB along the length of the section .

The bottom left table in annex II-2 gives the standard deviations between the participants for the average of the left and right tyre results on 100 m segments. The total standard deviation for the SRTT reference tyres in this case is 0,77 dB. Again 0,40 dB can be attributed to trailer related factors, while the residual in this case is 0,65 dB.

### 4.1.2 Section 2: porous asphalt concrete – 2/16 mm

For the porous asphalt concrete, with its larger stone sizes, the results fall in two groups, related to the test speeds. There is very little difference between the SRTT and the Avon AV4 tyres. For most of the trailers the reference SRTT tyre set produces the lowest CPX levels at 80 km/h.

Also the overall standard deviation of this set for single tyres is the lowest with a value of 0,41 dB. This is considerably lower than the standard deviation found for section 1 (2 layer porous asphalt), which is mainly due to the much lower residual variance . Apparently the road surface characteristics of section 2 are much more homogeneous than those of section 1.

The overall standard deviation for the average of left and right tyres is 0,36 dB for the SRTT reference tyres.

#### 4.1.3 Section 3: Low energy porous asphalt concrete – 2/16 m

The results of section 3 are rather similar to section 2, but the difference between left and right mounted tyres is considerably larger for all tyre types. As a consequence the residual standard deviation, which includes the uncertainty caused by left-right differences,is rather larger. This results in larger overall standard deviations (1,12 dB for single tyres and 0,55 dB for the left-right average for the SRTT Reference set).

#### 4.1.4 Section 4: stone mastic asphalt – 0/11 mm

Section 4, with its SMA road surface, shows the highest CPX levels, with hardly any difference between the SRTT and the Avon tyres. Only the SRTT reference tyre set shows again lower results at 80 km/h. In this section the difference between left and right mounted tyres is equally small as in section 1. This results in relatively low overall standard deviations (0,62 dB for single tyres and 0,54 dB he left-right average for the SRTT Reference set).

#### 4.1.5 Section 5: dense asphalt concrete – 0/16 mm

The results of section 5, with a dense asphalt surface, are generally very similar to section 4. Only the variation of the CPX values along the section is considerably larger than for sections 2, 3 and 4, but smaller than for section 1.

### 4.2 Standard deviation of 100 m segments within a test section – see Annex II

In annex II also the standard deviations between the 100 m segments within the test section are specified in the right-hand tables. The data of the left and right mounted tyres are presented in separate tables. Specifically for test section 1, and to a lesser degree test section 5, the inhomogeneity is considerably larger than for the other three test sections, resulting in standard deviations of 0,7 to 1,7 dB, while the more homogeneous test sections show much smaller standard deviations. One should bear in mind that the test sections 2 and 3 are much shorter than the other sections, so the values of the standard deviations are not fully comparable.
The information contained in these standard deviation tables is also visualised by the bottom right graphs that show the variation of the CPX values along the sections.

### 4.3 Average CPX values per tyre type – see annex III

The results of the analysis per tyre type are given in annex III. It presents the variations of the CPX levels per tyre type as a function of the type of road surface and the trailer. The averages per trailer and the deviations of each trailer from the overall average are presented. Also the differences between the left and right mounting sides are given.
The specific observations per tyre type – speed combination are discussed in the next sub-sections. From these findings and the graphs in annex III it can be inferred that the deviations between the individual averages of the trailers / operators and the general average are clearly dependent of the trailer / operator and not significantly of the type of tyre or the test speed.
As may be expected the deviations of each trailer from the overall average are smaller for the reference circulation tyre set than for the other tyres.

Annex III also shows the difference between CPX levels of the left and the right mounted tyres. The left-right differences are smallest for the SRTT reference tyre set, and slightly bigger for the Avon tyres than for the SRTT tyres.

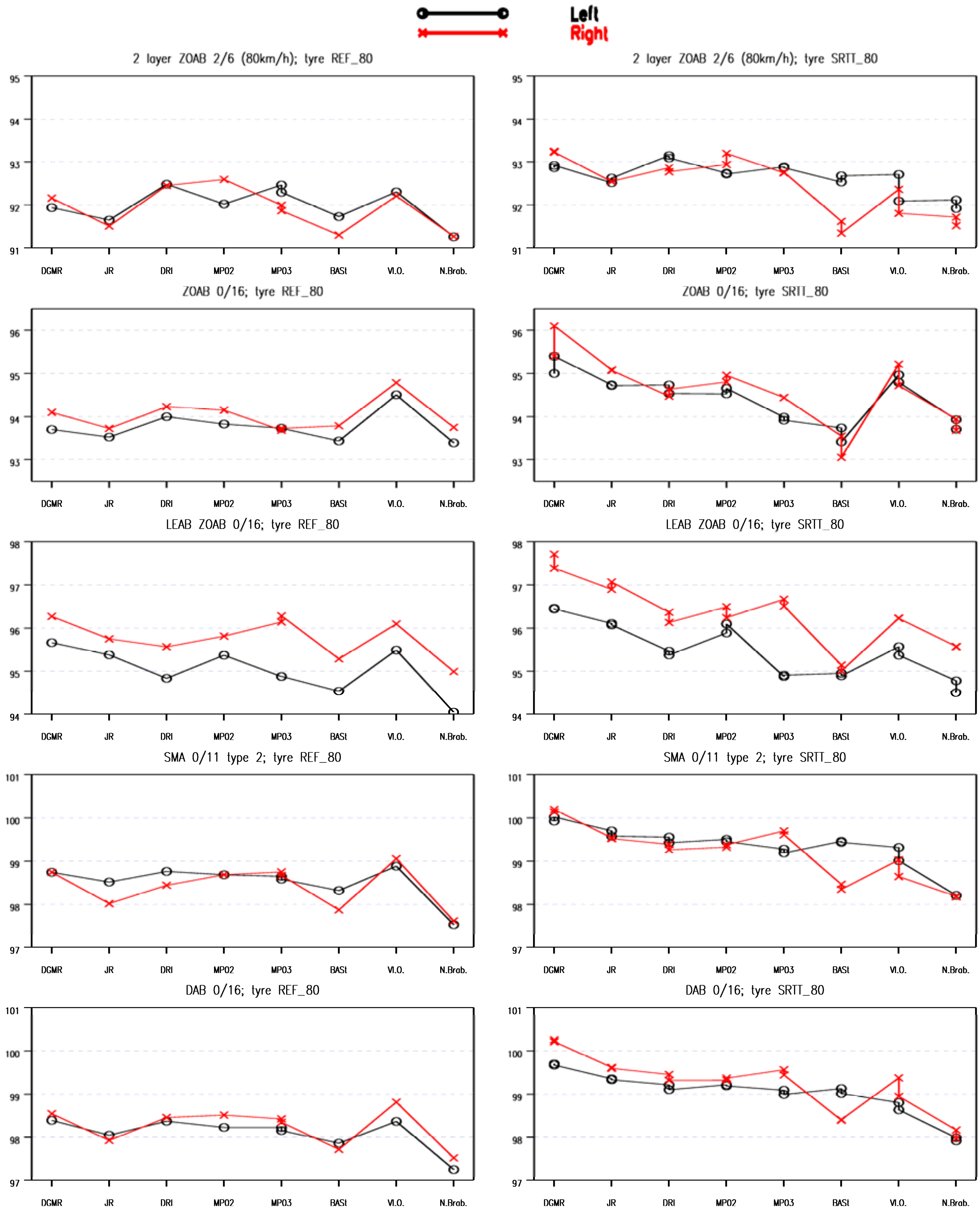



Figure 11. Average differences between left and right mounted test tyres, for 5 test section, for all trailers / operators; left-hand graphs: SRTT Reference tyres set; right-hand graphs: individual SRTT tyre sets

#### 4.3.1 SRTT reference circulation tyre set – 80 km/h

As the reference SRTT tyre set was used by all participants on all test sections in the same way, the test results with this tyre set represent directly the differences between the different trailers. On the open trailers (DGMR/Reubsaet and DRI) the reference tyre set is mounted in an inverse sense (left and right exchanged), because the wheel flanges are pointing inward. In order to maintain the direction of rotation, the left and right wheels must be exchanged.
The deviations between the individual results per test section and the general average per test section range from -0,90 to +0,77 dB.

#### 4.3.2 SRTT tyres – 50 km/h

The deviations from the mean of the individual results per test section for the SRTT tyre sets at 50 km/h range from -1,08to + 1,04 dB.

#### 4.3.3 SRTT tyres – 80 km/h

The deviations from the mean of the individual results per test section for the SRTT tyre sets at 80 km/h range from -1,07to + 1,10 dB.

#### 4.3.4 Avon AV 4 tyres – 50 km/h

The deviations from the mean of the individual results per test section for the Avon AV 4 tyre sets at 50 km/h range from-1,13to + 0,87 dB.

#### 4.3.5 Avon AV 4 tyres – 80 km/h

The deviations from the mean of the individual results per test section for the Avon AV 4 tyre sets at 80 km/h range from -1,36 to + 0,92 dB.

### 4.4 Spectral analysis of the average CPX levels per test section – see annex IV

In annex IV the spectral data in 1/3-octave bands are given in graphs for all test section / tyre/ speed combinations. The data are based on the overall averages of each section of the A-weighted 1/3 octave band levels.
The data are presented per test section with the data of the left mounted tyres printed in the left-hand column; the data of the right mounted tyres in right-hand column.

# 5 Acoustically relevant findings and conclusions

## 5.1 Differences between trailers

In the CPX comparison three different designs of trailers were involved: two open trailers constructed according to a design of DGMR / Reubsaet, four closed trailers with an absorbent hood constructed according to a design of M+P and one closed trailer with an absorbent hood constructed according to a design of Infrageluid. In table 7 the differences between the individual trailer results and the group average per test section are averaged over the different test sections and are sorted per trailer, per tyre type and speed.

In order to compare the acoustic characteristics of the trailers the data for the SRTT Reference tyre set are the most informative, because there is no bias due to tyre differences. The average differences range from - 0,72 to + 0,47 dB. For the open trailers the average is 0,08 dB; for the closed trailers of M+P design the average is 0,09 dB; for the closed trailer of Infrageluid design the value is – 0,72 dB. The standard deviations of the SRTT Reference tyre differences vary between 0,08 and 0,25 dB. When the individual tyres of the trailer operators are taken into account the findings do not change fundamentally: the range of average differences increases to -0,95 to + 0,67 dB, but the positions of various trailers within the range do not change much. This indicates that the deviations of the individual trailer results from the group average are predominantly systematic and not stochastic. There does not seem to be a distinct influence of the test speed on the average differences, but the standard deviations are slightly higher at 80 km/h than at 50 km/h.

**Table 7. Differences between individual CPX levels and the group averagesover the test sections, presented according to trailer, tyre type and speed.**

| Tyre type | Speed (km/h) | Difference | DGMR | Reubsaet | DRI | M+P02 | M+P03 | BASt | Vlaamse overheid | Noord-Brabant |
|---|---|---|---|---|---|---|---|---|---|---|
| SRTT Ref | 80 | **Average** | **0,24** | **-0,17** | **0,18** | **0,21** | **0,09** | **-0,40** | **0,47** | **-0,72** |
| | | Range | 0,54 | 0,55 | 0,69 | 0,22 | 0,43 | 0,23 | 0,49 | 0,59 |
| | | Stand. dev. | 0,21 | 0,20 | 0,25 | 0,08 | 0,15 | 0,09 | 0,18 | 0,24 |
| SRTT | 50 | **Average** | **0,89** | **0,32** | **0,20** | **0,29** | **0,04** | **-0,84** | **-0,06** | **-0,83** |
| | | Range | 0,41 | 0,37 | 0,35 | 0,10 | 0,20 | 0,36 | 0,58 | 0,58 |
| | | Stand. dev. | 0,16 | 0,15 | 0,13 | 0,04 | 0,10 | 0,17 | 0,25 | 0,23 |
| SRTT | 80 | **Average** | **0,85** | **0,34** | **0,15** | **0,23** | **0,03** | **-0,64** | **-0,08** | **-0,88** |
| | | Range | 0,59 | 0,62 | 0,49 | 0,19 | 0,57 | 0,74 | 0,72 | 0,42 |
| | | Stand. dev. | 0,22 | 0,22 | 0,18 | 0,08 | 0,25 | 0,33 | 0,29 | 0,19 |
| Avon AV4 | 50 | **Average** | **0,71** | **0,13** | **0,30** | **0,14** | **0,39** | **-0,25** | **-0,33** | **-1,08** |
| | | Range | 0,38 | 0,31 | 0,24 | 0,16 | 0,44 | 0,35 | 0,81 | 0,30 |
| | | Stand. dev. | 0,17 | 0,14 | 0,08 | 0,06 | 0,19 | 0,13 | 0,35 | 0,11 |
| Avon AV4 | 80 | **Average** | **0,64** | **0,15** | **0,18** | **0,42** | **0,44** | **-0,49** | **-0,51** | **-1,26** |
| | | Range | 0,50 | 0,51 | 0,22 | 0,35 | 0,71 | 0,51 | 1,02 | 0,25 |
| | | Stand. dev. | 0,20 | 0,18 | 0,10 | 0,13 | 0,25 | 0,18 | 0,38 | 0,10 |
| **Overall average** | | | **0,67** | **0,15** | **0,20** | **0,26** | **0,20** | **-0,52** | **-0,10** | **-0,95** |
| **Average standard deviation** | | | 0,19 | 0,18 | 0,15 | 0,08 | 0,19 | 0,18 | 0,29 | 0,17 |
| **Z-score** | | | **1.34** | **0.32** | **0.42** | **0.53** | **0.42** | **-1.00** | **-0.17** | **-1.85 *** |
| **CPX comparison 2008 - average differences** | | | | | | | | | | |
| SRTT Reference tyre | | | 0,18 | 0,18 | | 0,06 | | | | |
| Overall average SRTT + Avon | | | -0,29 | -0,32 | | 0,08 | | | | |

* When the recently determined device correction of the Noord-Brabant trailer would be applied its Z-score would presumably be lower than 1.

Comparing the current results with the findings from the previous CPX comparison for the three operators who participated in 2008, reveals only moderate changes. The average difference for DGMR seems to have increased compared to 2008, while positive and negative differences have switched for Reubsaet. Also the strong similarity between the results of DGMR and Reubsaet that was found in 2008 has disappeared in the new study. This may be caused by a different method of selection of 100 m segments within a test section. From annex V it may be inferred that the number of analysed segments per test section is not always equal for these two participants, even though they shared their measurement runs. Another influential factor may be that Reubsaet tries to minimise the contribution of the speed correction factor by selecting only test segments with small deviations from the preferred test speed, while DGMR includes more segments with deviating speeds within the tolerance band.

In table 7 the deviation of each trailer is also presented with the Z-score that is calculated by dividing the average deviation of a trailer by the standard deviation between the trailers.
The Z-scores constitute a normalised way of expressing the deviations and may be judged by the following criteria:

1) |Z-score| ≤ 1: very good;
2) |Z-score| ≤ 2: good;
3) |Z-score| ≤ 3: moderate;
4) |Z-score| > 3: poor.

**It can be concluded that all trailer operators involved in the comparison tests performed good or very good.**

## 5.2 Differences between left and right mounted tyres

**Table 8. Average differences between left and right mounted tyres per trailer and per tyre type.**

| Tyre type | Speed (km/h) | Difference | DGMR | Reubsaet | DRI | M+P0 2 | M+P0 3 | BASt | Vlaamse overheid | Noord-Brabant |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| SRTT Ref | 80 | **Average** | **-0,08** | **0,24** | **0,06** | **-0,12** | **-0,03** | **0,18** | **-0,08** | **-0,14** |
| | | Stand. dev. | 0,18 | 0,19 | 0,11 | 0,36 | 0,37 | 0,21 | 0,20 | 0,03 |
| SRTT | 50 | Average | -0,3 | -0,04 | 0,14 | 0 | -0,34 | 0,65 | -0,16 | 0,04 |
| | | Stand. dev. | 0,2 | 0,17 | 0,18 | 0,31 | 0,31 | 0,18 | 0,26 | 0,19 |
| | 80 | Average | -0,37 | -0,1 | 0,07 | -0,03 | -0,42 | 0,76 | 0,04 | 0,05 |
| | | Stand. dev. | 0,11 | 0,07 | 0,11 | 0,36 | 0,3 | 0,20 | 0,17 | 0,15 |
| | **SRTT Average** | | **-0,34** | **-0,07** | **0,11** | **-0,02** | **-0,38** | **0,71** | **-0,06** | **0,05** |
| | RMS avrg. stand. dev. | | 0,16 | 0,13 | 0,15 | 0,34 | 0,31 | 0,19 | 0,22 | 0,17 |
| Avon AV4 | 50 | Average | -0,38 | -0,1 | 0,57 | 0,1 | 0,17 | 0,27 | -0,73 | 0,09 |
| | | Stand. dev. | 0,15 | 0,15 | 0,07 | 0,32 | 0,29 | 0,10 | 0,10 | 0,16 |
| | 80 | Average | -0,52 | -0,26 | 0,71 | 0,7 | -0,23 | 0,61 | -0,63 | -0,16 |
| | | Stand. dev. | 0,09 | 0,17 | 0,32 | 0,2 | 0,22 | 0,33 | 0,83 | 0,08 |
| | **Avon AV4 Average** | | **-0,45** | **-0,18** | **0,64** | **0,40** | **-0,03** | **0,44** | **-0,68** | **-0,04** |
| | RMS avrg. stand. dev. | | 0,12 | 0,16 | 0,23 | 0,27 | 0,26 | 0,24 | 0,59 | 0,13 |
| **Overall average** | | | **-0,33** | **-0,05** | **0,31** | **0,13** | **-0,17** | **0,49** | **-0,31** | **-0,02** |
| **Average standard deviation** | | | **0,15** | **0,15** | **0,16** | **0,31** | **0,30** | **0,20** | **0,31** | **0,12** |

In the previous section the results were presented and discussed based on average CPX levels of left and right mounted tyres. Part of the variance between CPX levels is caused by differences between the left and right tyres. In this investigation this could not be evaluated with the analysis of variance method, because only one overall average result per test section was used in the analysis, so no variance could be determined.

The differences between left and right mounted tyres may be due to three causes:

- a difference between the characteristics of the left and the right tyre;
- a difference between the road surface characteristics in the left and the right wheel track;
- A difference between the measurement chains for the left and the right wheel microphones.

In order to assess the total of these effects, in table 8 the differences between the left and right mounted tyres are given as an average over the test sections with the standard deviations of these averages. The data are presented for each of the three tyres types. For the SRTT Reference tyres set the values range between - 0,14 and + 0,24 dB. For several trailers the left-right differences are larger for the individual tyre sets of SSRT and Avon AV4, but this phenomenon cannot be observed for all trailers.

No influence of the test speed on the left-right differences can be observed for the SRTT tyres and only a minor increase of the differences with speed for the Avon AV4 tyres. It is likely that this increase is caused by the less precise way of driving on the centre line of the lane at higher speeds, rather than by the tyre characteristics.

## 5.3 Overall average values of standard deviations per test tyre type

In annex II the standard deviations are given per tyre type and per test section, for single tyre measurements as well as for the average result of the left and right tyres. Both sets of standard deviations will be discussed hereafter. When these data are averaged over the test sections with the Root-Mean-Square method the values given in table 9 and table 11 are obtained.
The total standard deviations in these tables are a measure for the standard uncertainties that will be applicable for the reproducibility of CPX measurements under the circumstances that occurred during the CPX comparison test.
The residual is a combination of a number of effects such as: differences between left and right wheel-track, differences between the microphone positions at the left and right side of the trailer, differences between the two samples of the same type of tyre, measurement errors related to the left and right measurement equipment chains and to variations of the position of the driving line on the traffic lane.
The residual standard deviations are a measure for the standard uncertainties that apply for repeatability of CPX measurements.

### 5.3.1 Single tyre measurements(left or right)

In table 9 the RMS-average standard deviations are given for 100 m average CPX values of single tyre measurements, executed with the left or the right tyre.
As can be seen the standard deviations are smallest for the SRTT Reference tyre set, because differences between the test tyres are absent. For the other tyres the total standard deviations are approximately the same except for the Avon AV4 tyre at 80 km/h. The reason for this is not fully understood, but it may be related to the inhomogeneity of test sections 1 and 5, where a relatively large spread of results and a large difference between the left and right tyres was observed for the Avon AV 4 tyres (see annex II).

**Table 9. RMS averaged overall standard deviations for 100 m average values of single tyre measurements (left or right),according to sources of variance per tyre type and speed.**

| Source of variance | SRTT Ref | SRTT 50 km/h | SRTT 80 km/h | Avon AV4 50 km/h | Avon AV4 80 km/h |
|---|---|---|---|---|---|
| Trailer | 0,36 | 0,56 | 0,57 | 0,49 | 0,48 |
| Residual | 0,71 | 1,01 | 0,86 | 1,18 | 2,16 |
| **Total** | **0,80** | **1,15** | **1,03** | **1,28** | **2,21** |

The results in table 9 cannot be compared fully to the results that were obtained in the previous CPX comparison test in 2008.
In that investigation the variance caused by the differences between left and right mounted tyres could be evaluated as a separate source of variance. Because of this an additional component of the total standard deviation could be calculated. Table 10 gives the results that were obtained in 2008.

**Table 10. Overall standard deviations according to sources of variance per tyre type, as determined in the 2008 CPX comparison study.**

| Source of variance | SRTT Ref | SRTT | Avon AV4 |
|---|---|---|---|
| Trailer | 0,25 | 0,39 | 0,32 |
| Tyre mounting side | 0,47 | 0,68 | 0,83 |
| Residual | 0,29 | 0,41 | 0,32 |
| **Total** | **0,60** | **0,88** | **0,94** |

When comparing tables 9 and 10 one may conclude that the total standard deviations in the current study are somewhat larger than in 2008. This could be caused by the additional uncertainty caused by the variation in length and position of the measured road segments, in combination with the inhomogeneity of some of the road surfaces. This source of uncertainty did not exist in the 2008 study, because the data were corrected for the shift of the measured road surfaces.

### 5.3.2 Average results of left and right tyres

In table11 the RMS-average standard deviations are given for 100 m average CPX values that are obtained by averaging the results of the left and right tyre measurements.
Also for average results of both tyres sides the standard deviations are smallest for the SRTT Reference tyre set. Again the Avon AV4 tyre results at 80 km/h are out of line with the other tyres.

**Table 11. RMS averaged overall standard deviations for 100 m average values obtained by averaging the results of left and right tyre measurements, according to sources of variance per tyre type and speed.**

| Source of variance | SRTT Ref | SRTT 50 km/h | SRTT 80 km/h | Avon AV4 50 km/h | Avon AV4 80 km/h |
|---|---|---|---|---|---|
| Trailer | 0,41 | 0,58 | 0,58 | 0,54 | 0,62 |
| Residual | 0,38 | 0,56 | 0,52 | 0,63 | 0,84 |
| **Total** | **0,56** | **0,81** | **0,78** | **0,83** | **1,05** |

In the report of the 2008 trailer comparison [3] an estimate was given of the standard deviations that would occur in case of averaging of the left and right tyre results. This estimate is given in table 12. It was based on the assumption that the influence of the mounting side would be eliminated and that the residual standard deviation would be reduced by a factor $\sqrt{2}$, due to the averaging of the left and right tyre data. This assessment method is very similar to the one used to derive the values in table 11 (see section 4.2). Therefore a comparison between the data in tables 11 and 12 is relevant.
As can be seen the current data in table 11 are less favourable than the estimate from 2008.

**Table 12. Overall standard deviations according to sources of variance per tyre type, as determined in the 2008 CPX comparison study, for the averaged result of similar left and right tyres.**

| Source of variance | SRTT Ref | SRTT | Avon AV4 |
|---|---|---|---|
| Trailer | 0,25 | 0,39 | 0,32 |
| Tyre mounting side | - | - | - |
| Residual | 0,21 | 0,29 | 0,23 |
| **Total** | **0,32** | **0,49** | **0,39** |

The differences between the tables 11 and 12 are probably partially caused by the less well controlled methodology of the comparison tests in 2011. Other factors of influence may be:

- The larger number of trailers (8 in 2011 vs. 4 in 2008), causing more variation.
- Interaction between road surface inhomogeneities and tyre differences, causing a larger residual variance than was assumed in the theoretical estimate from 2008. The effects of tyre mounting side did not disappear completely, as was assumed in 2008, but contributed to a certain extent to the residual variance.

Probably the results obtained in 2011 are more realistic with respect to the measurement uncertaintiesthat will occur in uncontrolled comparisons of results of different operators. This will occur when road surface tests are repeated by another operator after a certain period of use of the road. If, however, more specific instructions are given concerning the length and location of the segments to be measured, and if the homogeneity of the road surface characteristics is good, measurement uncertainties as estimated in 2008, might be achievable.

## 5.4 General observations

The most important lesson learned from the first Dutch CPX comparison study in 2008 was that fundamental differences between the designs of the trailers (reflective hood vs. absorptive hood) were dominating the test results with respect to differences between trailers. This resulted in the recommendation either to standardise the design and construction principles of trailers, or to use correction factors to correct for the systematic differences introduced by the different design principles.
This cause for systematic differences did not occur in the current CPX comparison study. The trailers used were either open or closed with an absorbent hood, while the reflecting hood design was not involved.
This resulted in smaller differences between the trailers than in the previous study. Nevertheless the differences that were observed are predominantly of a systematic nature. In this study no explanations for such systematic differences were found. It may be useful for the participants to verify the results of the calibration of their trailers with the artificial noise source in a mock-up tyre. Also other checks of the operating procedure may useful to detect possible causes for systematic deviations.

The most important lesson learned from the trailer comparison in 2011 is thatwithout precise instructions or marking ofthe road segments to be measured a considerable variation of the starting points and length of the test sections will occur. This implies that the object of the investigation, being a road section, is not invariable between the different trailers in the investigation. This variation of the test object will interact with inhomogeneities of the road surface and add to the total variance of the results. This will produce a larger measurement uncertainty than would be the case without this contribution.

If the goal of the comparison test was to obtain realistic data concerning the spread of results that may occur in practice, the procedure followed in 2011 was useful. The freedom of interpretation in the 2011 comparison test was probably representative of general practice for the average road maintenance authority.

If, however, the goal was to produce reliable data concerning the measurement uncertainty of the CPX method in itself, without contributions from variations of the tested road sections, the procedure followed in 2011 was not adequate. For future comparison tests with the aim to evaluate the CPX method, a more controlled methodology would be advisable. Specifically, selection of road sections of sufficient length and sufficient homogeneity will be important issues.

# 6 Recommendations

## 6.1 Recommendations for reduction of measurement uncertainty of CPX tests

Based on the observations and conclusions discussed in chapter5 the following recommendations for adjustments to the CPX measurement procedures can be made:

- A significant source of measurement uncertainty proves to be the variation in length and position of the actually measured road segment. In fact this conclusion implies that different operators do not measure the same test object, but slightly different test objects. By developing stricter rules to determine which part of a road section shall be measured this source of uncertainty may be diminished.
  It is recommended to develop practical rules for the determination of the start and end locations of test segments as a function of the total length of a test section, taking into account the test speed to be used and the attainable acceleration of the towing vehicles.
- From a comparison of the average differences of the individual trailer results from the group average values it appeared that these differences have a predominantly systematic nature. This opens the possibility either to correct for these differences with an average correction factor or to investigate the individual procedures of the operators in detail and to check whether possible modifications of their operating procedure may reduce the systematic deviation.
  One aspect of the total procedure which may have a direct influence on the potential deviations from the average is the calibration test with an artificial sound source to assess the spectral correction factors for the influence of sound reflections within the hood of a closed trailer.
  Further factors that may be a cause for deviations are: temperature and speed corrections; variation (within the tolerance) of the microphone positions relative to the test tyre.
- There are indications that the speed correction procedure may introduce additional measurement uncertainties. It is recommended to investigate the accuracy of the current speed coefficient values used for the speed correction and to reconsider these values and the test speed tolerances, if necessary.

## 6.2 Recommendations for future CPX comparison tests

The CPX comparison study has revealed quite a few new facts and experiences concerning the possible differences between the participants with respect to the details of the test procedure. Although fairly extensive instructions for the execution of the CPX comparison tests were given in the memorandum describing the experimental approach [4], parts of the test procedure were not executed in the way it was intended by a number of participants.
The reason for this was that the instructions were interpreted in different ways.
Topics that would need further attention in future CPX comparison tests are addressed in the following recommendations:

- For the selection of test sections for CPX comparison tests emphasis should be on sufficient length of the section (preferably >2 km) and a good homogeneity of the road surface in lateral and longitudinal direction. This second aspect should be verified by executing a preliminary CPX test on all road sections that are up for selection;
- The definitions andinstructions concerning the length and location of the road segments that will be measured should be improved;
- A clear marking of the start and end points of road segments to be measured should be applied for all test sections;
- Unification of the methods and instruments for the determination of the length and the location of the actually measured road segments should be achieved by further elaboration of the instructions on this topic;
- Misunderstandings about the data processing should be avoided by giving a detailed flow chart of all calculation and corrections steps. The ISO standard may be too elaborate to enable

a clear and unambiguous choice of data processing steps, so this should be described in the experimental approach;

- The numbering of test runs should be related in a logical sense to the time stamps of the measurements;
- In the file name allocation for the test result files a version number should be included in order to distinguish earlier from later, corrected files;
- The report of the test results should include a specification of the corrections applied with respect to temperature, speed and the device dependent correction for the influence of reflections under the enclosure.
- The experimental approach should be discussed in detail during a briefing meeting shortly before the start of the CPX comparison tests with the staff members that will execute the tests. In that way possible misunderstandings and ambiguities can be detected and corrected.

# References


[1] ISO 11819-1:1997, “Acoustics – Measurement of the influence of road surfaces on traffic noise – Part 1:Statistical Pass-By method”, ISO, Geneva, 1997.

[2] 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.

[3] Roo, F. de, J. Telman, “Ringonderzoek CPX-meetaanhangers – Analyse van de resultaten”, TNO-report MON-RPT-033-DTS-2009-00414, TNO, Delft, 22 June 2009.

[4] Roo, F. de, G. Derksen, “CPX trailer comparison 2011 – Experimental approach – v4”, TNO-memorandum TNO-MEM-2011-01434-B, TNO, Delft, 24 August 2011.

[5] ISO CD/TS 11819-3, “Acoustics – Measurement of the influence of road surfaces on traffic noise – Part 3: Reference tyres”, document of ISO TC 43/SC 1/WG 33, xx Yyy 201?.

[6] ASTM F2493-06, “Standard Specification for 225/60 R16 97S Radial Standard Reference Test Tyres.

[7] Roo, F. de, J. Telman, G.J. van Blokland, J.J.A. van Leeuwen, J. Reubsaet, W.J. van Vliet, “Uncertainty of Close Proximity (CPX) tyre-road noise measurements – round robin test results”, Proceedings NAG/DAGA, Rotterdam, 2009, p.p. 510-513.

# Annex I Mapof the road sections in the test circuit

# Annex II Analysis of test data per test section

**Table II-1 – Overview of the total number of 100 m CPX values delivered by the different operators**

| | length of section (hm) | toplayer | | | | |
|---|---|---|---|---|---|---|
| | company | 2 layer ZOAB 2/6 | DAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | ZOAB 2/16 |
| AV4_50 | BASt | 17 | 13 | 5 | 9 | 3 |
| | DGMR | 15 | 11 | 4 | 8 | 3 |
| | DRI | 16 | 11 | 2 | 9 | 2 |
| | JR | 15 | 11 | 3 | 8 | 2 |
| | MP02 | 17 | 11 | 4 | 9 | 3 |
| | MP03 | 16 | 12 | 4 | 10 | 3 |
| | Noord-Brabant | 17 | 12 | 4 | 10 | 3 |
| | Vlaamse overheid | 15 | 9 | 2 | 4 | 1 |
| AV4_80 | BASt | 15 | 13 | 4 | 8 | 2 |
| | DGMR | 13 | 7 | 3 | 6 | 1 |
| | DRI | 13 | 11 | 2 | 7 | 2 |
| | JR | 13 | 7 | 3 | 5 | 1 |
| | MP02 | 17 | 11 | 4 | 9 | 3 |
| | MP03 1 | 16 | 12 | 4 | 10 | 3 |
| | MP03 2 | 16 | 12 | 4 | 10 | 3 |
| | Noord Brabant | 16 | 12 | 4 | 9 | 3 |
| | Vlaamse overheid | 12 | 9 | 2 | 4 | 1 |
| REF_80 | BASt | 15 | 13 | 4 | 8 | 2 |
| | DGMR | 13 | 7 | 3 | 5 | 1 |
| | DRI | 14 | 11 | 2 | 7 | 2 |
| | JR | 13 | 7 | 3 | 5 | 1 |
| | MP02 | 17 | 11 | 4 | 9 | 3 |
| | MP03 1 | 16 | 12 | 4 | 10 | 3 |
| | MP03 2 | 16 | 12 | 4 | 10 | 3 |
| | Noord-Brabant | 16 | 10 | 4 | 9 | 3 |
| | Vlaamse overheid | 13 | 9 | 2 | 4 | 1 |
| SRTT_50 | BASt | 17 | 13 | 5 | 9 | 3 |
| | DGMR | 15 | 11 | 4 | 8 | 3 |
| | DRI | 16 | 11 | 2 | 8 | 2 |
| | JR | 15 | 11 | 3 | 8 | 2 |
| | MP02 | 17 | 11 | 4 | 9 | 3 |
| | MP03 | 16 | 12 | 4 | 10 | 3 |
| | Noord-Brabant | 17 | 12 | 4 | 10 | 3 |
| | Vlaamse overheid | 15 | 9 | 2 | 4 | 1 |
| SRTT_80 | BASt | 15 | 13 | 4 | 8 | 2 |
| | | 15 | 13 | 4 | 9 | 2 |
| | DGMR | 13 | 7 | 3 | 6 | 1 |
| | | 13 | 7 | 3 | 6 | 1 |
| | DRI | 15 | 11 | 2 | 8 | 2 |
| | | 15 | 10 | 2 | 7 | 2 |
| | IR | 13 | 7 | 3 | 5 | 1 |
| | | 13 | 7 | 3 | 5 | 1 |
| | MP02 | 17 | 11 | 4 | 9 | 3 |
| | | 17 | 11 | 4 | 9 | 3 |
| | MP03 | 16 | 12 | 4 | 10 | 3 |
| | | 16 | 12 | 4 | 10 | 3 |
| | Noord-Brabant | 16 | 12 | 3 | 9 | 3 |
| | | 16 | 12 | 4 | 9 | 3 |
| | Vlaamse overheid | 12 | 9 | 1 | 4 | 1 |
| | | 11 | 9 | 1 | 4 | 1 |

# Table II-2 – CPX levels of test section 1: 2-Layer porous asphalt concrete – 2/6 mm – length 1,644 km

**2 layer ZOAB 2/6**

Mean

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 92,05 | 87,34 | 93,06 | 88,65 | 94,69 |
| JR | 91,58 | 86,79 | 92,56 | 88,11 | 94,15 |
| DRI | 92,46 | 86,91 | 92,97 | 88,45 | 94,54 |
| MP02 | 92,30 | 87,02 | 92,90 | 88,31 | 94,90 |
| MP03 1 | 92,23 | 86,83 | 92,81 | 88,65 | 94,98 |
| MP03 2 | 92,08 | | | | 95,00 |
| BASt | 91,52 | 85,81 | 92,04 | 87,96 | 93,49 |
| Vlaamse overheid | 92,25 | 86,77 | 92,24 | 88,02 | 93,72 |
| Noord Brabant | 91,27 | 86,28 | 91,82 | 87,09 | 92,95 |
| range | 1,04 | 1,21 | 1,08 | 1,57 | 2,06 |
| Stan dev | 0,41 | | | | |

Left-right

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | -0,22 | -0,76 | -0,34 | -0,45 | -1,72 |
| JR | 0,14 | -0,48 | 0,02 | -0,26 | -1,41 |
| DRI | 0,03 | 0,04 | 0,30 | 0,26 | 0,02 |
| MP02 | -0,57 | -0,81 | -0,34 | -0,58 | -0,59 |
| MP03 1 | 0,47 | -0,40 | 0,12 | 0,40 | -1,19 |
| MP03 2 | 0,42 | | | | -1,05 |
| BASt | 0,43 | 0,16 | 1,12 | 0,01 | -1,01 |
| Vlaamse overheid | 0,10 | -0,05 | 0,31 | -1,00 | -2,53 |
| Noord Brabant | -0,01 | -0,14 | 0,40 | -0,01 | -1,45 |
| range | 1,04 | 0,96 | 1,46 | 1,40 | 2,55 |
| mean | 0,10 | -0,33 | 0,17 | -0,23 | -1,19 |

Variances left or right side

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,16 | 0,17 | 0,19 | 0,20 | 0,26 |
| residual | 0,82 | 1,65 | 1,39 | 1,77 | 11,20 |
| total | 0,98 | 1,83 | 1,59 | 1,97 | 11,46 |

Standard deviation left or right side - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,40 | 0,42 | 0,44 | 0,45 | 0,51 |
| residual | 0,90 | 1,28 | 1,18 | 1,33 | 3,35 |
| total | 0,99 | 1,35 | 1,26 | 1,40 | 3,39 |

Variance corrected for side effects

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,16 | 0,19 | 0,19 | 0,21 | 0,46 |
| Residual | 0,85 | 1,06 | 1,25 | 1,67 | 2,89 |
| total | 1,01 | 1,25 | 1,45 | 1,88 | 3,36 |

Standard deviation for average of left and right tyres - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,40 | 0,44 | 0,44 | 0,46 | 0,68 |
| mean (left,right) | 0,65 | 0,73 | 0,79 | 0,91 | 1,20 |
| total | 0,77 | 0,85 | 0,91 | 1,02 | 1,38 |

left side

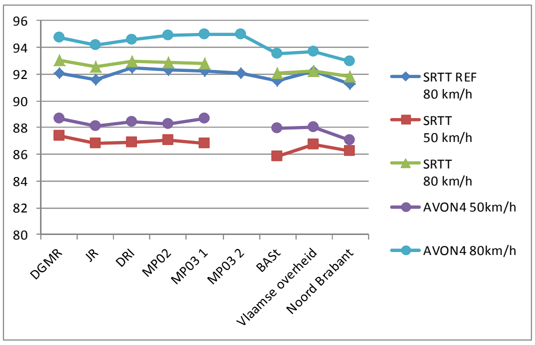
standarddeviation between 100m segments within testsection

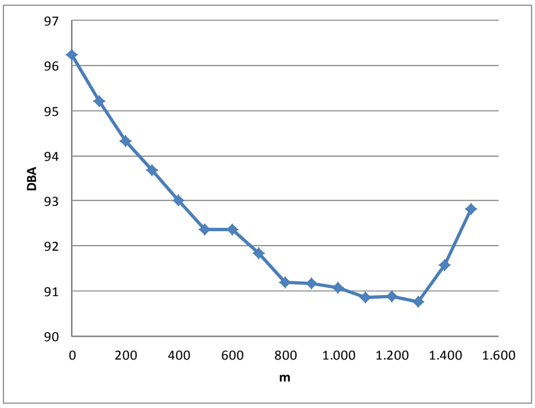
| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,97 | 1,19 | 0,77 | 0,95 | 0,68 |
| JR | 1,01 | 1,26 | 0,83 | 0,98 | 0,69 |
| DRI | 1,50 | 1,39 | 1,32 | 1,12 | 0,91 |
| MP02 | 1,58 | 1,36 | 1,42 | 1,14 | 1,39 |
| MP03 1 | 1,67 | 1,25 | 1,46 | 1,16 | 0,90 |
| MP03 2 | 1,53 | | | | 0,94 |
| BASt | 1,36 | 1,44 | 1,36 | 1,09 | 1,08 |
| Vlaamse ove | 1,07 | 1,26 | 0,98 | 0,95 | 0,69 |
| Noord Braba | 1,38 | 1,39 | 1,42 | 1,25 | 1,22 |

right side

standarddeviation between 100m segments within testsection

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,72 | 1,24 | 0,63 | 1,02 | 1,02 |
| JR | 0,76 | 1,32 | 0,69 | 1,23 | 1,05 |
| DRI | 1,24 | 1,45 | 1,28 | 1,34 | 1,31 |
| MP02 | 1,19 | 1,21 | 1,22 | 1,14 | 1,16 |
| MP03 1 | 1,30 | 1,44 | 1,32 | 1,25 | 1,11 |
| MP03 2 | 1,21 | | | | 1,17 |
| BASt | 1,02 | 1,42 | 1,11 | 1,19 | 1,12 |
| Vlaamse ove | 0,81 | 1,34 | 0,78 | 1,13 | 0,98 |
| Noord Braba | 1,24 | 1,46 | 1,23 | 1,39 | 1,27 |



# Table II-3 – CPX levels of test section 2:Porous asphalt concrete – 0/16 mm – length 0,292 km

**ZOAB 0/16**

Mean

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 93,90 | 89,69 | 95,48 | 88,97 | 94,80 |
| JR | 93,62 | 89,15 | 94,90 | 88,43 | 94,45 |
| DRI | 94,12 | 89,18 | 94,59 | 88,84 | 94,61 |
| MP02 | 93,99 | 89,07 | 94,74 | 88,48 | 94,73 |
| MP03 1 | 93,71 | 88,77 | 94,20 | 88,48 | 94,40 |
| MP03 2 | 93,73 | | | | 94,34 |
| BASt | 93,61 | 88,00 | 93,44 | 88,11 | 93,83 |
| Noord Brabant | 93,57 | 87,92 | 93,82 | 87,51 | 93,20 |
| Vlaamse overheid | 94,65 | 88,90 | 94,92 | 88,48 | 94,43 |
| range | 1,08 | 1,77 | 2,04 | 1,46 | 1,60 |

Left-right

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | -0,40 | -0,87 | -0,55 | -0,79 | -1,00 |
| JR | -0,20 | -0,67 | -0,35 | -0,50 | -0,96 |
| DRI | -0,23 | -0,40 | 0,08 | 0,22 | 0,15 |
| MP02 | -0,33 | -0,47 | -0,29 | -0,38 | 0,01 |
| MP03 1 | 0,05 | -0,34 | -0,49 | -0,23 | -0,56 |
| MP03 2 | 0,00 | | | | -0,76 |
| BASt | -0,35 | 0,02 | 0,28 | -0,08 | -0,11 |
| Vlaamse overheid | -0,28 | -0,49 | -0,09 | -1,01 | 0,00 |
| Noord Brabant | -0,36 | -0,15 | 0,01 | -0,26 | -0,58 |
| range | 0,45 | 0,89 | 0,83 | 1,23 | 1,15 |
| mean | -0,22 | -0,46 | -0,20 | -0,40 | -0,40 |

Variances left or right side

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,10 | 0,33 | 0,42 | 0,17 | 0,24 |
| residual | 0,07 | 0,29 | 0,11 | 0,26 | 0,27 |
| total | 0,17 | 0,62 | 0,53 | 0,42 | 0,52 |

Standarddeviation left or right side - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,31 | 0,57 | 0,64 | 0,41 | 0,49 |
| residual | 0,27 | 0,54 | 0,34 | 0,51 | 0,52 |
| total | 0,41 | 0,79 | 0,73 | 0,65 | 0,72 |

Variance corrected for side effects

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,12 | 0,35 | 0,42 | 0,18 | 0,26 |
| Residual | 0,03 | 0,11 | 0,10 | 0,14 | 0,14 |
| total | 0,15 | 0,46 | 0,52 | 0,32 | 0,41 |

Standard deviation for average of left and right tyres - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,34 | 0,59 | 0,65 | 0,43 | 0,51 |
| mean (left,right) | 0,12 | 0,24 | 0,22 | 0,26 | 0,27 |
| total | 0,36 | 0,64 | 0,68 | 0,50 | 0,58 |

left side

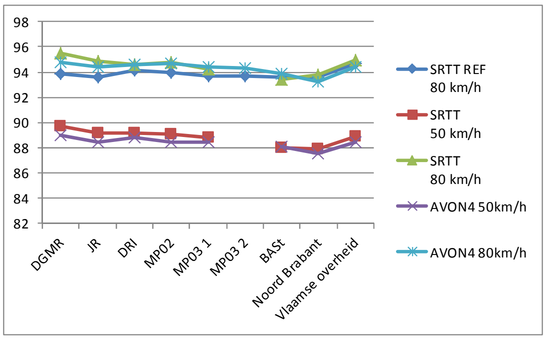
standarddeviation between 100m segments within testsection

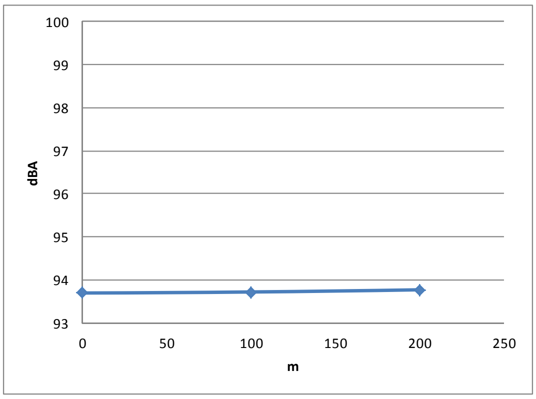
| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,00 | 0,24 | 0,00 | 0,19 | 0,00 |
| JR | 0,00 | 0,22 | 0,00 | 0,02 | 0,00 |
| DRI | 0,14 | 0,02 | 0,26 | 0,17 | 0,13 |
| MP02 | 0,14 | 0,14 | 0,17 | 0,23 | 0,27 |
| MP03 1 | 0,04 | 0,04 | 0,05 | 0,20 | 0,06 |
| MP03 2 | 0,08 | | | | 0,09 |
| BASt | 0,03 | 0,35 | 0,07 | 0,29 | 0,26 |
| Noord Braba | 0,27 | 0,12 | 0,17 | 0,15 | 0,25 |
| Vlaamse ove | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |

right side

standarddeviation between 100m segments within testsection

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,00 | 0,44 | 0,00 | 0,34 | 0,00 |
| JR | 0,00 | 0,09 | 0,00 | 0,11 | 0,00 |
| DRI | 0,08 | 0,00 | 0,24 | 0,09 | 0,24 |
| MP02 | 0,33 | 0,21 | 0,44 | 0,21 | 0,03 |
| MP03 1 | 0,22 | 0,14 | 0,12 | 0,09 | 0,14 |
| MP03 2 | 0,23 | | | | 0,28 |
| BASt | 0,21 | 0,22 | 0,15 | 0,35 | 0,06 |
| Vlaamse ove | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Noord Braba | 0,22 | 0,06 | 0,23 | 0,24 | 0,17 |



## Table II-4 – CPX levels of test section 3:Low energy porous asphalt concrete – 0/16 mm – length 0,416 km

**LEAB ZOAB 0/16**

Mean

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 95,97 | 90,71 | 97,00 | 90,35 | 96,69 |
| JR | 95,56 | 90,11 | 96,53 | 89,72 | 96,17 |
| DRI | 95,20 | 89,67 | 95,83 | 89,82 | 96,04 |
| MP02 | 95,59 | 89,95 | 96,18 | 89,63 | 96,37 |
| MP03 1 | 95,51 | 89,60 | 95,74 | 89,88 | 96,35 |
| MP03 2 | 95,58 | | | | 96,31 |
| BASt | 94,91 | 88,59 | 95,00 | 89,09 | 95,69 |
| Vlaamse overheid | 95,79 | 89,91 | 95,85 | 89,36 | 95,33 |
| Noord Brabant | 94,52 | 88,83 | 95,10 | 88,44 | 94,70 |
| range | 1,06 | 2,12 | 2,00 | 1,26 | 1,36 |

Left-right

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | -0,61 | -0,86 | -1,10 | -1,22 | -2,04 |
| JR | -0,37 | -0,80 | -0,89 | -0,90 | -1,72 |
| DRI | -0,74 | -0,97 | -0,83 | -0,40 | -1,01 |
| MP02 | -0,44 | -0,58 | -0,38 | -0,93 | -0,74 |
| MP03 1 | -1,27 | -1,56 | -1,70 | -1,24 | -1,95 |
| MP03 2 | -1,41 | | | | -1,79 |
| BASt | -0,76 | -0,04 | -0,15 | -0,58 | -0,47 |
| Vlaamse overheid | -0,60 | -1,26 | -0,76 | -1,68 | -1,30 |
| Noord Brabant | -0,95 | -1,07 | -0,94 | -1,21 | -1,62 |
| range | 1,04 | 1,52 | 1,54 | 1,29 | 1,57 |
| mean | -0,77 | -0,87 | -0,83 | -0,99 | -1,38 |

Variances left or right side

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,07 | 0,34 | 0,40 | 0,14 | 0,03 |
| residual | 1,19 | 1,49 | 0,99 | 1,81 | 3,19 |
| total | 1,26 | 1,82 | 1,39 | 1,95 | 3,22 |

Standarddeviation left or right side - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,27 | 0,58 | 0,63 | 0,38 | 0,18 |
| residual | 1,09 | 1,22 | 1,00 | 1,35 | 1,79 |
| total | 1,12 | 1,35 | 1,18 | 1,40 | 1,80 |

Variance corrected for side effects

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,20 | 0,43 | 0,44 | 0,31 | 0,35 |
| Residual | 0,21 | 0,43 | 0,29 | 0,22 | 0,50 |
| total | 0,41 | 0,86 | 0,73 | 0,53 | 0,85 |

Standard deviation for average of left and right tyres - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,45 | 0,66 | 0,66 | 0,56 | 0,59 |
| mean (left,right) | 0,32 | 0,46 | 0,38 | 0,33 | 0,50 |
| total | 0,55 | 0,80 | 0,77 | 0,65 | 0,78 |

left side

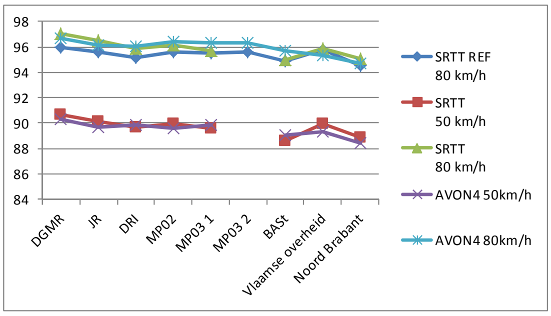
standarddeviation between 100m segments within testsection

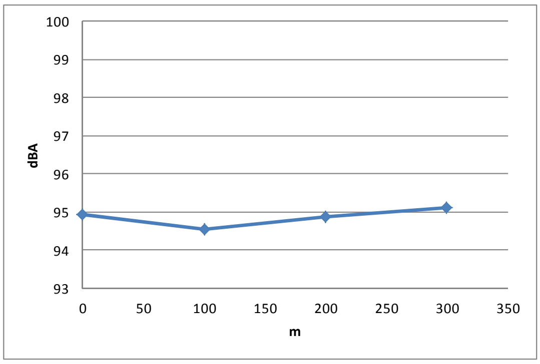
| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| JR | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| DRI | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| MP02 | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| MP03 1 | 0,24 | 0,14 | 0,20 | 0,28 | 0,30 |
| MP03 2 | 0,32 | | | | 0,22 |
| BASt | 0,21 | 0,28 | 0,43 | 0,19 | 0,11 |
| Vlaamse ove | 0,15 | 0,02 | 0,00 | 0,06 | 0,27 |
| Noord Braba | 0,11 | 0,19 | 0,14 | 0,30 | 0,18 |

right side

standarddeviation between 100m segments within testsection

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| JR | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| DRI | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| MP02 | 0,31 | 0,32 | 0,45 | 0,34 | 0,30 |
| MP03 1 | 0,38 | 0,23 | 0,33 | 0,14 | 0,30 |
| MP03 2 | 0,27 | | | | 0,40 |
| BASt | 0,38 | 0,35 | 0,47 | 0,44 | 0,41 |
| Vlaamse ove | 0,28 | 0,21 | 0,00 | 0,04 | 0,21 |
| Noord Braba | 0,14 | 0,17 | 0,31 | 0,17 | 0,24 |



# Table II-5 – CPX levels of test section 4:Stone Mastic Asphalt– 1/11 mm – length 0,950 km

**SMA 0/11**

Mean

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 98,74 | 93,47 | 100,07 | 93,19 | 100,04 |
| JR | 98,27 | 92,95 | 99,58 | 92,61 | 99,51 |
| DRI | 98,60 | 92,71 | 99,41 | 92,64 | 99,22 |
| MP02 | 98,68 | 92,80 | 99,41 | 92,59 | 99,48 |
| MP03 1 | 98,70 | 92,62 | 99,44 | 92,87 | 99,69 |
| MP03 2 | 98,62 | | | | 99,51 |
| BASt | 98,09 | 91,80 | 98,92 | 92,13 | 98,62 |
| Vlaamse overheid | 98,97 | 92,22 | 99,00 | 91,62 | 98,22 |
| Noord Brabant | 97,57 | 91,57 | 98,19 | 91,23 | 97,76 |
| range | 0,87 | 1,67 | 1,14 | 1,57 | 1,82 |

Left-right

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,00 | -0,40 | -0,19 | -0,82 | -1,28 |
| JR | 0,50 | -0,11 | 0,11 | -0,53 | -0,96 |
| DRI | 0,32 | 0,15 | 0,17 | 0,17 | -0,27 |
| MP02 | 0,00 | 0,02 | 0,13 | -0,01 | -0,03 |
| MP03 1 | -0,10 | -0,63 | -0,42 | -0,29 | -1,12 |
| MP03 2 | -0,09 | | | | -1,11 |
| BASt | 0,45 | 0,61 | 1,04 | -0,19 | -0,08 |
| Vlaamse overheid | -0,17 | -0,42 | 0,33 | -1,06 | -1,96 |
| Noord Brabant | -0,09 | -0,24 | 0,03 | -0,27 | -1,03 |
| range | 0,67 | 1,24 | 1,46 | 1,23 | 1,93 |
| mean | 0,11 | -0,11 | 0,17 | -0,39 | -0,85 |

Variances left or right side

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,19 | 0,36 | 0,29 | 0,37 | 0,39 |
| residual | 0,20 | 0,63 | 0,54 | 0,89 | 3,25 |
| total | 0,39 | 0,98 | 0,83 | 1,26 | 3,63 |

Standard deviation left or right side - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,43 | 0,60 | 0,54 | 0,61 | 0,62 |
| residual | 0,45 | 0,79 | 0,73 | 0,94 | 1,80 |
| total | 0,62 | 0,99 | 0,91 | 1,12 | 1,91 |

Variance corrected for side effects

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,19 | 0,36 | 0,29 | 0,39 | 0,52 |
| Residual | 0,20 | 0,65 | 0,52 | 0,56 | 1,19 |
| total | 0,39 | 1,01 | 0,81 | 0,95 | 1,71 |

Standard deviation for average of left and right tyres - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,43 | 0,60 | 0,54 | 0,63 | 0,72 |
| mean (left,right) | 0,32 | 0,57 | 0,51 | 0,53 | 0,77 |
| total | 0,54 | 0,83 | 0,74 | 0,82 | 1,06 |

left side

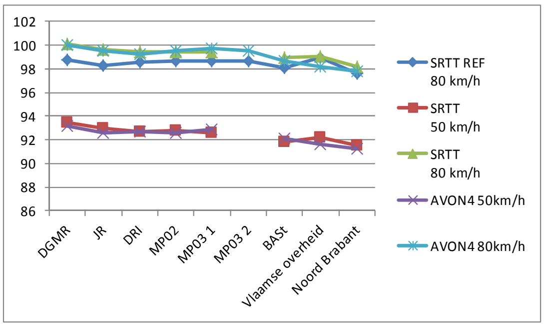
standarddeviation between 100m segments within testsection

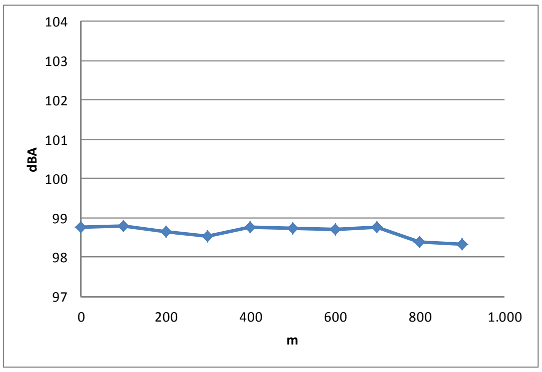
| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,16 | 0,10 | 0,15 | 0,08 | 0,27 |
| JR | 0,14 | 0,11 | 0,12 | 0,08 | 0,17 |
| DRI | 0,11 | 0,16 | 0,14 | 0,09 | 0,30 |
| MP02 | 0,18 | 0,08 | 0,20 | 0,08 | 0,46 |
| MP03 1 | 0,17 | 0,13 | 0,34 | 0,20 | 0,33 |
| MP03 2 | 0,21 | | | | 0,28 |
| BASt | 0,15 | 0,11 | 0,10 | 0,12 | 0,13 |
| Vlaamse ove | 0,03 | 0,01 | 0,16 | 0,04 | 0,39 |
| Noord Braba | 0,16 | 0,17 | 0,19 | 0,11 | 0,10 |

right side

standarddeviation between 100m segments within testsection

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,16 | 0,14 | 0,36 | 0,09 | 0,25 |
| JR | 0,62 | 0,14 | 0,44 | 0,09 | 0,24 |
| DRI | 0,39 | 0,20 | 0,36 | 0,10 | 0,17 |
| MP02 | 0,37 | 0,12 | 0,26 | 0,17 | 0,24 |
| MP03 1 | 0,27 | 0,13 | 0,21 | 0,17 | 0,34 |
| MP03 2 | 0,39 | | | | 0,28 |
| BASt | 0,45 | 0,22 | 0,38 | 0,13 | 0,18 |
| Vlaamse ove | 0,44 | 0,14 | 0,36 | 0,00 | 0,45 |
| Noord Braba | 0,32 | 0,20 | 0,21 | 0,12 | 0,26 |



# Table II-6 – CPX levels of test section 5:Dense asphalt concrete – 0/16 mm – length 1,200 km

**DAB 0/16**

Mean

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 98,47 | 93,22 | 99,96 | 92,89 | 99,38 |
| JR | 97,99 | 92,58 | 99,47 | 92,27 | 98,86 |
| DRI | 98,41 | 92,52 | 99,27 | 92,21 | 98,86 |
| MP02 | 98,37 | 92,60 | 99,27 | 92,14 | 99,02 |
| MP03 1 | 98,33 | 92,38 | 99,27 | 92,52 | 99,38 |
| MP03 2 | 98,25 | | | | 99,23 |
| BASt | 97,79 | 91,60 | 98,74 | 91,93 | 98,31 |
| Vlaamse overheid | 98,59 | 91,91 | 98,94 | 91,36 | 98,14 |
| Noord Brabant | 97,39 | 91,23 | 98,01 | 90,82 | 97,47 |
| range | 0,80 | 1,63 | 1,22 | 1,53 | 1,25 |

left side

standarddeviation between 100m sections within testsection

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,67 | 0,47 | 0,77 | 0,31 | 0,58 |
| JR | 0,62 | 0,46 | 0,72 | 0,30 | 0,65 |
| DRI | 0,51 | 0,58 | 0,60 | 0,44 | 0,48 |
| MP02 | 0,62 | 0,54 | 0,72 | 0,36 | 0,77 |
| MP03 1 | 0,61 | 0,56 | 0,66 | 0,30 | 0,38 |
| MP03 2 | 0,55 | | | | 0,50 |
| BASt | 0,54 | 0,54 | 0,52 | 0,36 | 0,52 |
| Vlaamse ove | 0,74 | 0,53 | 0,71 | 0,41 | 0,58 |
| Noord Braba | 0,70 | 0,54 | 0,59 | 0,32 | 0,50 |

Left-right

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | -0,15 | -0,58 | -0,55 | -1,03 | -1,40 |
| JR | 0,12 | -0,11 | -0,26 | -0,73 | -1,09 |
| DRI | -0,09 | -0,09 | -0,23 | 0,18 | -0,20 |
| MP02 | -0,29 | -0,13 | -0,14 | -0,02 | 0,01 |
| MP03 1 | -0,20 | -0,73 | -0,46 | -0,25 | -1,24 |
| MP03 2 | -0,19 | | | | -1,15 |
| BASt | 0,14 | 0,49 | 0,67 | -0,23 | -0,10 |
| Vlaamse overheid | -0,45 | -0,56 | -0,44 | -1,32 | -2,21 |
| Noord Brabant | -0,27 | -0,21 | -0,12 | -0,24 | -0,96 |
| range | 0,59 | 1,22 | 1,21 | 1,50 | 2,22 |
| mean | -0,14 | -0,25 | -0,20 | -0,48 | -0,92 |

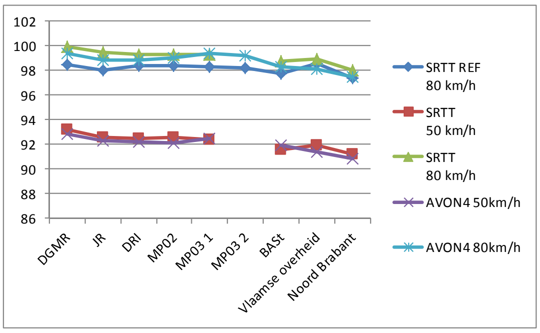
right side

standarddeviation between 100m sections within testsection

| trailer | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| DGMR | 0,65 | 0,38 | 0,73 | 0,36 | 0,50 |
| JR | 0,62 | 0,35 | 0,66 | 0,35 | 0,44 |
| DRI | 0,54 | 0,46 | 0,49 | 0,37 | 0,36 |
| MP02 | 0,51 | 0,46 | 0,51 | 0,28 | 0,30 |
| MP03 1 | 0,66 | 0,52 | 0,63 | 0,37 | 0,16 |
| MP03 2 | 0,66 | | | | 0,20 |
| BASt | 0,52 | 0,51 | 0,59 | 0,40 | 0,48 |
| Vlaamse ove | 0,53 | 0,41 | 0,48 | 0,33 | 0,30 |
| Noord Braba | 0,63 | 0,53 | 0,60 | 0,38 | 0,31 |

Variances left or right side

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,15 | 0,36 | 0,31 | 0,33 | 0,22 |
| residual | 0,25 | 1,06 | 0,64 | 2,21 | 5,37 |
| total | 0,41 | 1,42 | 0,95 | 2,54 | 5,59 |

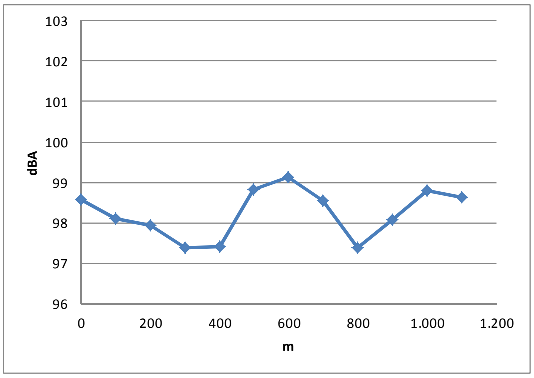



Standard deviation left or right side - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,39 | 0,60 | 0,56 | 0,58 | 0,47 |
| residual | 0,50 | 1,03 | 0,80 | 1,49 | 2,32 |
| total | 0,64 | 1,19 | 0,97 | 1,60 | 2,36 |

Variance corrected for side effects

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,16 | 0,37 | 0,31 | 0,37 | 0,33 |
| Residual | 0,17 | 0,89 | 0,59 | 1,38 | 2,33 |
| total | 0,32 | 1,26 | 0,90 | 1,74 | 2,66 |




Standard deviation for average of left and right tyres - 100 m segments

| | SRTT REF 80 km/h | SRTT 50 km/h | SRTT 80 km/h | AVON4 50km/h | AVON4 80km/h |
|---|---|---|---|---|---|
| Trailer | 0,40 | 0,61 | 0,56 | 0,61 | 0,57 |
| mean (left,right) | 0,29 | 0,67 | 0,54 | 0,83 | 1,08 |
| total | 0,49 | 0,90 | 0,78 | 1,03 | 1,22 |

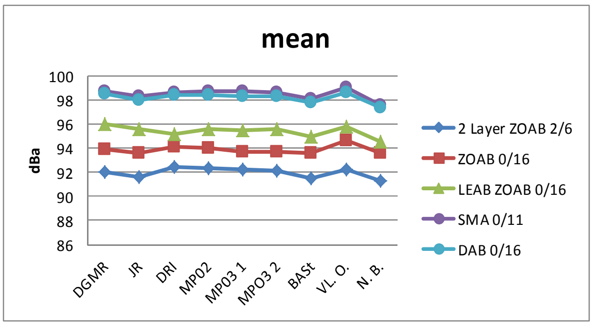
## Annex III Analysis of test data per tyre type



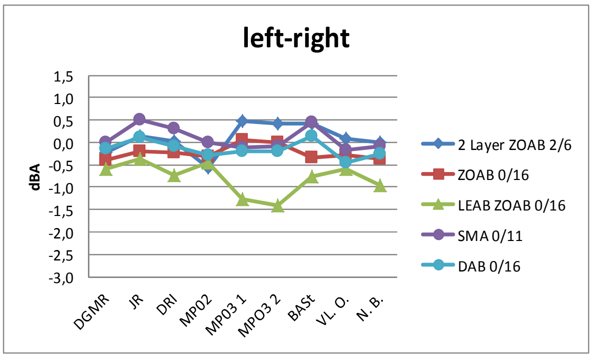
### Table III-1 – SRTT reference circulation tyre set – 80 km/h

SRTT ref 80 km/h

| Mean | 2 Layer ZOAB 2/6 | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 92,05 | 93,90 | 95,97 | 98,74 | 98,47 |
| JR | 91,58 | 93,62 | 95,56 | 98,27 | 97,99 |
| DRI | 92,46 | 94,12 | 95,20 | 98,60 | 98,41 |
| MP02 | 92,30 | 93,99 | 95,59 | 98,68 | 98,37 |
| MP03 1 | 92,23 | 93,71 | 95,51 | 98,70 | 98,33 |
| MPO3 2 | 92,08 | 93,73 | 95,58 | 98,62 | 98,25 |
| BASt | 91,52 | 93,61 | 94,91 | 98,09 | 97,79 |
| VL. O. | 92,25 | 94,65 | 95,79 | 98,97 | 98,59 |
| N. B. | 91,27 | 93,57 | 94,52 | 97,57 | 97,39 |
| overall mean | 91,97 | 93,88 | 95,40 | 98,47 | 98,18 |

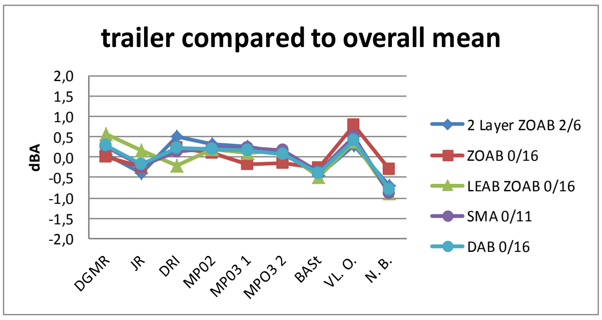



| Left-Right | 2 Layer ZOAB 2/6 | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | -0,22 | -0,40 | -0,61 | 0,00 | -0,15 |
| JR | 0,14 | -0,20 | -0,37 | 0,50 | 0,12 |
| DRI | 0,03 | -0,23 | -0,74 | 0,32 | -0,09 |
| MP02 | -0,57 | -0,33 | -0,44 | 0,00 | -0,29 |
| MP03 1 | 0,47 | 0,05 | -1,27 | -0,10 | -0,20 |
| MPO3 2 | 0,42 | 0,00 | -1,41 | -0,09 | -0,19 |
| BASt | 0,43 | -0,35 | -0,76 | 0,45 | 0,14 |
| VL. O. | 0,10 | -0,28 | -0,60 | -0,17 | -0,45 |
| N. B. | -0,01 | -0,36 | -0,95 | -0,09 | -0,27 |




| | | | | | |
|---|---|---|---|---|---|
| overall mean | 91,97 | 93,88 | 95,40 | 98,47 | 98,18 |

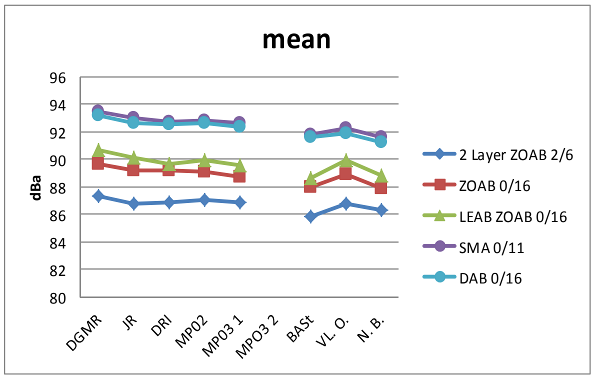
| trailer compared to overall mean | 2 Layer ZOAB 2/6 | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 0,08 | 0,02 | 0,56 | 0,27 | 0,29 |
| JR | -0,39 | -0,25 | 0,16 | -0,21 | -0,19 |
| DRI | 0,49 | 0,24 | -0,20 | 0,13 | 0,24 |
| MP02 | 0,33 | 0,11 | 0,19 | 0,21 | 0,19 |
| MP03 1 | 0,26 | -0,17 | 0,10 | 0,22 | 0,15 |
| MPO3 2 | 0,11 | -0,15 | 0,18 | 0,15 | 0,07 |
| BASt | -0,45 | -0,27 | -0,50 | -0,38 | -0,39 |
| VL. O. | 0,28 | 0,77 | 0,39 | 0,50 | 0,41 |
| N. B. | -0,70 | -0,31 | -0,89 | -0,90 | -0,79 |



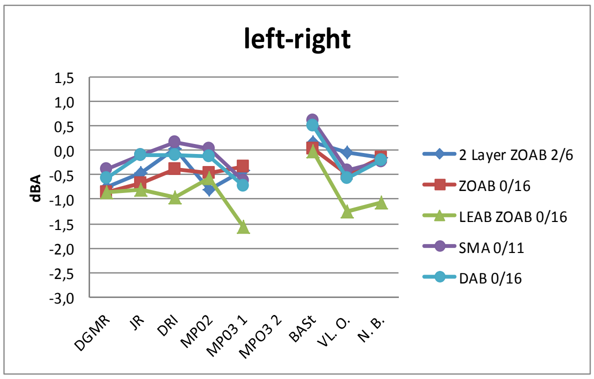
# Table III-2 – SRTT tyres – 50 km/h

**SRTT 50 km/h**

| Mean | 2 Layer ZOAB 2/6 | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 87,34 | 89,69 | 90,71 | 93,47 | 93,22 |
| JR | 86,79 | 89,15 | 90,11 | 92,95 | 92,58 |
| DRI | 86,91 | 89,18 | 89,67 | 92,71 | 92,52 |
| MP02 | 87,02 | 89,07 | 89,95 | 92,80 | 92,60 |
| MP03 1 | 86,83 | 88,77 | 89,60 | 92,62 | 92,38 |
| MPO3 2 | | | | | |
| BASt | 85,81 | 88,00 | 88,59 | 91,80 | 91,60 |
| VL. O. | 86,77 | 88,90 | 89,91 | 92,22 | 91,91 |
| N. B. | 86,28 | 87,92 | 88,83 | 91,57 | 91,23 |
| overall mean | 86,72 | 88,84 | 89,67 | 92,52 | 92,26 |

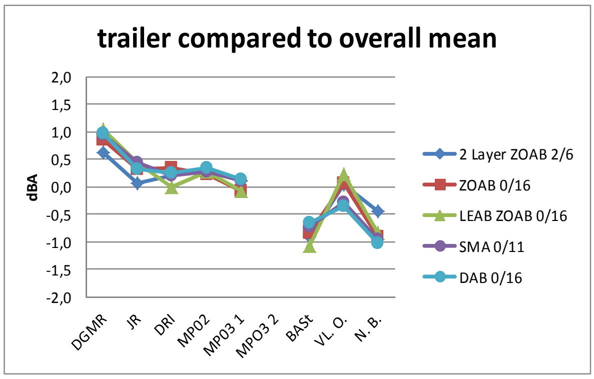



| Left-Right | 2 Layer ZOAB 2/6 | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | -0,76 | -0,87 | -0,86 | -0,40 | -0,58 |
| JR | -0,48 | -0,67 | -0,80 | -0,11 | -0,11 |
| DRI | 0,04 | -0,40 | -0,97 | 0,15 | -0,09 |
| MP02 | -0,81 | -0,47 | -0,58 | 0,02 | -0,13 |
| MP03 1 | -0,40 | -0,34 | -1,56 | -0,63 | -0,73 |
| MPO3 2 | | | | | |
| BASt | 0,16 | 0,02 | -0,04 | 0,61 | 0,49 |
| VL. O. | -0,05 | -0,49 | -1,26 | -0,42 | -0,56 |
| N. B. | -0,14 | -0,15 | -1,07 | -0,24 | -0,21 |




| | | | | | |
|---|---|---|---|---|---|
| overall mean | 86,72 | 88,84 | 89,67 | 92,52 | 92,26 |

| trailer compared to overall mean | 2 Layer ZOAB 2/6 | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 0,63 | 0,85 | 1,04 | 0,95 | 0,97 |
| JR | 0,07 | 0,32 | 0,44 | 0,43 | 0,32 |
| DRI | 0,20 | 0,35 | 0,00 | 0,19 | 0,26 |
| MP02 | 0,30 | 0,24 | 0,28 | 0,28 | 0,34 |
| MP03 1 | 0,11 | -0,07 | -0,07 | 0,10 | 0,13 |
| MPO3 2 | | | | | |
| BASt | -0,91 | -0,83 | -1,08 | -0,72 | -0,66 |
| VL. O. | 0,05 | 0,07 | 0,23 | -0,29 | -0,35 |
| N. B. | -0,44 | -0,92 | -0,84 | -0,95 | -1,02 |



## Table III-3 – SRTT tyres – 80 km/h

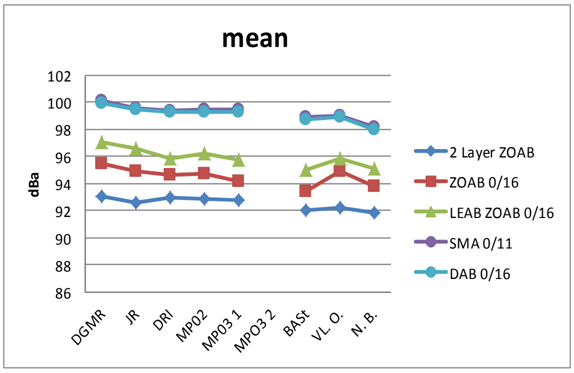
**SRTT 80 km/h**

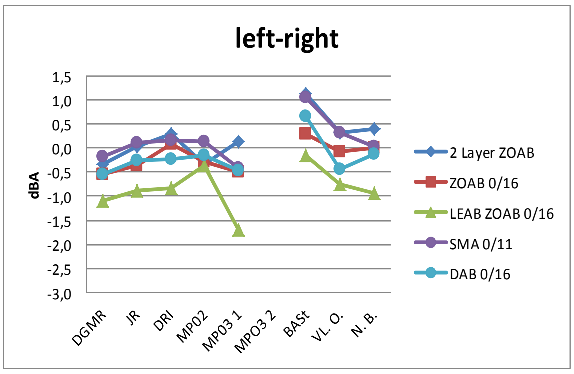
| Mean | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 93,06 | 95,48 | 97,00 | 100,07 | 99,96 |
| JR | 92,56 | 94,90 | 96,53 | 99,58 | 99,47 |
| DRI | 92,97 | 94,59 | 95,83 | 99,41 | 99,27 |
| MP02 | 92,90 | 94,74 | 96,18 | 99,41 | 99,27 |
| MP03 1 | 92,81 | 94,20 | 95,74 | 99,44 | 99,27 |
| MPO3 2 | | | | | |
| BASt | 92,04 | 93,44 | 95,00 | 98,92 | 98,74 |
| VL. O. | 92,24 | 94,92 | 95,85 | 99,00 | 98,94 |
| N. B. | 91,82 | 93,82 | 95,10 | 98,19 | 98,01 |
| overall mean | 92,55 | 94,51 | 95,90 | 99,25 | 99,12 |

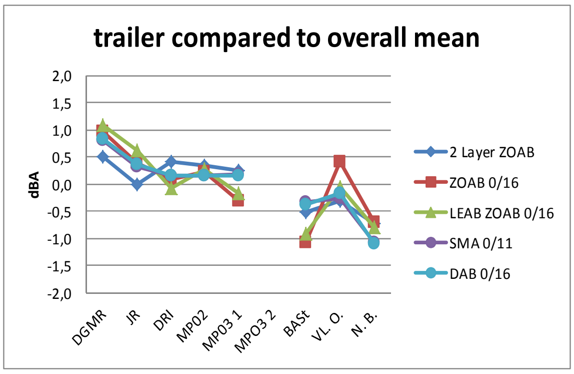
| Left-Right | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | -0,34 | -0,55 | -1,10 | -0,19 | -0,55 |
| JR | 0,02 | -0,35 | -0,89 | 0,11 | -0,26 |
| DRI | 0,30 | 0,08 | -0,83 | 0,17 | -0,23 |
| MP02 | -0,34 | -0,29 | -0,38 | 0,13 | -0,14 |
| MP03 1 | 0,12 | -0,49 | -1,70 | -0,42 | -0,46 |
| MPO3 2 | | | | | |
| BASt | 1,12 | 0,28 | -0,15 | 1,04 | 0,67 |
| VL. O. | 0,31 | -0,09 | -0,76 | 0,33 | -0,44 |
| N. B. | 0,40 | 0,01 | -0,94 | 0,03 | -0,12 |

| | | | | | |
|---|---|---|---|---|---|
| overall mean | 92,55 | 94,51 | 95,90 | 99,25 | 99,12 |

| trailer compared to overall mean | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 0,51 | 0,97 | 1,10 | 0,81 | 0,84 |
| JR | 0,01 | 0,39 | 0,63 | 0,33 | 0,36 |
| DRI | 0,42 | 0,08 | -0,07 | 0,15 | 0,15 |
| MP02 | 0,35 | 0,23 | 0,27 | 0,16 | 0,16 |
| MP03 1 | 0,26 | -0,31 | -0,17 | 0,19 | 0,15 |
| MPO3 2 | | | | | |
| BASt | -0,51 | -1,07 | -0,91 | -0,33 | -0,38 |
| VL. O. | -0,31 | 0,41 | -0,06 | -0,26 | -0,18 |
| N. B. | -0,73 | -0,69 | -0,80 | -1,06 | -1,11 |



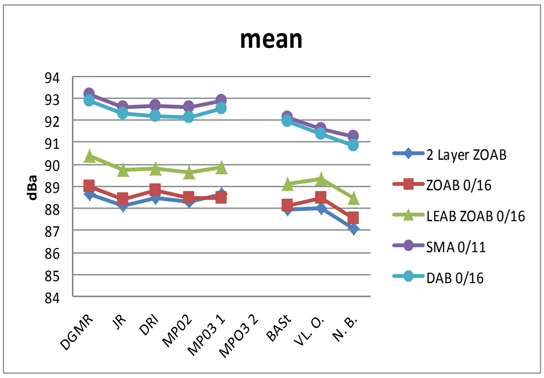



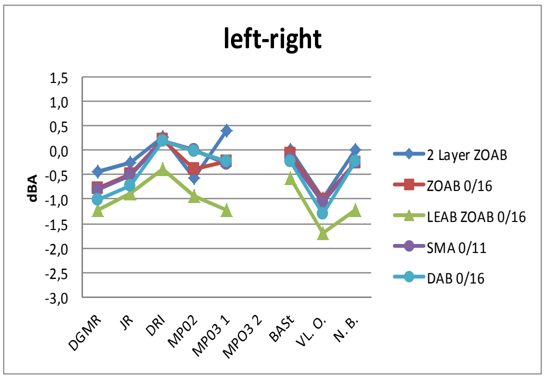
# Table III-4 – Avon AV 4 tyres – 50 km/h

**AVON4 50 km/h**

| Mean | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 88,65 | 88,97 | 90,35 | 93,19 | 92,89 |
| JR | 88,11 | 88,43 | 89,72 | 92,61 | 92,27 |
| DRI | 88,45 | 88,84 | 89,82 | 92,64 | 92,21 |
| MP02 | 88,31 | 88,48 | 89,63 | 92,59 | 92,14 |
| MP03 1 | 88,65 | 88,48 | 89,88 | 92,87 | 92,52 |
| MPO3 2 | | | | | |
| BASt | 87,96 | 88,11 | 89,09 | 92,13 | 91,93 |
| VL O. | 88,02 | 88,48 | 89,36 | 91,62 | 91,36 |
| N. B. | 87,09 | 87,51 | 88,44 | 91,23 | 90,82 |
| Overall mean | 88,15 | 88,41 | 89,54 | 92,36 | 92,02 |

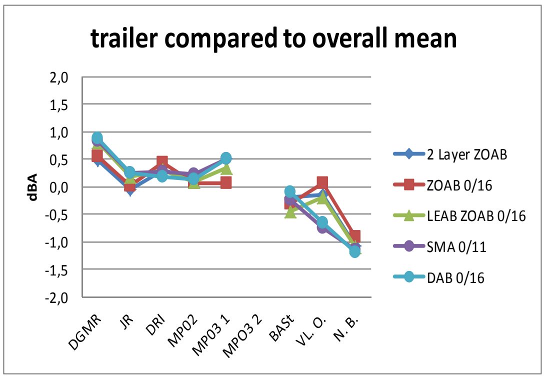



| Left-Right | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | -0,45 | -0,79 | -1,22 | -0,82 | -1,03 |
| JR | -0,26 | -0,50 | -0,90 | -0,53 | -0,73 |
| DRI | 0,26 | 0,22 | -0,40 | 0,17 | 0,18 |
| MP02 | -0,58 | -0,38 | -0,93 | -0,01 | -0,02 |
| MP03 1 | 0,40 | -0,23 | -1,24 | -0,29 | -0,25 |
| MPO3 2 | | | | | |
| BASt | 0,01 | -0,08 | -0,58 | -0,19 | -0,23 |
| VL O. | -1,00 | -1,01 | -1,68 | -1,06 | -1,32 |
| N. B. | -0,01 | -0,26 | -1,21 | -0,27 | -0,24 |




| | | | | | |
|---|---|---|---|---|---|
| overall mean | 88,15 | 88,41 | 89,54 | 92,36 | 92,02 |

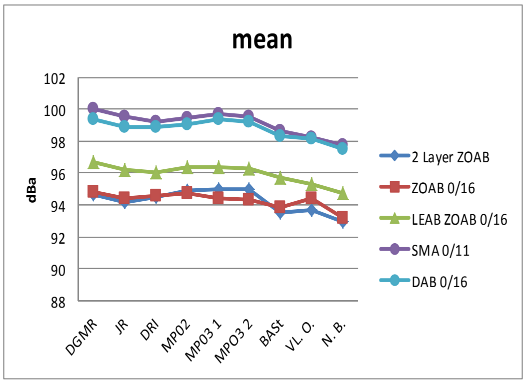
| trailer compared to overall mean | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 0,49 | 0,56 | 0,81 | 0,83 | 0,87 |
| JR | -0,05 | 0,01 | 0,18 | 0,25 | 0,26 |
| DRI | 0,30 | 0,43 | 0,29 | 0,28 | 0,19 |
| MP02 | 0,15 | 0,07 | 0,10 | 0,23 | 0,12 |
| MP03 1 | 0,50 | 0,07 | 0,35 | 0,51 | 0,50 |
| MPO3 2 | | | | | |
| BASt | -0,19 | -0,30 | -0,44 | -0,23 | -0,09 |
| VL O. | -0,14 | 0,07 | -0,18 | -0,74 | -0,66 |
| N. B. | -1,07 | -0,90 | -1,10 | -1,13 | -1,20 |



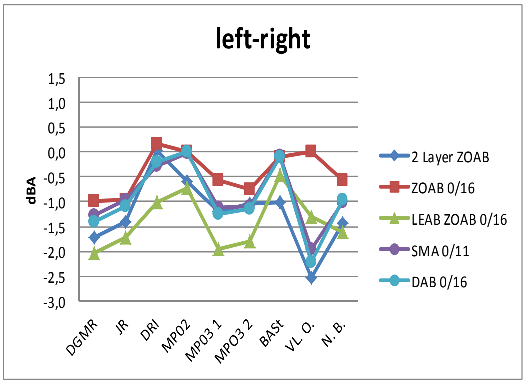
## Table III-5 – Avon AV 4 tyres – 80 km/h

AVON4 80 km/h

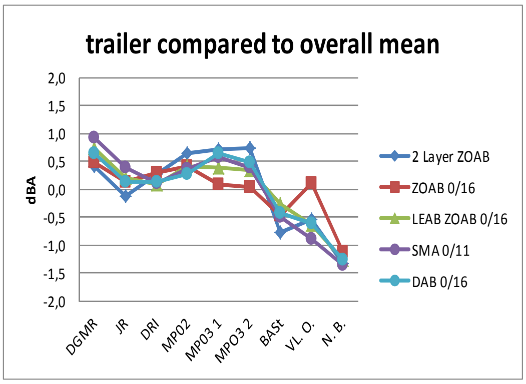
| Mean | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | 94,69 | 94,80 | 96,69 | 100,04 | 99,38 |
| JR | 94,15 | 94,45 | 96,17 | 99,51 | 98,86 |
| DRI | 94,54 | 94,61 | 96,04 | 99,22 | 98,86 |
| MP02 | 94,90 | 94,73 | 96,37 | 99,48 | 99,02 |
| MP03 1 | 94,98 | 94,40 | 96,35 | 99,69 | 99,38 |
| MPO3 2 | 95,00 | 94,34 | 96,31 | 99,51 | 99,23 |
| BASt | 93,49 | 93,83 | 95,69 | 98,62 | 98,31 |
| VL O. | 93,72 | 94,43 | 95,33 | 98,22 | 98,14 |
| N. B. | 92,95 | 93,20 | 94,70 | 97,76 | 97,47 |
| overall mean | 94,27 | 94,31 | 95,96 | 99,12 | 98,74 |




| Left-Right | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
|---|---|---|---|---|---|
| DGMR | -1,72 | -1,00 | -2,04 | -1,28 | -1,40 |
| JR | -1,41 | -0,96 | -1,72 | -0,96 | -1,09 |
| DRI | 0,02 | 0,15 | -1,01 | -0,27 | -0,20 |
| MP02 | -0,59 | 0,01 | -0,74 | -0,03 | 0,01 |
| MP03 1 | -1,19 | -0,56 | -1,95 | -1,12 | -1,24 |
| MPO3 2 | -1,05 | -0,76 | -1,79 | -1,11 | -1,15 |
| BASt | -1,01 | -0,11 | -0,47 | -0,08 | -0,10 |
| VL O. | -2,53 | 0,00 | -1,30 | -1,96 | -2,21 |
| N. B. | -1,45 | -0,58 | -1,62 | -1,03 | -0,96 |

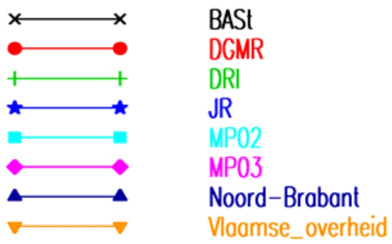



| overall mean | 94,27 | 94,31 | 95,96 | 99,12 | 98,74 |
|---|---|---|---|---|---|
| trailer compared to overall mean | 2 Layer ZOAB | ZOAB 0/16 | LEAB ZOAB 0/16 | SMA 0/11 | DAB 0/16 |
| DGMR | 0,42 | 0,49 | 0,73 | 0,92 | 0,64 |
| JR | -0,12 | 0,14 | 0,21 | 0,39 | 0,12 |
| DRI | 0,27 | 0,30 | 0,08 | 0,11 | 0,12 |
| MP02 | 0,63 | 0,42 | 0,41 | 0,36 | 0,28 |
| MP03 1 | 0,71 | 0,09 | 0,38 | 0,58 | 0,64 |
| MPO3 2 | 0,74 | 0,03 | 0,34 | 0,39 | 0,49 |
| BASt | -0,78 | -0,48 | -0,27 | -0,49 | -0,43 |
| VL O. | -0,55 | 0,12 | -0,63 | -0,90 | -0,60 |
| N. B. | -1,32 | -1,11 | -1,26 | -1,36 | -1,27 |



# Annex IV Spectral presentation of test data per test section and per tyre type

Legend of line types in following graphs:




Left mounted tyres are shown in left-hand graphs
Right mounted tyres are shown in right-hand graphs

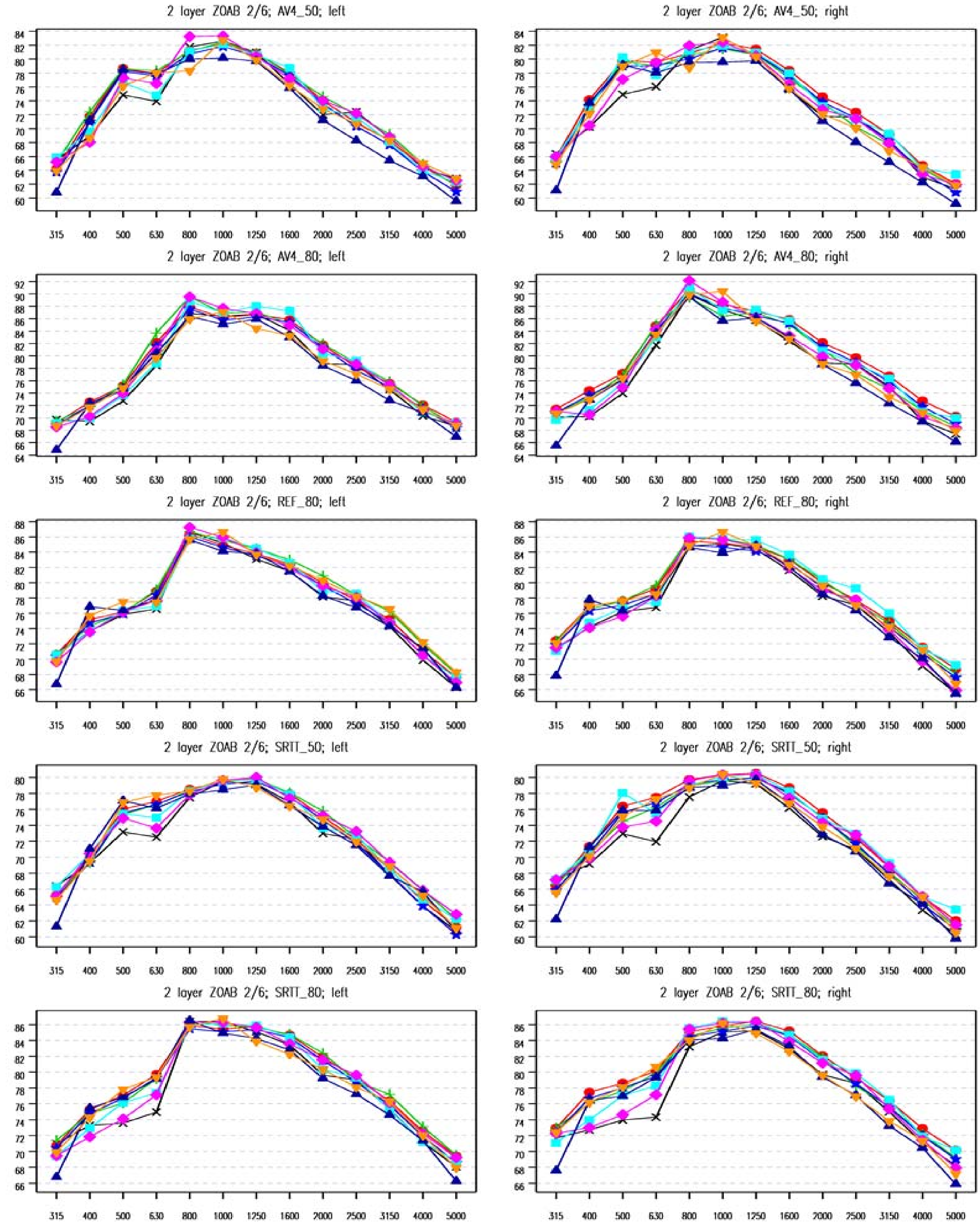



Figure IV-1. Spectral data in A-weighted 1/3-octave bands of the overall average CPX levels for test section 1: 2 Layer porous asphalt – 2/6 mm

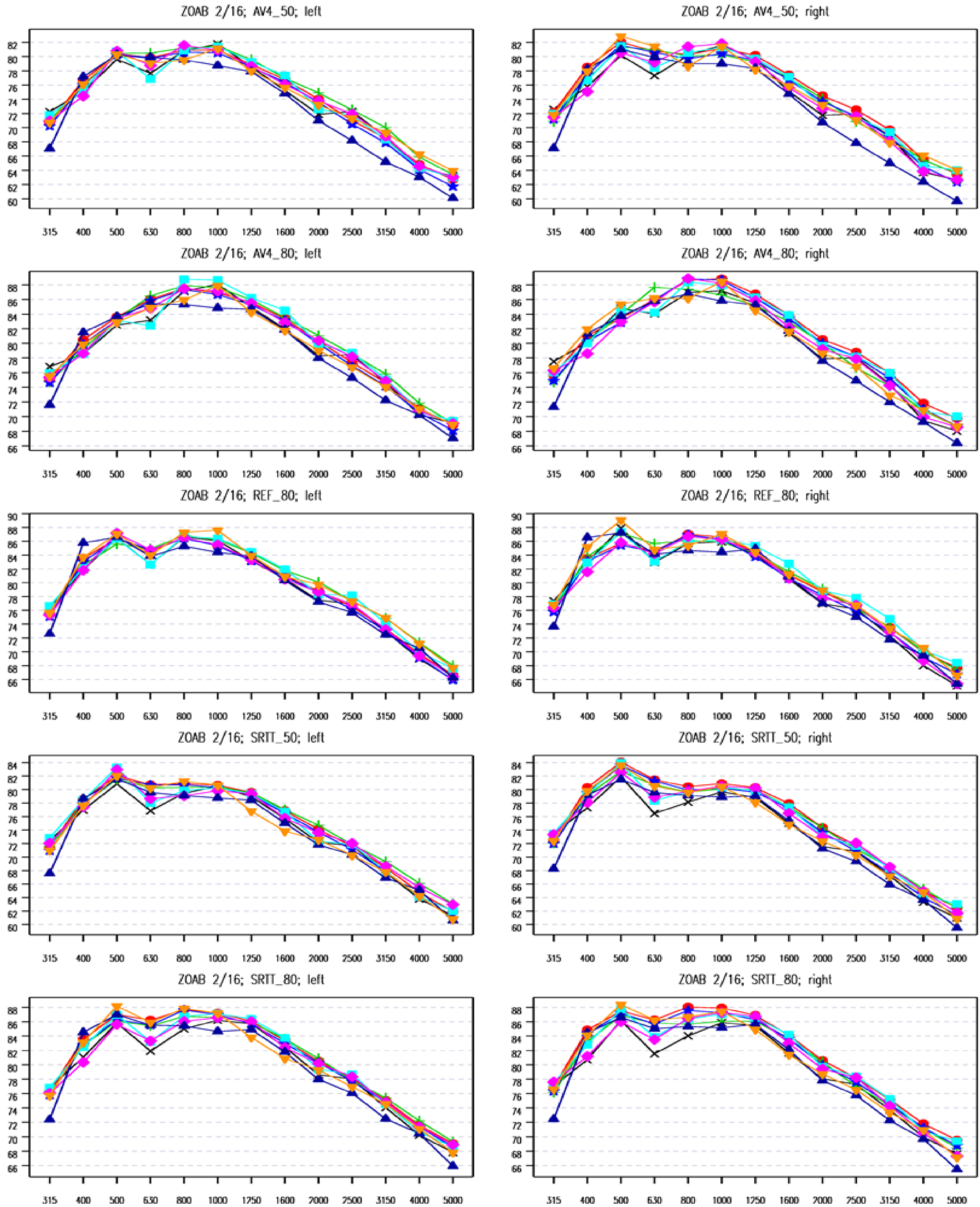



Figure IV-2. Spectral data in A-weighted 1/3-octave bands of the overall average CPX levels for test section 2: Porous asphalt – 0/16 mm

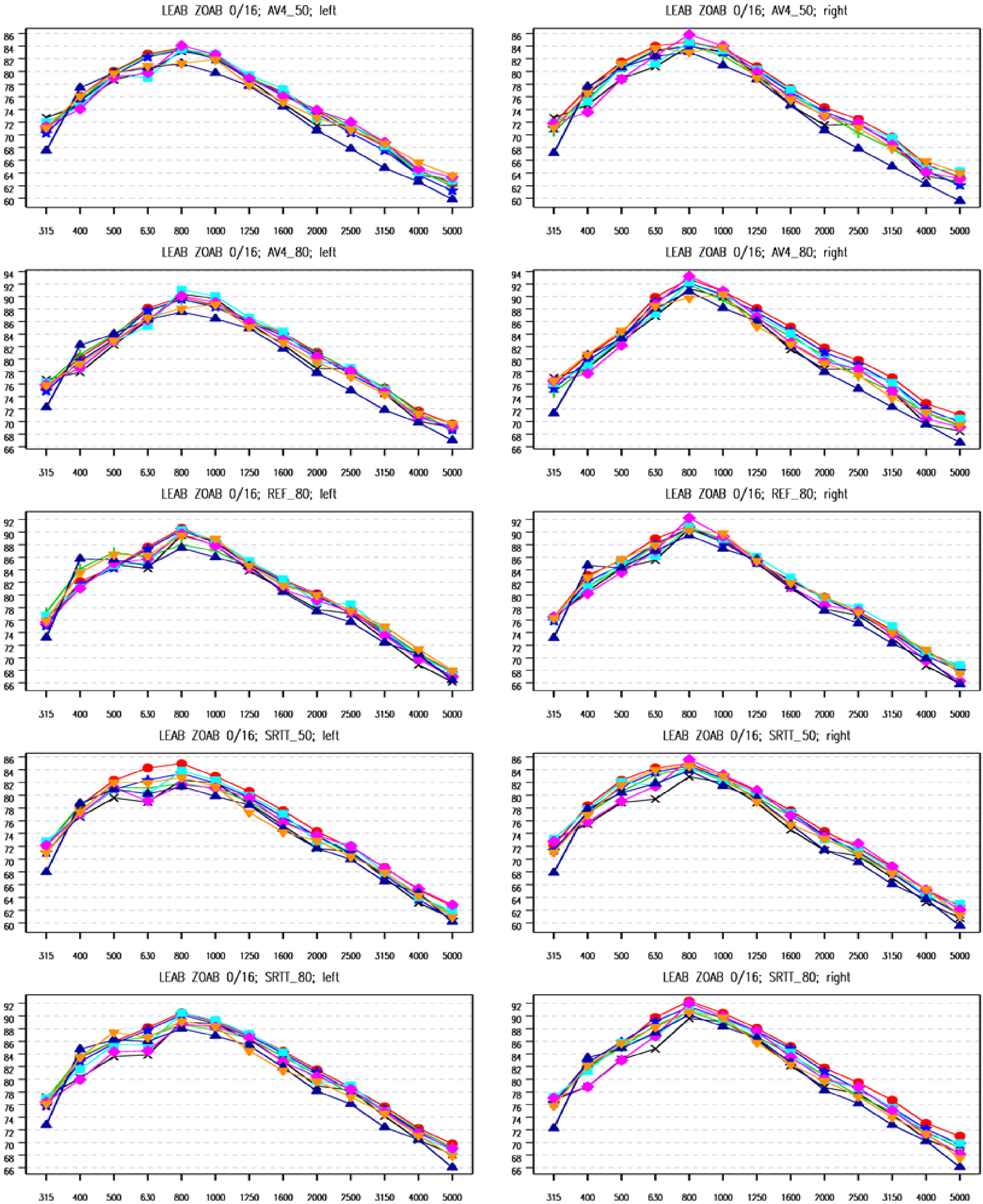



Figure IV-3. Spectral data in A-weighted 1/3-octave bands of the overall average CPX levels for test section 3: Low energy porous asphalt – 0/16 mm

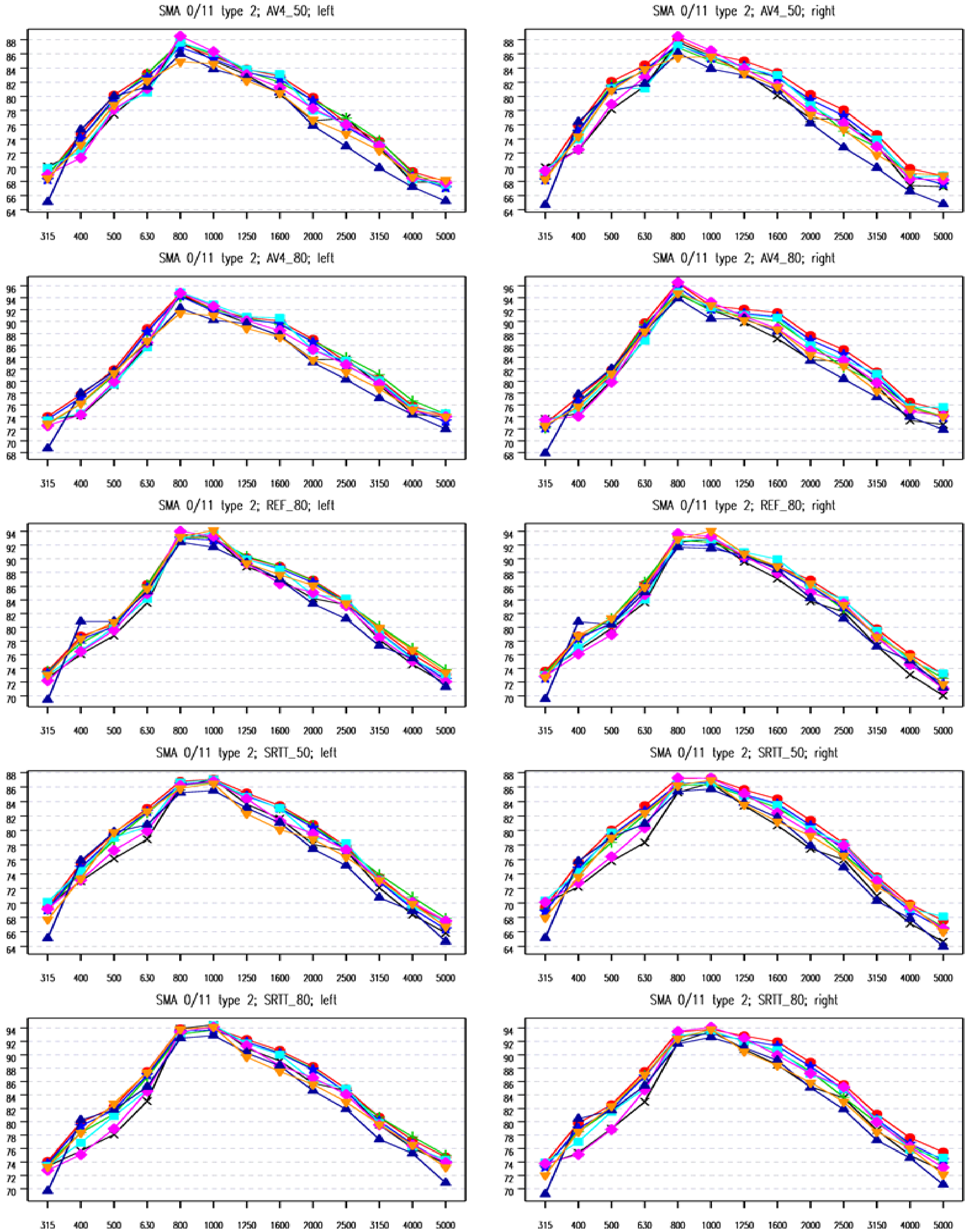



Figure IV-4. Spectral data in A-weighted 1/3-octave bands of the overall average CPX levels for test section 4: Stone Mastic Asphalt – 0/11 mm

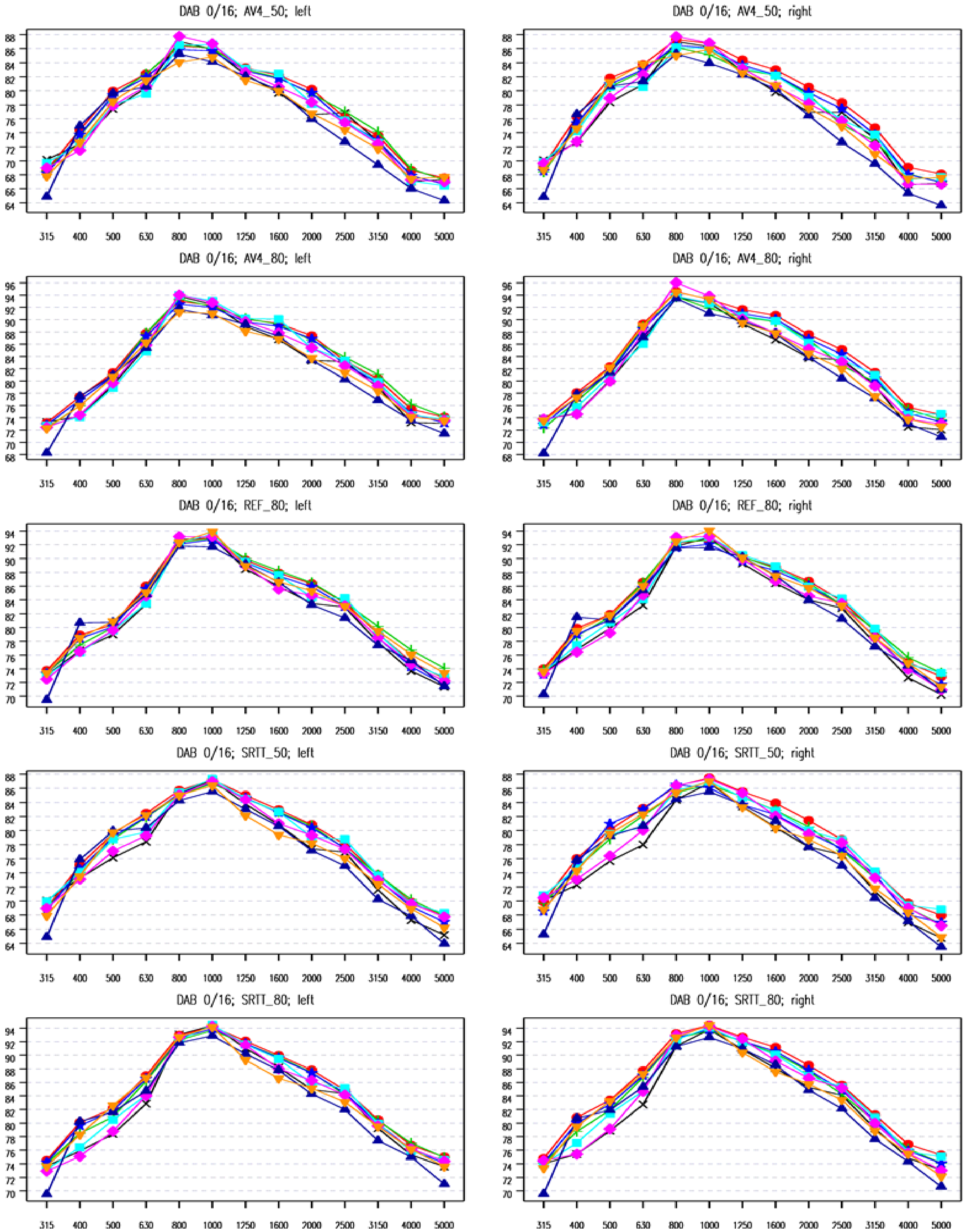



Figure IV-5. Spectral data in A-weighted 1/3-octave bands of the overall average CPX levels for test section 5: Dense asphalt concrete– 0/16 mm

# Annex V Overview of series of test results of 100 m segments per test section and per operator

| | DRI | | | | | | DGMR | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| spe | 50 | 80 | 80 | 80 | 50 | 80 | 50 | 80 | 80 | 50 | 80 | 80 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 1,00 | 2,00 | 3,00 | 4,00 | 5,00 | 6,00 |
| sectie 1 | 0 | | | | 0 | | | | | | | |
| | 0,10 | 0,12 | | | 0,10 | 0,06 | | | | | | |
| | 0,20 | 0,22 | | | 0,20 | 0,16 | 31,90 | | | 31,90 | | |
| | 0,30 | 0,32 | | | 0,30 | 0,26 | 32,00 | | | 32,00 | | |
| | 0,40 | 0,42 | | | 0,40 | 0,36 | 32,10 | 32,10 | 32,10 | 32,10 | 32,10 | 32,10 |
| | 0,50 | 0,52 | | | 0,50 | 0,46 | 32,20 | 32,20 | 32,20 | 32,20 | 32,20 | 32,20 |
| | 0,60 | 0,62 | 0,60 | 0,60 | 0,60 | 0,56 | 32,30 | 32,30 | 32,30 | 32,30 | 32,30 | 32,30 |
| | 0,70 | 0,72 | 0,70 | 0,70 | 0,70 | 0,66 | 32,40 | 32,40 | 32,40 | 32,40 | 32,40 | 32,40 |
| | 0,80 | 0,82 | 0,80 | 0,80 | 0,80 | 0,76 | 32,50 | 32,50 | 32,50 | 32,50 | 32,50 | 32,50 |
| | 0,90 | 0,92 | 0,90 | 0,90 | 0,90 | 0,86 | 32,60 | 32,60 | 32,60 | 32,60 | 32,60 | 32,60 |
| | 1,00 | 1,02 | 1,00 | 1,00 | 1,00 | 0,96 | 32,70 | 32,70 | 32,70 | 32,70 | 32,70 | 32,70 |
| | 1,10 | 1,12 | 1,10 | 1,10 | 1,10 | 1,06 | 32,80 | 32,80 | 32,80 | 32,80 | 32,80 | 32,80 |
| | 1,20 | 1,22 | 1,20 | 1,20 | 1,20 | 1,16 | 32,90 | 32,90 | 32,90 | 32,90 | 32,90 | 32,90 |
| | 1,30 | 1,32 | 1,30 | 1,30 | 1,30 | 1,26 | 33,00 | 33,00 | 33,00 | 33,00 | 33,00 | 33,00 |
| | 1,40 | | 1,40 | 1,40 | 1,40 | 1,36 | 33,10 | 33,10 | 33,10 | 33,10 | 33,10 | 33,10 |
| | 1,50 | | 1,50 | 1,50 | 1,50 | 1,46 | 33,20 | 33,20 | 33,20 | 33,20 | 33,20 | 33,20 |
| | | | 1,60 | 1,60 | | | 33,30 | 33,30 | 33,30 | 33,30 | 33,30 | 33,30 |
| | | | 1,70 | 1,70 | | | | | | | | |
| | | | 1,80 | 1,80 | | | | | | | | |
| | | | 1,90 | 1,90 | | | | | | | | |
| | | | | 2,00 | | | | | | | | |
| sectie 2 | 1,80 | | 1,84 | 1,84 | 1,80 | 1,84 | | | | | | |
| | 1,90 | 1,86 | 1,94 | 1,94 | 1,90 | 1,94 | 33,65 | | | 33,65 | | |
| | | 1,96 | | | | | 33,70 | | | 33,70 | | |
| | | | | | | | 33,80 | 33,80 | 33,80 | 33,80 | 33,80 | 33,80 |
| | | | | | | | | | | | | |
| sectie 3 | 2,20 | 2,20 | 2,20 | 2,20 | 2,20 | 2,20 | | | | | | |
| | 2,30 | 2,30 | 2,30 | 2,30 | 2,30 | 2,30 | 33,90 | 33,90 | 33,90 | 33,90 | 33,90 | 33,90 |
| | | | | | | | 34,00 | 34,00 | 34,00 | 34,00 | 34,00 | 34,00 |
| | | | | | | | 34,10 | 34,10 | 34,10 | 34,10 | 34,10 | 34,10 |
| | | | | | | | 34,20 | | | 34,20 | | |
| sectie 4 | 2,66 | | | | 2,68 | | | | | | | |
| | 2,76 | 2,76 | 2,74 | 2,74 | 2,78 | 2,74 | 4,40 | | | 4,40 | | |
| | 2,86 | 2,86 | 2,84 | 2,84 | 2,88 | 2,84 | 4,30 | | | 4,30 | | |
| | 2,96 | 2,96 | 2,94 | 2,94 | 2,98 | 2,94 | 4,20 | 4,15 | | 4,20 | 4,15 | 4,15 |
| | 3,06 | 3,06 | 3,04 | 3,04 | 3,08 | 3,04 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 |
| | 3,16 | 3,16 | 3,14 | 3,14 | 3,18 | 3,14 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 |
| | 3,26 | 3,26 | 3,24 | 3,24 | 3,28 | 3,24 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 |
| | 3,36 | 3,36 | 3,34 | 3,34 | 3,38 | 3,34 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 |
| | 3,46 | | | 3,44 | | | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| sectie 5 | 3,76 | | | | 3,76 | | | | | | | |
| | 3,86 | 3,84 | 3,82 | | 3,86 | 3,90 | | | | | | |
| | 3,96 | 3,94 | 3,92 | 3,92 | 3,96 | 4,00 | 3,60 | | | 3,60 | | |
| | 4,06 | 4,04 | 4,02 | 4,02 | 4,06 | 4,10 | 3,70 | | | 3,70 | | |
| | 4,16 | 4,14 | 4,12 | 4,12 | 4,16 | 4,20 | 3,80 | | | 3,80 | | |
| | 4,26 | 4,24 | 4,22 | 4,22 | 4,26 | 4,30 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 |
| | 4,36 | 4,34 | 4,32 | 4,32 | 4,36 | 4,40 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 |
| | 4,46 | 4,44 | 4,42 | 4,42 | 4,46 | 4,50 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 |
| | 4,56 | 4,54 | 4,52 | 4,52 | 4,56 | 4,60 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 |
| | 4,66 | 4,64 | 4,62 | 4,62 | 4,66 | 4,70 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 |
| | 4,76 | 4,74 | 4,72 | 4,72 | 4,76 | 4,80 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 |
| | | 4,84 | 4,82 | 4,82 | | | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 |
| | | | | | | | 4,60 | | | 4,60 | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

| | Vlaamse overheid | | | | | | BASt | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| spe | 50 | 80 | 80 | 80 | 50 | 80 | 50 | 80 | 80 | 80 | 50 | 80 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| sectie 1 | | | | | | | | | | | | |
| | | | | | | | 31,82 | 31,82 | 31,82 | 31,82 | 31,82 | 31,82 |
| | 31,90 | | | | 31,90 | | 31,92 | 31,92 | 31,92 | 31,92 | 31,92 | 31,92 |
| | 32,00 | | 32,00 | | 32,00 | | 32,02 | 32,02 | 32,02 | 32,02 | 32,02 | 32,02 |
| | 32,10 | 32,10 | 32,10 | 32,10 | 32,10 | | 32,12 | 32,12 | 32,12 | 32,12 | 32,12 | 32,12 |
| | 32,20 | 32,20 | 32,20 | 32,20 | 32,20 | 32,20 | 32,22 | 32,22 | 32,22 | 32,22 | 32,22 | 32,22 |
| | 32,30 | 32,30 | 32,30 | 32,30 | 32,30 | 32,30 | 32,32 | 32,32 | 32,32 | 32,32 | 32,32 | 32,32 |
| | 32,40 | 32,40 | 32,40 | 32,40 | 32,40 | 32,40 | 32,42 | 32,42 | 32,42 | 32,42 | 32,42 | 32,42 |
| | 32,50 | 32,50 | 32,50 | 32,50 | 32,50 | 32,50 | 32,52 | 32,52 | 32,52 | 32,52 | 32,52 | 32,52 |
| | 32,60 | 32,60 | 32,60 | 32,60 | 32,60 | 32,60 | 32,62 | 32,62 | 32,62 | 32,62 | 32,62 | 32,62 |
| | 32,70 | 32,70 | 32,70 | 32,70 | 32,70 | 32,70 | 32,72 | 32,72 | 32,72 | 32,72 | 32,72 | 32,72 |
| | 32,80 | 32,80 | 32,80 | 32,80 | 32,80 | 32,80 | 32,82 | 32,82 | 32,82 | 32,82 | 32,82 | 32,82 |
| | 32,90 | 32,90 | 32,90 | 32,90 | 32,90 | 32,90 | 32,92 | 32,92 | 32,92 | 32,92 | 32,92 | 32,92 |
| | 33,00 | 33,00 | 33,00 | 33,00 | 33,00 | 33,00 | 33,02 | 33,02 | 33,02 | 33,02 | 33,02 | 33,02 |
| | 33,10 | 33,10 | 33,10 | 33,10 | 33,10 | 33,10 | 33,12 | 33,12 | 33,12 | 33,12 | 33,12 | 33,12 |
| | 33,20 | 33,20 | 33,20 | 33,20 | 33,20 | 33,20 | 33,22 | 33,20 | 33,20 | 33,22 | 33,22 | 33,20 |
| | 33,30 | | | | 33,30 | | 33,32 | | | | 33,32 | |
| | | | | | | | 33,36 | | | | 33,38 | |
| | | | | | | | 31,72 | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| sectie 2 | | | | | | | | | | | | |
| | | | | | | | 33,60 | 33,60 | 33,60 | 33,60 | 33,60 | 33,60 |
| | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 | 33,70 |
| | | | | | | | 33,80 | | | | 33,80 | |
| | | | | | | | | | | | | |
| sectie 3 | | | | | | | | | | | | |
| | | | | | | | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 |
| | 34,00 | 34,00 | 34,00 | 34,00 | 34,00 | 34,00 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 |
| | 34,10 | 34,10 | 34,10 | | 34,10 | | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 |
| | | | | | | | 34,19 | | | 34,19 | 34,19 | |
| sectie 4 | | | | | | | 4,49 | 4,49 | 4,49 | 4,49 | 4,49 | 4,49 |
| | 4,40 | | 4,40 | | 4,40 | | 4,39 | 4,39 | 4,39 | 4,39 | 4,39 | 4,39 |
| | 4,30 | | 4,30 | | 4,30 | | 4,29 | 4,29 | 4,29 | 4,29 | 4,29 | 4,29 |
| | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,19 | 4,19 | 4,19 | 4,19 | 4,19 | 4,19 |
| | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,09 | 4,09 | 4,09 | 4,09 | 4,09 | 4,09 |
| | | 4,00 | | 4,00 | | 4,00 | 3,99 | 3,99 | 3,99 | 3,99 | | |
| | | 3,90 | | 3,90 | | 3,90 | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| sectie 5 | | | | | | | | | | | | |
| | | | | | | | 3,50 | 3,50 | 3,50 | 3,50 | 3,50 | 3,50 |
| | 3,60 | 3,60 | 3,60 | 3,60 | 3,60 | | 3,60 | 3,60 | 3,60 | 3,60 | 3,60 | 3,60 |
| | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 | | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 |
| | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 |
| | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 |
| | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 |
| | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | | | | | | |
| | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | | | | | | |
| | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | | | | | | |
| | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | | | | | | |
| | | | | | | 4,50 | | | | | | |
| | | | | | | 4,60 | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

| | Noord Brabant | | | | | | Reubsaet | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| spe | 80 | 80 | 50 | 50 | 80 | 80 | 50 | 80 | 80 | 50 | 80 | 80 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| sectie 1 | | | | | | | | | | | | |
| | | | 31,80 | 31,82 | | | | | | | | |
| | 31,86 | 31,86 | 31,90 | 31,92 | 31,84 | 31,86 | 31,90 | | | 31,90 | | |
| | 31,96 | 31,96 | 32,00 | 32,02 | 31,94 | 31,96 | 32,00 | | | 32,00 | | |
| | 32,06 | 32,06 | 32,10 | 32,12 | 32,04 | 32,06 | 32,10 | 32,10 | 32,10 | 32,10 | 32,10 | 32,10 |
| | 32,16 | 32,16 | 32,20 | 32,22 | 32,14 | 32,16 | 32,20 | 32,20 | 32,20 | 32,20 | 32,20 | 32,20 |
| | 32,26 | 32,26 | 32,30 | 32,32 | 32,24 | 32,26 | 32,30 | 32,30 | 32,30 | 32,30 | 32,30 | 32,30 |
| | 32,36 | 32,36 | 32,40 | 32,42 | 32,34 | 32,36 | 32,40 | 32,40 | 32,40 | 32,40 | 32,40 | 32,40 |
| | 32,46 | 32,46 | 32,50 | 32,52 | 32,44 | 32,46 | 32,50 | 32,50 | 32,50 | 32,50 | 32,50 | 32,50 |
| | 32,56 | 32,56 | 32,60 | 32,62 | 32,54 | 32,56 | 32,60 | 32,60 | 32,60 | 32,60 | 32,60 | 32,60 |
| | 32,66 | 32,66 | 32,70 | 32,72 | 32,64 | 32,66 | 32,70 | 32,70 | 32,70 | 32,70 | 32,70 | 32,70 |
| | 32,76 | 32,76 | 32,80 | 32,82 | 32,74 | 32,76 | 32,80 | 32,80 | 32,80 | 32,80 | 32,80 | 32,80 |
| | 32,86 | 32,86 | 32,90 | 32,92 | 32,84 | 32,86 | 32,90 | 32,90 | 32,90 | 32,90 | 32,90 | 32,90 |
| | 32,96 | 32,96 | 33,00 | 33,02 | 32,94 | 32,96 | 33,00 | 33,00 | 33,00 | 33,00 | 33,00 | 33,00 |
| | 33,06 | 33,06 | 33,10 | 33,12 | 33,04 | 33,06 | 33,10 | 33,10 | 33,10 | 33,10 | 33,10 | 33,10 |
| | 33,16 | 33,16 | 33,20 | 33,22 | 33,14 | 33,16 | 33,20 | 33,20 | 33,20 | 33,20 | 33,20 | 33,20 |
| | 33,26 | 33,26 | 33,30 | 33,32 | 33,24 | 33,26 | 33,30 | 33,30 | 33,30 | 33,30 | 33,30 | 33,30 |
| | 33,36 | 33,36 | 33,40 | 33,42 | 33,34 | 33,36 | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| sectie 2 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 33,66 | 33,64 | 33,62 | 33,64 | 33,64 | 33,64 | 33,65 | | | 33,65 | | |
| | 33,76 | 33,74 | 33,72 | 33,74 | 33,74 | 33,74 | 33,75 | 33,80 | 33,80 | 33,75 | 33,80 | 33,80 |
| | 33,86 | 33,84 | 33,82 | 33,84 | 33,84 | 33,84 | | | | | | |
| sectie 3 | | | | | | | | | | | | |
| | 33,90 | 33,90 | 33,90 | 33,90 | 33,90 | 33,90 | 33,95 | 33,90 | 33,90 | 33,95 | 33,90 | 33,90 |
| | 34,00 | 34,00 | 34,00 | 34,00 | 34,00 | 34,00 | 34,05 | 34,00 | 34,00 | 34,05 | 34,00 | 34,00 |
| | 34,10 | 34,10 | 34,10 | 34,10 | 34,10 | 34,10 | 34,15 | 34,10 | 34,10 | 34,15 | 34,10 | 34,10 |
| | 34,20 | 34,20 | 34,20 | 34,20 | | 34,20 | | | | | | |
| sectie 4 | | | | | | | | | | | | |
| | 4,42 | 4,40 | 4,48 | 4,48 | 4,40 | 4,42 | 4,40 | | | 4,40 | | |
| | 4,32 | 4,30 | 4,38 | 4,38 | 4,30 | 4,32 | 4,30 | | | 4,30 | | |
| | 4,22 | 4,20 | 4,28 | 4,28 | 4,20 | 4,22 | 4,20 | | | 4,20 | | |
| | 4,12 | 4,10 | 4,18 | 4,18 | 4,10 | 4,12 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 |
| | 4,02 | 4,00 | 4,08 | 4,08 | 4,00 | 4,02 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 |
| | 3,92 | 3,90 | 3,98 | 3,98 | 3,90 | 3,92 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 |
| | 3,82 | 3,80 | 3,88 | 3,88 | 3,80 | 3,82 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 |
| | 3,72 | 3,70 | 3,78 | 3,78 | 3,70 | 3,72 | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 |
| | 3,62 | 3,60 | 3,68 | 3,68 | 3,60 | 3,62 | | | | | | |
| | | | 3,58 | 3,58 | | | | | | | | |
| sectie 5 | | | | | | | | | | | | |
| | | | 3,50 | 3,54 | 3,56 | 3,56 | 3,50 | | | 3,50 | | |
| | 3,58 | 3,56 | 3,60 | 3,64 | 3,66 | 3,66 | 3,60 | | | 3,60 | | |
| | 3,68 | 3,66 | 3,70 | 3,74 | 3,76 | 3,76 | 3,70 | | | 3,70 | | |
| | 3,78 | 3,76 | 3,80 | 3,84 | 3,86 | 3,86 | 3,80 | | | 3,80 | | |
| | 3,88 | 3,86 | 3,90 | 3,94 | 3,96 | 3,96 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 |
| | 3,98 | 3,96 | 4,00 | 4,04 | 4,06 | 4,06 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 |
| | 4,08 | 4,06 | 4,10 | 4,14 | 4,16 | 4,16 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 |
| | 4,18 | 4,16 | 4,20 | 4,24 | 4,26 | 4,26 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 |
| | 4,28 | 4,26 | 4,30 | 4,34 | 4,36 | 4,36 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 |
| | 4,38 | 4,36 | 4,40 | 4,44 | 4,46 | 4,46 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 |
| | 4,48 | 4,46 | 4,50 | 4,54 | 4,56 | 4,56 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 |
| | | 4,56 | 4,60 | 4,64 | 4,66 | 4,66 | | | | | | |
| | | 4,66 | | | | | | | | | | |
| | | | | | | | | | | | | |

| | MP2 | | | | | | MP3 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| spe | 50 | 80 | 80 | 80 | 50 | 80 | 50 | 80 | 50 | 80 | 80 | 80 |
| | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| sectie 1 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 | 31,86 |
| | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 | 31,96 |
| | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 | 32,06 |
| | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 | 32,16 |
| | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 | 32,26 |
| | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 | 32,36 |
| | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 | 32,46 |
| | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 | 32,56 |
| | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 | 32,66 |
| | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 | 32,76 |
| | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 | 32,86 |
| | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 | 32,96 |
| | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 | 33,06 |
| | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 | 33,16 |
| | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 | 33,26 |
| | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 | 33,36 |
| | 33,46 | 33,46 | 33,46 | 33,46 | 33,46 | 33,46 | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| sectie 2 | | | | | | | | | | | | |
| | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 | 33,63 |
| | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 | 33,73 |
| | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 | 33,83 |
| | | | | | | | | | | | | |
| sectie 3 | | | | | | | | | | | | |
| | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 | 33,89 |
| | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 | 33,99 |
| | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 | 34,09 |
| | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 | 34,19 |
| sectie 4 | | | | | | | | | | | | |
| | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 | 4,45 |
| | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 | 4,35 |
| | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 | 4,25 |
| | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 | 4,15 |
| | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 | 4,05 |
| | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 | 3,95 |
| | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 | 3,85 |
| | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 | 3,75 |
| | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 | 3,65 |
| | | | | | | | 3,55 | 3,55 | 3,55 | 3,55 | 3,55 | 3,55 |
| sectie 5 | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | 3,60 | 3,60 | 3,60 | 3,60 | 3,60 | 3,60 |
| | | | | | | | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 | 3,70 |
| | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 | 3,80 |
| | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 | 3,90 |
| | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 |
| | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 | 4,10 |
| | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 | 4,20 |
| | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 | 4,30 |
| | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 | 4,40 |
| | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 | 4,50 |
| | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 | 4,60 |
| | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 | 4,70 |
| | 4,80 | 4,80 | 4,80 | 4,80 | 4,80 | 4,80 | | | | | | |

geen 100 m

alleen gps

eenmalig gps in combinatie met hm