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SINTEF REPORT

TITLE

Tyre/road noise modelling – results from noise and texture measurements in Norway

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CLIENT(S)

State Pollution Agency/ The Norwegian Public Roads Administration, The Norwegian Research Council

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ABSTRACT

As an input to the SPERoN tyre/road noise model, noise and texture measurements have been performed on a selection of typical Norwegian road surfaces.
The noise from one single passenger car tyre was measured at 50 and 80 km/h, using the CPX-trailer of the Norwegian Public Roads Administration.
The texture was measured using a stationary 3D laser profilometer. A total of 6 surfaces in the Trondheim region were measured.

This report presents the results from the measurements. They will be used as input data to the SPERoN model in a continuation of this project.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Acoustics	Akustikk
GROUP 2	Noise	Støy
SELECTED BY AUTHOR	Modelling	Modellering
	Tyre/road noise	Dekk/vegbanestøy
	Texture	Tekstur

Preface

The project was financed jointly by the State Pollution Agency and the Norwegian Public Roads Administration.

In addition, The Norwegian Research Council, through the program “Environmental Noise”, has financially supported the analysis and reporting of data.

Reaseach Scientist Truls Berge has been the project manager. The measurements have been performed with the assistance of senior engineer Asbjørn Ustad, SINTEF, and staff at the Norwegian Public Roads Administration (SVV). SVV was responsible for closing down the vehicles lanes and general security during measurements.

Contact persons are Dr.Thomas Beckenbauer at MüllerBBM and Dr.Wolfgang Kropp at Chalmers University.

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1. Background

The Norwegian authorities are focused on the reduction of tyre/road noise on typical Norwegian road surfaces. The use of more low noise tyres could be one way to achieve this.

In this context, a pre-project was established to work out the possibilities to use the tyre/road noise model SPERoN to rank the noise from passenger car tyres, without performing an extensive measurement program on such tyres.
As an input to this model, the texture of the road surface, as well as a range of tyre parameters are needed to predict rolling noise levels.

The goal of the pre-project was to establish a co-operation with MüllerBBM in Germany, Chalmers University in Sweden and SINTEF, to see if the model itself can be used to rank tyres on Norwegian road surfaces.

MüllerBBM and Chalmers University have been responsible for the development of SPERoN.

Due to budget reasons, only one passenger car tyre and limited number of texture measurements could be included within the pre-project. This report summarises the results from these measurements and give a limited analysis of data.

The use of SPERoN on the available data from the pre-project is planned in a continuation of this project.

2. Measurement lay-out and equipment

In this pre-project, texture measurements were performed on a selection of typical Norwegian road surfaces. A total of 6 road surfaces in the Trondheim region were chosen:

Road surface 1*: E6 Trondheim (Omkjøringsvegen) – SMA11 2005*
Road surface 2*: E6 Trondheim (Omkjøringsvegen) – SMA11 2006*
Road surface 3: *E6 Trondheim (Omkjøringsvegen) – SMA16 1999*
Road surface 4: *E6 Melhus – SMA11 2005 (Thin layer with 1 % rubber added to the bitumen)*
Road surface 5*: E6 Melhus – SMA11 2005 (Thin layer with 3 % rubber added to the bitumen)*
Road surface 6: *Rv707 Flakk, AC16 1992*

(SMA= Stone Mastic Asphalt, AC= Asphalt Concrete).

The year indicated is year of production. This means that road surface 2 has not been exposed to a winter season with studded tyres. Road surfaces 1, 4 and 5 have been exposed to one winter season.

Road surface 1-3 is part of a 4 lane ring road, with ADT close to 32 000 with 8 % HDV. Posted speed is 80 km/h.
Road surface 4 and 5 are part of a test program in the project “Environmental friendly roads” in Norway. The road is a 4 lane motorway and the test surfaces are parallel to each other (right and left lane in direction north). The ADT is approximately 12 000 with 14 % HDV. The posted speed is 90 km/h. On road surface 4, approximately 90 % of the traffic is in the right lane. This indicates possible different noise behaviour of these two road surfaces over time, due to different traffic load.

Road surface 6 is a small country road with less than 2000 ADT and posted speed is 60 km/h.

2.1 Noise measurements

The noise measurements were performed using the CPX-trailer of the Norwegian Public Road Administration (TEK-T). The tyre was mounted on the right side of the trailer. Measurements were done at 50 and 80 km/h, except on Road surface 6, where the posted speed was 60 km/h. Only measurements at 50 km/h were possible here.

The tyre chosen for the measurements was ***Continental EcoContact3 195/65 R15 91T,*** production week/year 07/2006.

This tyre is among the most popular tyres in Norway and is commonly used, both as original equipment (OE) tyres and as replacement tyres.

At each road surface, the average noise level was measured over a distance covering the area for texture measurements. The CPX-analysis program is averaging the level over sections of 20 m length, and as the system works now, it is not possible to pinpoint the exact location where the texture has been measured. However, the noise level varies very little pr. 20 m over this area, so this "inaccuracy" is not considered important for the analysis and modelling work.

2.2 Texture measurements

The texture measurements were performed with a 3D laser profilometer hired from M+P in the Netherlands.
The laser rig measures the texture profiles in a horizontal length of 1.5 m. In the transversal direction, the laser was adjusted to measure a profile every 10 mm. A total of 20 profile traces were measured at each road section, giving a 3D map of the texture over an area of 1.5 x 0.2 m. The scan resolution was set to 5 samples/mm.

At each road surface, the texture was measured in the right wheel track, at 3 sections approximately 10 m apart, as shown in figure 2.2.

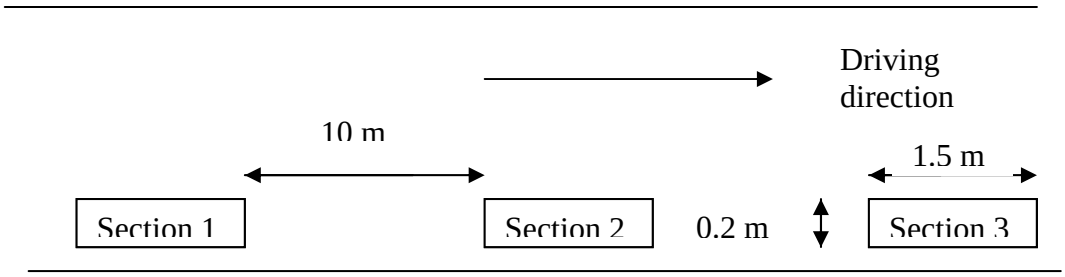


Figure 2.2 Texture measurement section lay-out

Figure 2.3 Texture measurement rig at Road surface2 (SMA11 2006)

3. Measurement results

3.1 Noise

The CPX-noise level (CPX_{cars}) is calculated according to ISO/DIS 11819-2, i.e. as the average level over the measured distance, L_A + 1.0 dB. The levels given are the average of front and rear microphone positions (inner positions).

The results of the noise measurements are given in table 3.1 and table 3.2. The noise levels are ***not*** temperature corrected. The noise levels are corrected to the reference speed of 50 and 80 km/h. Together with the measured average speed and noise levels, the standard deviation (STD) is given.

Table 3.1 Measured speed and CPX noise levels for Conti EcoContact3, 50 km/h

	Road surface 1 SMA11 2005	Road surface 2 SMA11 2006	Road surface 3 SMA16 1999	Road surface 4 SMA11 2005	Road surface 5 SMA11 2005	Road surface 6 AC16 1992
Average speed + STD (km/h)	49.4 0.1	50.8 0.2	49.9 0.4	49.5 0.1	50.7 0.3	50.5 0.4
CPX_{cars} + STD dB(A)	94.2 0.2	91.9 0.1	94.4 0.1	93.7 0.1	92.6 0.1	92.8 0.1

Table 3.2 Measured speed and CPX noise levels for Conti EcoContact3, 80 km/h

	Road surface 1 SMA11 2005	Road surface 2 SMA11 2006	Road surface 3 SMA16 1999	Road surface 4 SMA11 2005	Road surface 5 SMA11 2005	Road surface 6 AC16 1992
Average speed + STD (km/h)	78.8 0.1	80.5 0.1	79.4 0.1	79.4 0.1	80.5 0.1	-
CPX_{cars} + STD dB(A)	101.2 0.2	99.0 0.2	101.8 0.3	99.7 0.4	97.4 0.4	-

In Annex A, the data sheets from the analysis for each measurement are shown, including the noise spectra for each of the two microphones.

3.2 Texture

Table 3.3 shows MPD-values, including standard deviation for each of the 3 sections and the average of all sections. For each section, the MPD represents the average of 20 parallel profiles. The average of 3 sections then represents the average of 60 profiles.

Table 3.3 MPD-results for the 6 road surfaces

Road Surface	Section 1 MPD [mm] + STD	Section 2 MPD [mm] + STD	Section 3 MPD [mm] + STD	Average of 1+ 2+3 MPD [mm] + STD
1 SMA11 2005	1.06 0.09	1.23 0.09	1.18 0.09	1.16 0.11
2 SMA11 2006	0.97 0.10	0.93 0.08	0.97 0.09	0.96 0.09
3 SMA16 1999	1.46 0.11	1.38 0.14	1.48 0.14	1.44 0.14
4 SMA11 2005	1.26 0.08	1.22 0.09	1.25 0.09	1.24 0.09
5 SMA11 2005	1.10 0.07	1.17 0.07	1.18 0.08	1.15 0.08
6 AC16 1992	1.03 0.08	1.02 0.07	0.95 0.07	1.00 0.08

Figure 3.1 shows the average texture amplitudes for the different wavelengths, averaged over all 3 sections.

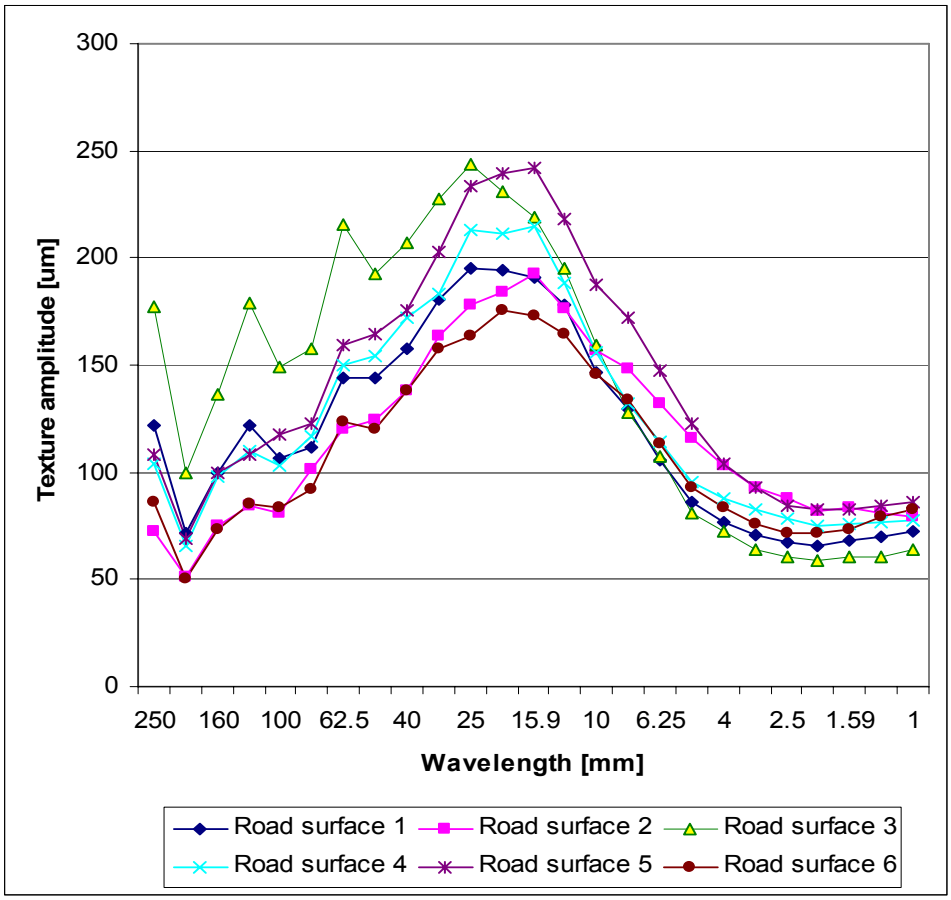


Figure 3.1 Comparison of texture levels, averaged over 3 sections at each road surface

In Annex B all individual texture data is presented, including the texture wavelength amplitudes.

4. Analysis

A limited analysis of some of the results has been performed. In table 4.1 and figure 4.1, the correlation between measured noise levels (CPX_{cars} - see table 3.1) for the CONTI-tyre and the texture amplitudes for the wavelengths between 20 and 200 mm are shown. The results show that the correlation is highest at 125 mm. The reason may be that this correlates best to the area of the footprint of the tyre to the surface.

Table 4.1 Correlation between noise levels at 50 km/h and texture levels

Texture wavelength mm	Correlation coefficient R^2
20	0.1132
32	0.3284
80	0.4509
125	0.6422
200	0.6082

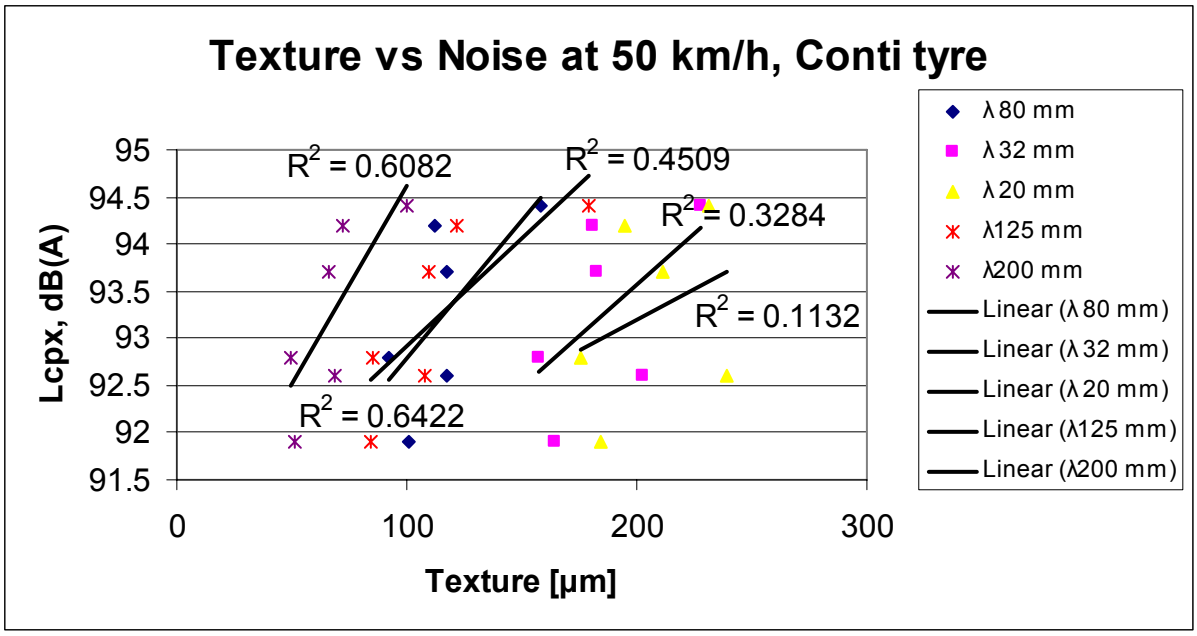


Figure 4.1 Correlation between texture and measured noise at 50 km/h.

We have also analysed the correlation at 80 km/h, as shown in figure 4.2. Only the results for the wavelengths 32, 80 and 125 mm are shown.

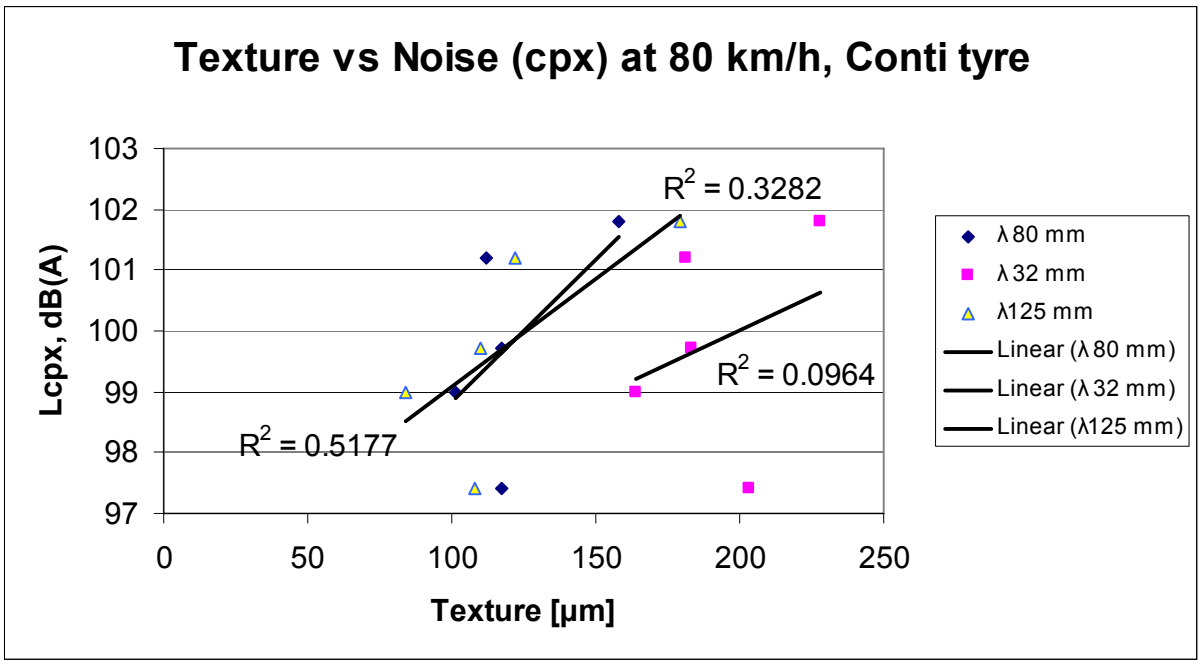


Figure 4.2 Correlation between texture and measured noise at 80 km/h.

As can been seen in figure 4.2, the correlation at 80 km/h is somewhat lower than at 50 km/h, for the same texture wavelengths.

In figure 4.3 we have looked at the correlation between the average MPD-values over 3 sections and the measured average Lcpx-levels, at 50 and 80 km/h.

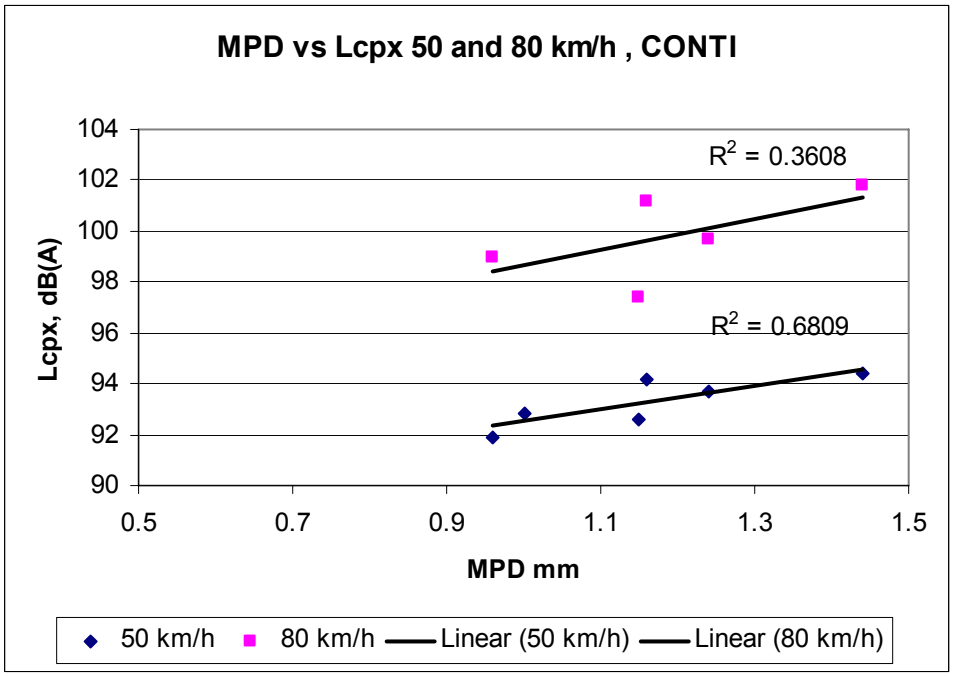


Figure 4.3 Correlation between average MPD-value for each road surface and measured noise level at 50 and 80 km/h.

The figure shows that the correlation is higher at 50 than 80 km/h.

In figure 4.4, the correlation between the average MPD-values for each road surface and measured texture level [Ltx, dB] at 32 and 80 mm are given.

As the figure show, the correlation is somewhat higher for 80 mm than for 32 mm.

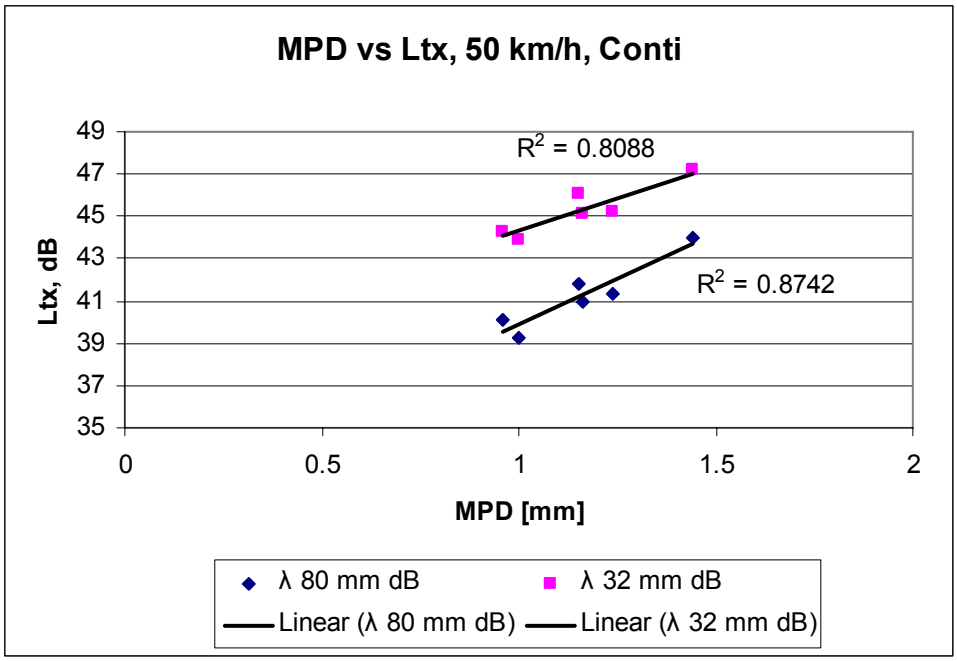


Figure 4.4 Correlation between average MPD-value for each road surface and measured texture levels at 32 and 80 mm.

ANNEX A.
NOISE MEASUREMENT RESULTS

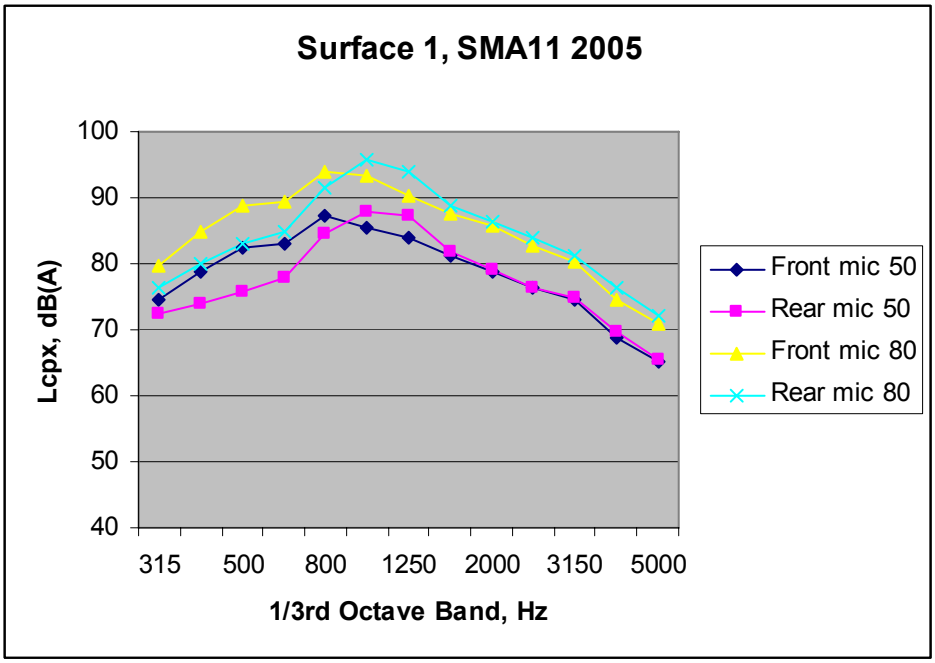
The measured frequency spectra are given separately for the front and rear microphone position. These microphone positions are according to "Inner positions" in ISO/CD11819-2 The values given in the tables are CXP_{cars} – 1.0 dB(A). They are speed corrected, but not temperature corrected. During the measurements, the air temperature was in the area of 18-20 ° C.

The data sheets show the average spectra for these two microphones, as CXP_{cars} , in dB(A).

ROAD SURFACE 1: SMA11 2005

CXP_{cars} – 1.0 dB(A)

1/3 octave freq.	50 km/h		80 km/h	
	Front mic	Rear mic	Front mic	Rear mic
Hz	dB(A)	dB(A)	dB(A)	dB(A)
315	74.4	72.5	79.7	76.3
400	78.8	73.9	84.7	80.1
500	82.3	75.7	88.9	83.1
630	83.0	78.0	89.4	84.9
800	87.2	84.5	93.9	91.6
1000	85.5	88.0	93.3	95.8
1250	83.9	87.2	90.3	93.8
1600	81.1	81.8	87.5	88.9
2000	78.9	79.1	85.9	86.4
2500	76.4	76.5	82.7	83.8
3150	74.6	74.9	80.3	81.3
4000	68.8	69.7	74.5	76.3
5000	65.2	65.5	70.9	72.2

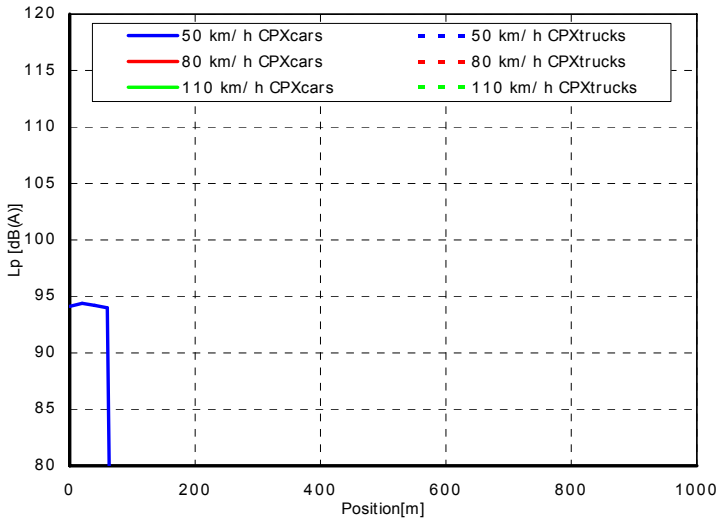


Close Proximity (survey)

(right tyre)

Location	Trondheim - SURFACE 1, E6
Road surface type	SMA11 2005
Test section length	80
Direction	North
Date	22.09.2006
Air temperature	19
Road temperature	20

CPX-LEVELS

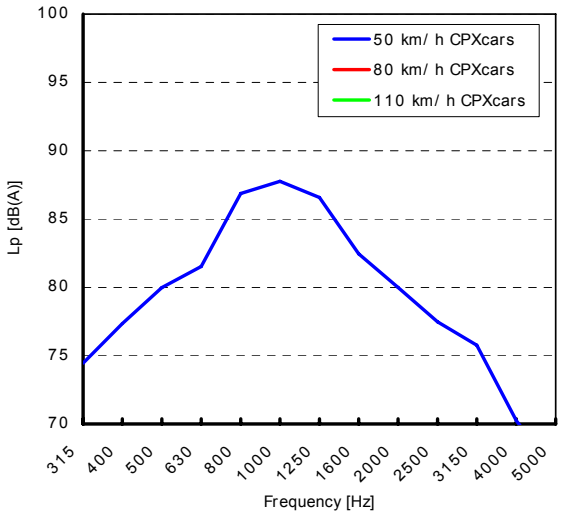


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

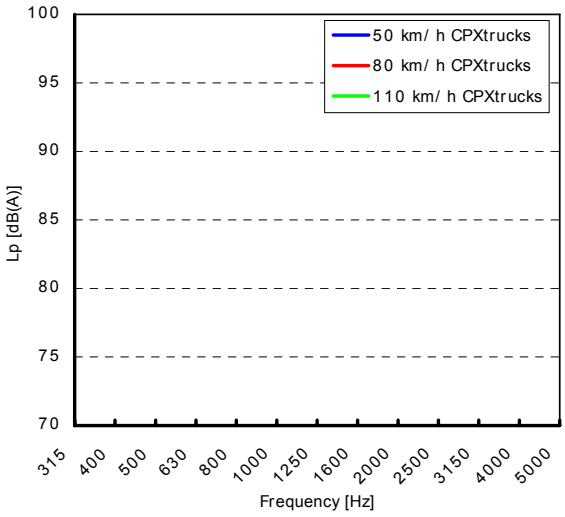
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	94.2	#REF!	#REF!
stand. dev	0.2	####	####
CPX_{trucks} [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	#REF!	#REF!
CPXI [dB(A)]	####	#REF!	#REF!
stand. dev	0.1	####	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 2005

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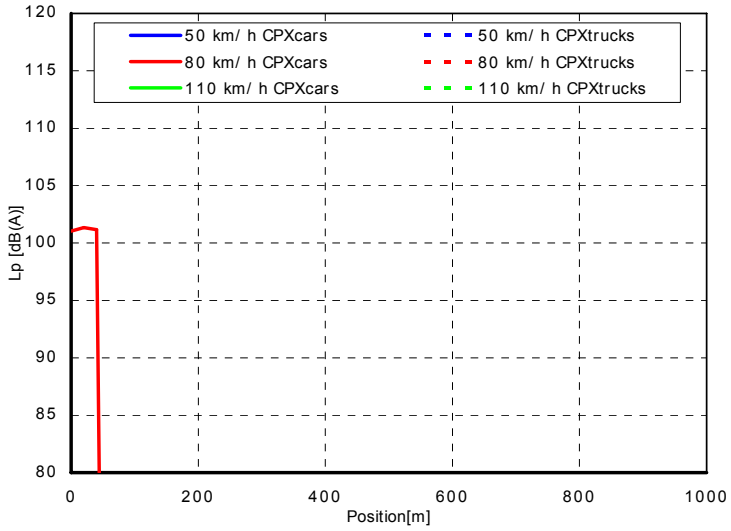
Close Proximity (survey)

(right tyre)

Location	Trondheim - SURFACE 1, E6
Road surface type	SMA11 2005
Test section length	60
Direction	North
Date	22.09.2006
Air temperature	19
Road temperature	20

CPX-LEVELS

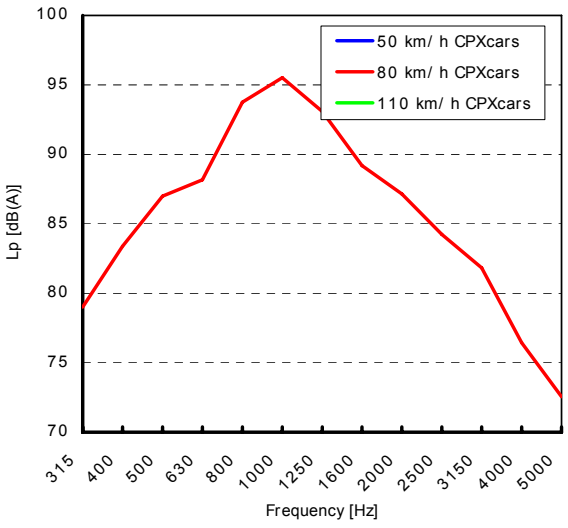


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

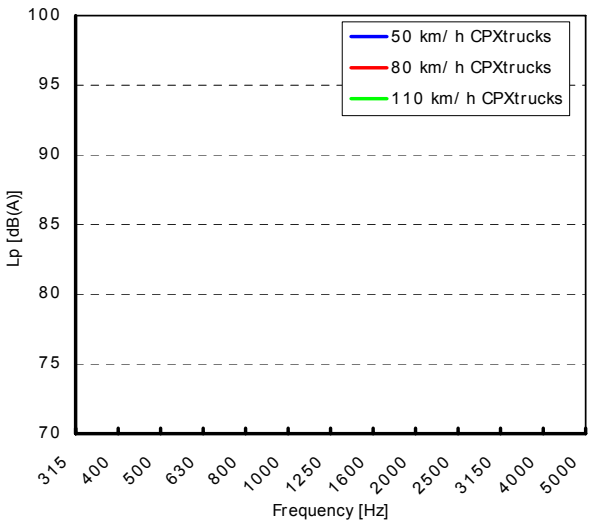
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	#REF!	101.2	#REF!
stand. dev	####	0.2	####
CPX_{trucks} [dB(A)]	#REF!	#####	#REF!
stand. dev	#REF!	0.0	#REF!
CPXI [dB(A)]	#REF!	#####	#REF!
stand. dev	####	0.1	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 2005

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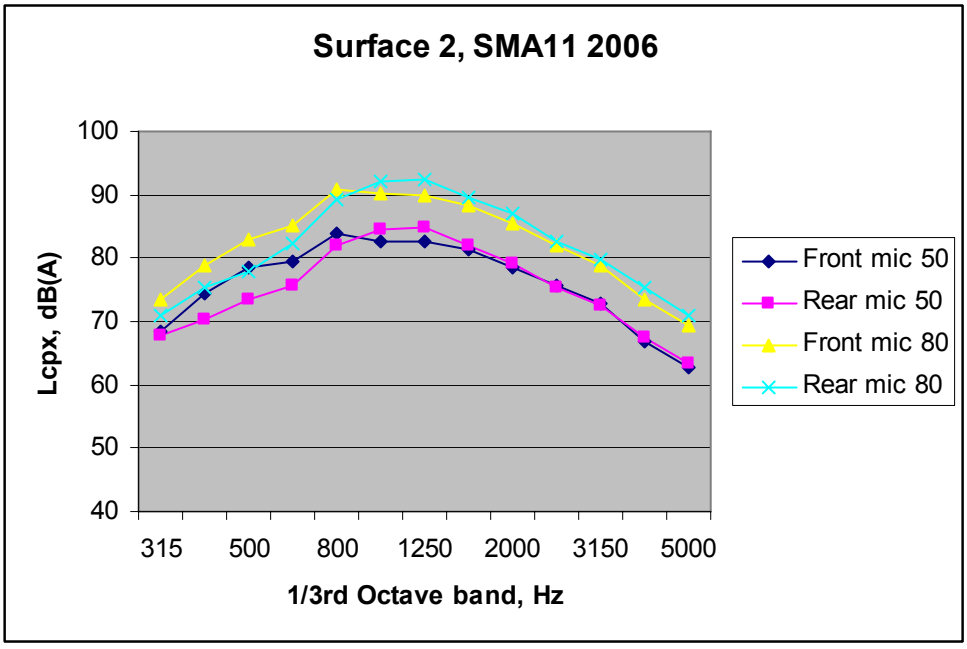
ROAD SURFACE 2: SMA11 2006

CXP_{cars} – 1.0 dB(A)

1/3 octave freq.	50 km/h		80 km/h	
	Front mic	Rear mic	Front mic	Rear mic
Hz	dB(A)	dB(A)	dB(A)	dB(A)
315	68.5	67.9	73.4	71.1
400	74.3	70.2	79.0	75.3
500	78.5	73.4	83.1	77.9
630	79.6	75.7	85.3	82.3
800	83.9	82.1	90.8	89.4
1000	82.6	84.5	90.3	92.1
1250	82.5	84.9	89.8	92.4
1600	81.5	82.0	88.2	89.5
2000	78.5	79.3	85.6	87.0
2500	75.6	75.4	81.9	82.6
3150	72.9	72.6	79.0	79.9
4000	67.0	67.5	73.4	75.4
5000	62.8	63.4	69.5	71.1

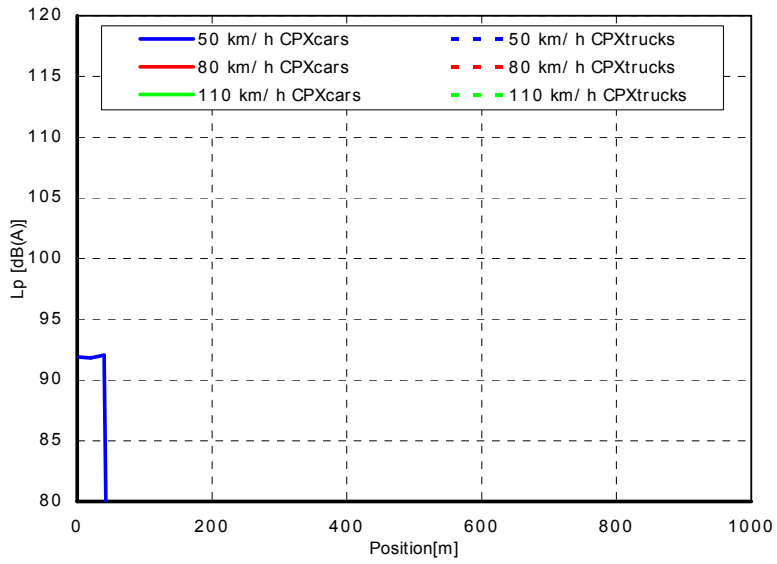


Close Proximity (survey)

(right tyre)

Location	Trondheim - SURFACE 2, E6
Road surface type	SMA11 2006
Test section length	60
Direction	South
Date	22.09.2006
Air temperature	19
Road temperature	20

CPX-LEVELS

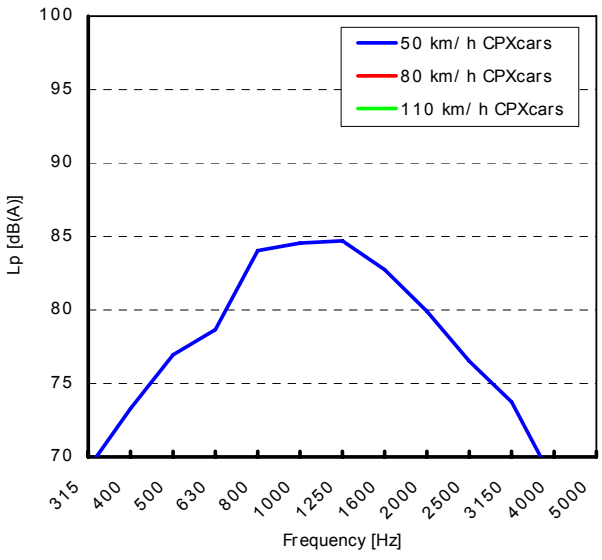


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

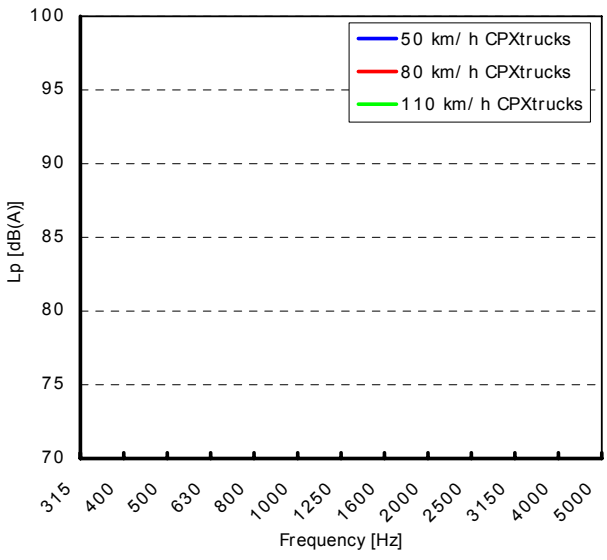
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	91.9	#REF!	#REF!
stand. dev	0.1	####	####
CPX_{trucks} [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	#REF!	#REF!
CPXI [dB(A)]	####	#REF!	#REF!
stand. dev	0.1	####	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 2006

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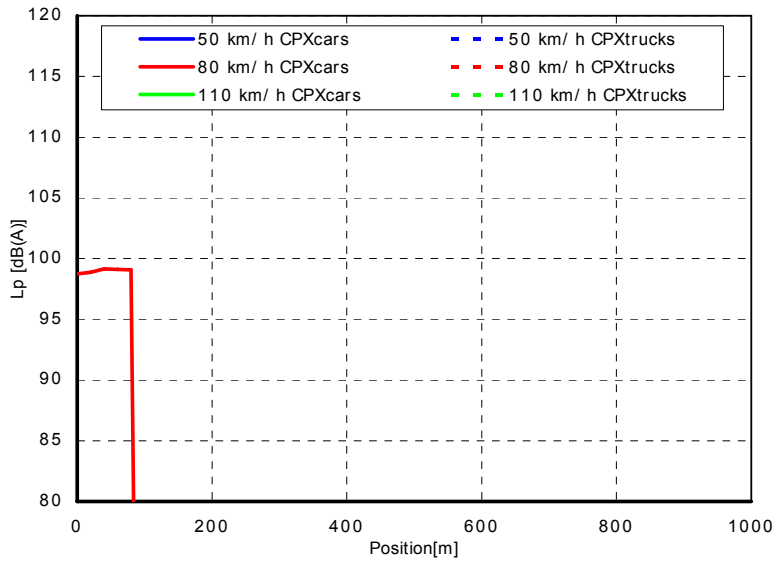
Close Proximity (survey)

(right tyre)

Location	Trondheim - SURFACE 2, E6
Road surface type	SMA11 2006
Test section length	80
Direction	South
Date	22.09.2006
Air temperature	19
Road temperature	20

CPX-LEVELS

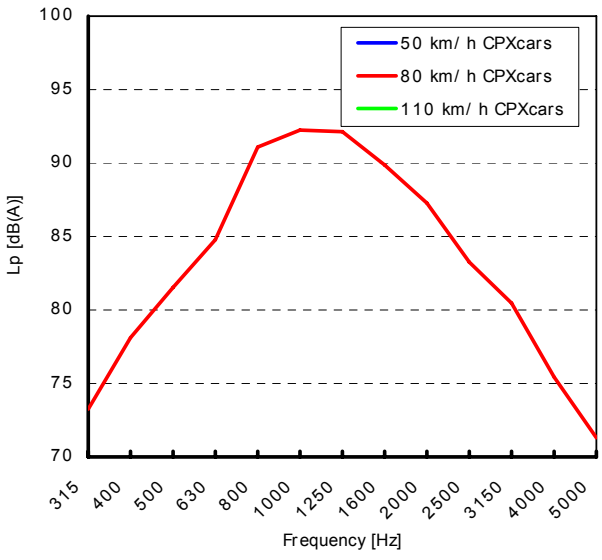


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

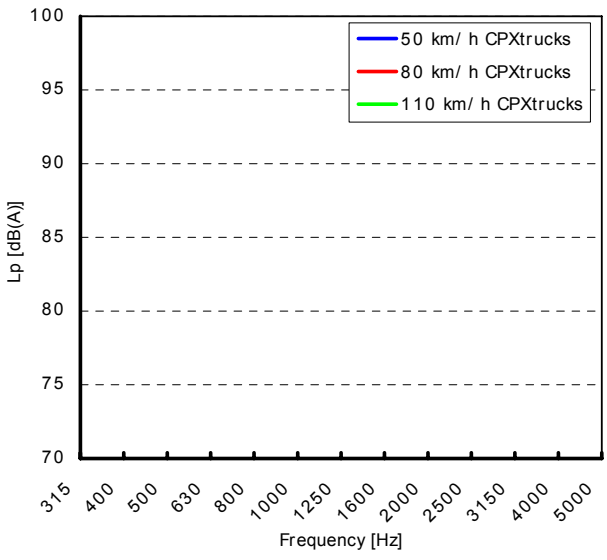
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	#REF!	99.0	#REF!
stand. dev	####	0.2	####
CPX_{trucks} [dB(A)]	#REF!	####	#REF!
stand. dev	#REF!	0.0	#REF!
CPXI [dB(A)]	#REF!	####	#REF!
stand. dev	####	0.1	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 2006

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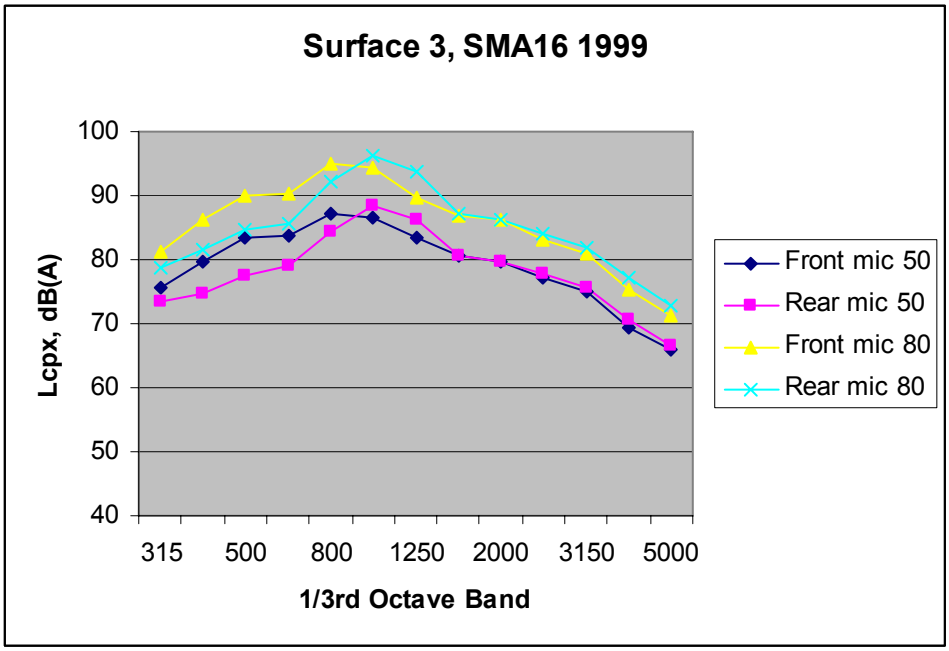
ROAD SURFACE 3: SMA16 1999

CXP_{cars} – 1.0 dB(A)

1/3 octave freq.	50 km/h		80 km/h	
	Front mic	Rear mic	Front mic	Rear mic
Hz	dB(A)	dB(A)	dB(A)	dB(A)
315	75.7	73.5	81.3	78.8
400	79.7	74.8	86.3	81.7
500	83.3	77.5	89.9	84.7
630	83.6	79.0	90.3	85.7
800	87.2	84.3	94.9	92.2
1000	86.6	88.4	94.5	96.1
1250	83.3	86.1	89.8	93.9
1600	80.7	80.5	86.9	87.3
2000	79.8	79.8	86.1	86.4
2500	77.3	77.8	83.2	84.1
3150	75.0	75.5	80.8	81.8
4000	69.3	70.7	75.2	77.2
5000	65.8	66.7	71.4	72.9

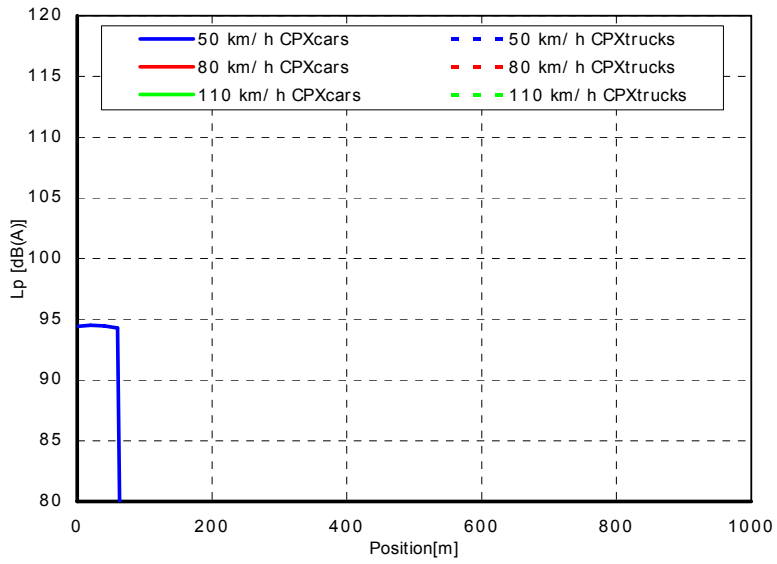


Close Proximity (survey)

(right tyre)

Location	Trondheim - SURFACE 3, E6
Road surface type	SMA16 1999
Test section length	80
Direction	South
Date	22.09.2006
Air temperature	19
Road temperature	20

CPX-LEVELS

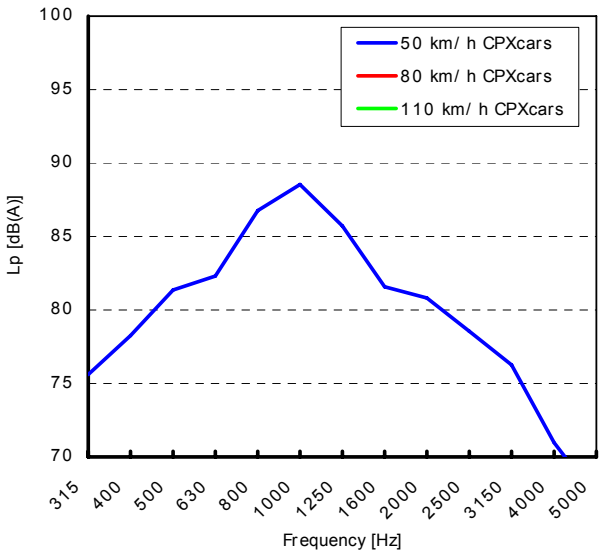


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

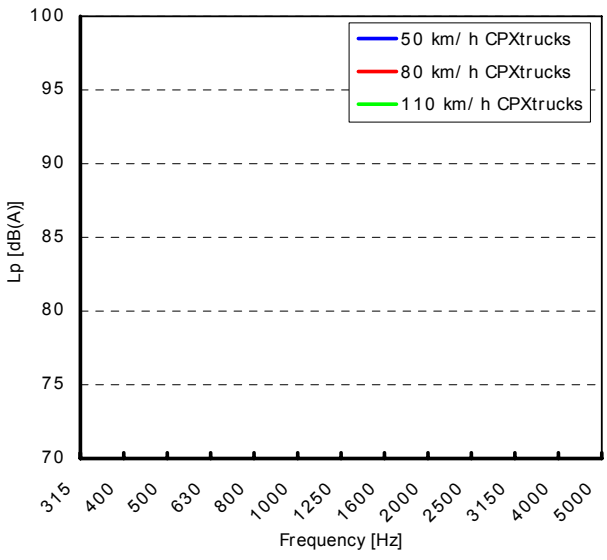
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	94.4	#REF!	#REF!
stand. dev	0.1	####	####
CPX_{trucks} [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	#REF!	#REF!
CPXI [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	####	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA16 1999

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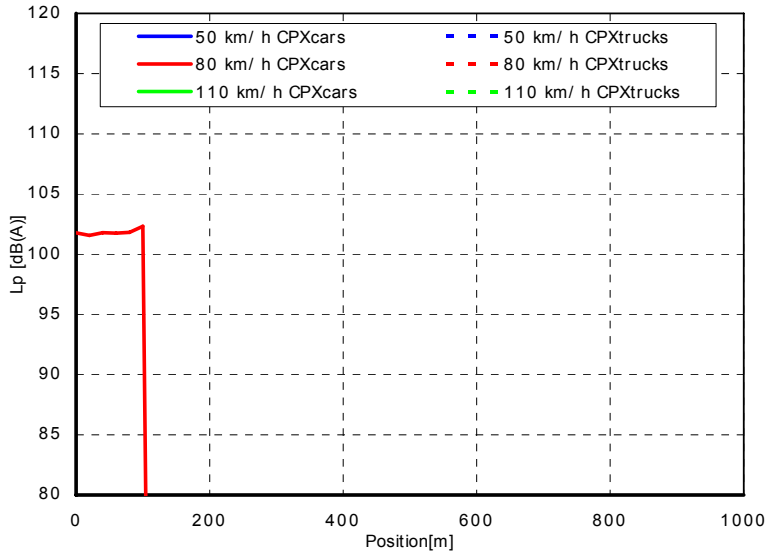
Close Proximity (survey)

(right tyre)

Location	Trondheim - SURFACE 3, E6
Road surface type	SMA16 1999
Test section length	80
Direction	South
Date	22.09.2006
Air temperature	19
Road temperature	20

CPX-LEVELS

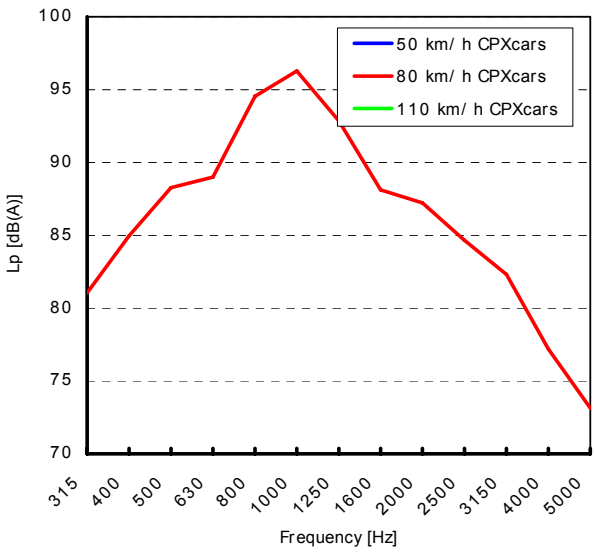


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

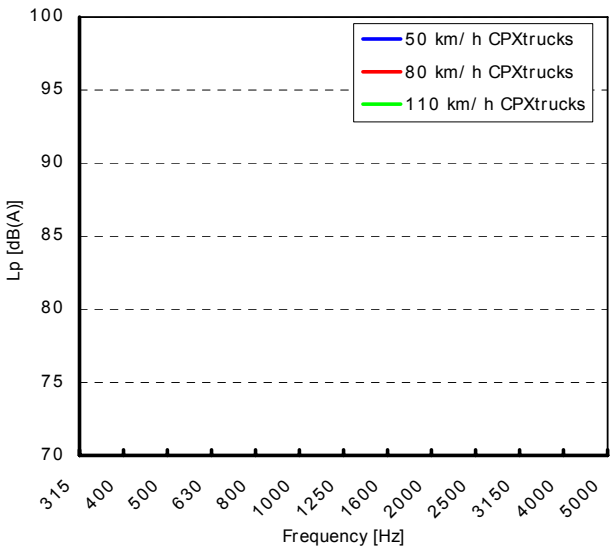
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	#REF!	101.8	#REF!
stand. dev	####	0.3	####
CPX_{trucks} [dB(A)]	#REF!	####	#REF!
stand. dev	#REF!	0.0	#REF!
CPXI [dB(A)]	#REF!	####	#REF!
stand. dev	####	0.1	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA16 1999

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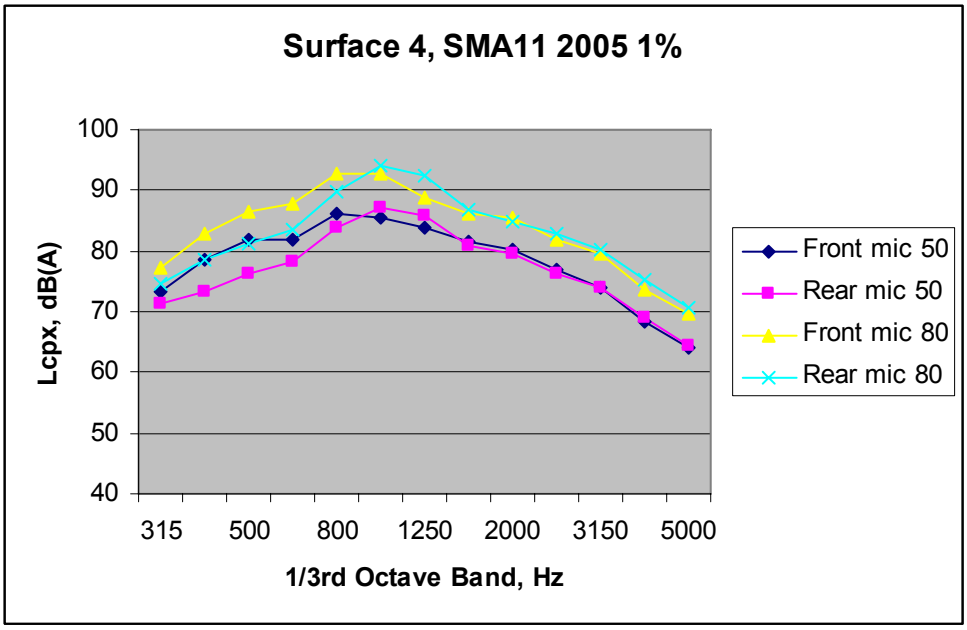
ROAD SURFACE 4: SMA11 2005 (1% rubber)

CXP_{cars} – 1.0 dB(A)

1/3 octave freq.	50 km/h		80 km/h	
	Front mic	Rear mic	Front mic	Rear mic
Hz	dB(A)	dB(A)	dB(A)	dB(A)
315	73.3	71.2	77.2	74.5
400	78.6	73.3	82.7	78.7
500	81.9	76.1	86.6	81.1
630	81.9	78.1	87.8	83.6
800	86.3	83.9	92.7	89.9
1000	85.6	87.1	92.8	94.1
1250	83.9	85.7	88.7	92.3
1600	81.5	81.0	86.3	86.7
2000	80.1	79.5	85.4	85.0
2500	76.8	76.4	82.0	82.7
3150	74.0	73.9	79.7	80.3
4000	68.2	69.0	73.7	75.4
5000	64.2	64.5	69.7	70.8

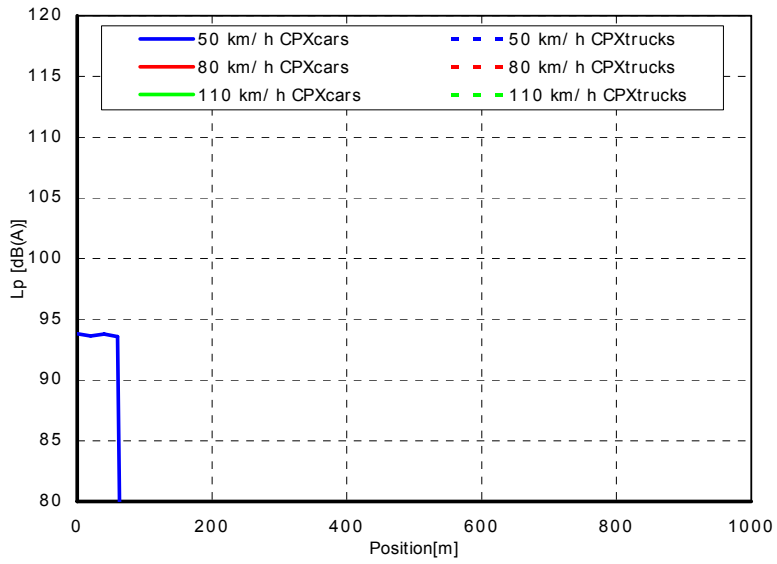


Close Proximity (survey)

(right tyre)

Location	Melhus - SURFACE 4, E6
Road surface type	SMA11 1% 2005
Test section length	80
Direction	North
Date	22.09.2006
Air temperature	20
Road temperature	20

CPX-LEVELS

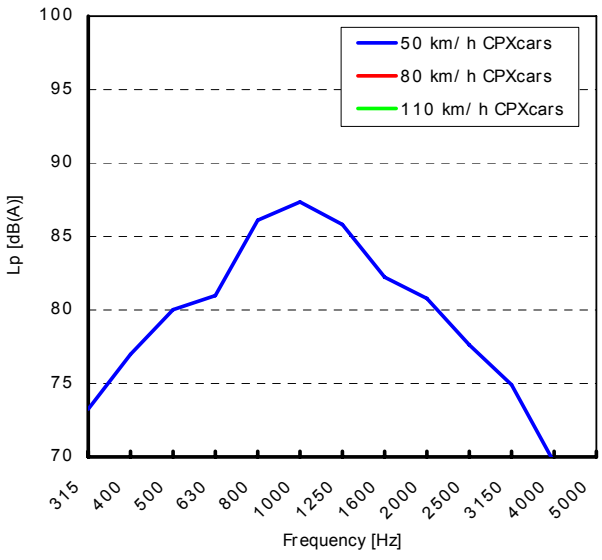


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

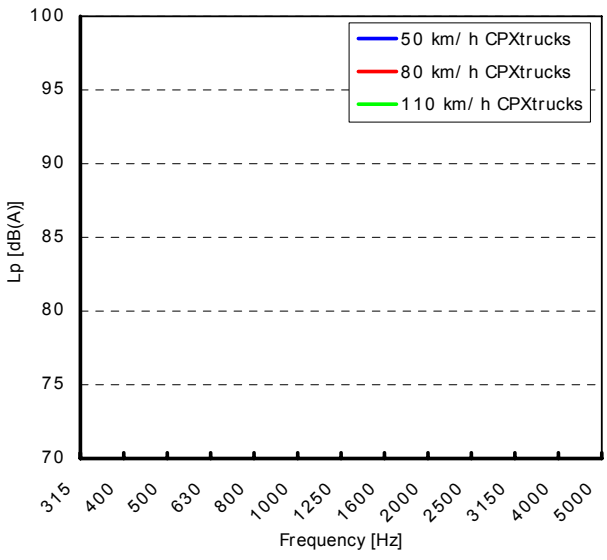
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	93.7	#REF!	#REF!
stand. dev	0.1	####	####
CPX_{trucks} [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	#REF!	#REF!
CPXI [dB(A)]	####	#REF!	#REF!
stand. dev	0.1	####	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 1% 2005

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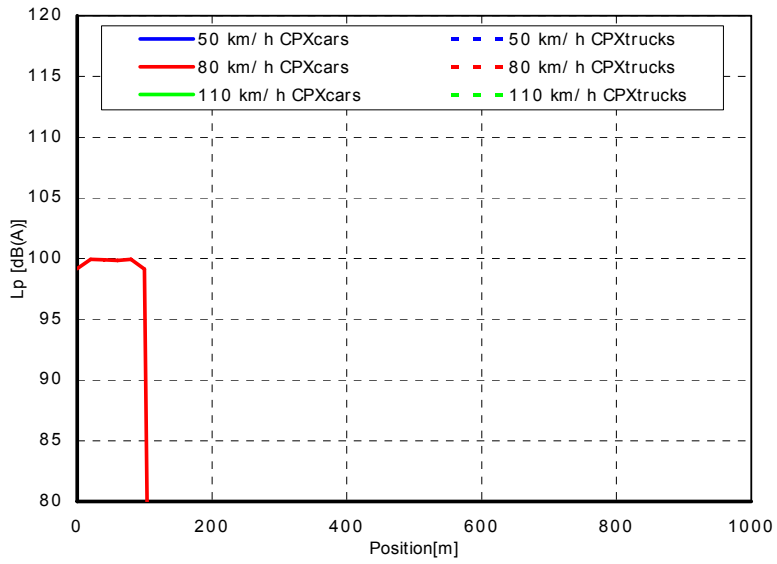
Close Proximity (survey)

(right tyre)

Location	Melhus - SURFACE 4, E6
Road surface type	SMA11 1% 2005
Test section length	100
Direction	North
Date	22.09.2006
Air temperature	20
Road temperature	20

CPX-LEVELS

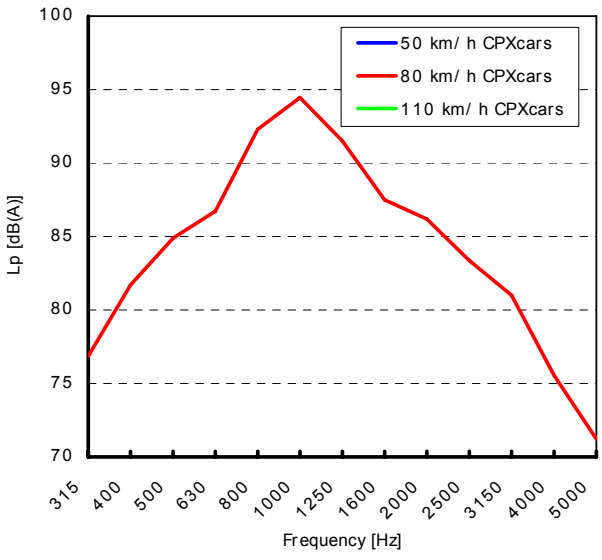


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

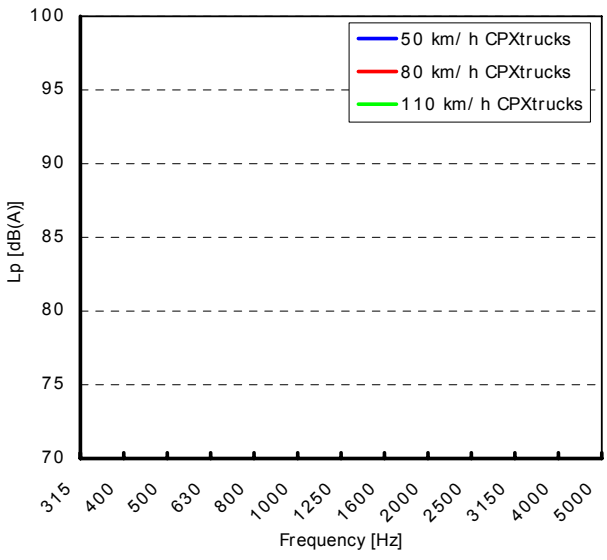
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	#REF!	99.7	#REF!
stand. dev	####	0.4	####
CPX_{trucks} [dB(A)]	#REF!	####	#REF!
stand. dev	#REF!	0.0	#REF!
CPXI [dB(A)]	#REF!	####	#REF!
stand. dev	####	0.2	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 1% 2005

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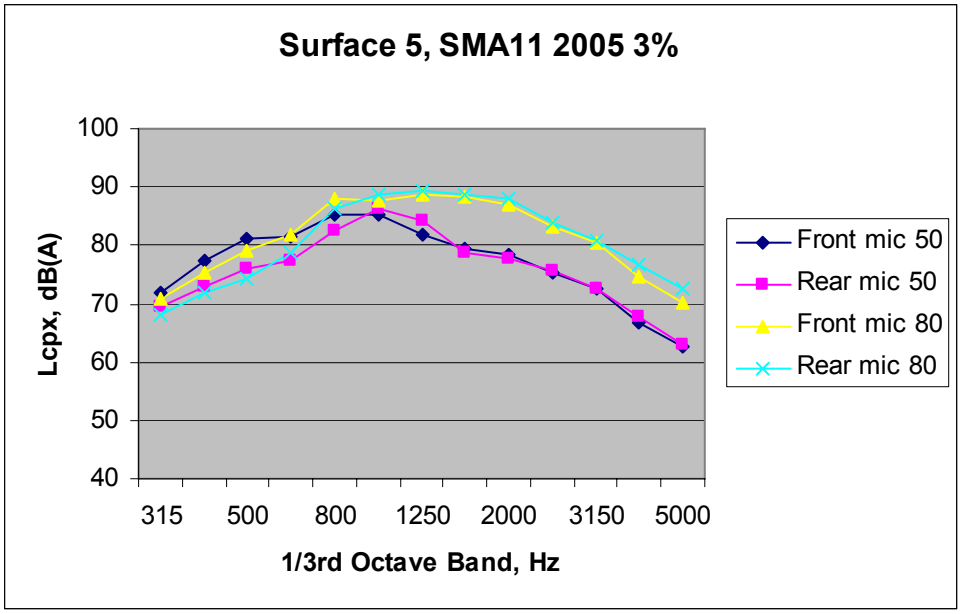
ROAD SURFACE 5: SMA11 2005 (3% rubber)

CXP_{cars} – 1.0 dB(A)

1/3 octave freq.	50 km/h		80 km/h	
	Front mic	Rear mic	Front mic	Rear mic
Hz	dB(A)	dB(A)	dB(A)	dB(A)
315	71.9	69.5	70.7	68.2
400	77.5	72.8	75.2	71.8
500	81.3	76.0	79.0	74.4
630	81.6	77.3	81.9	78.8
800	85.3	82.4	88.1	86.4
1000	85.1	86.3	87.7	88.7
1250	82.0	84.3	88.7	89.5
1600	79.6	78.9	88.3	88.7
2000	78.5	77.8	87.0	87.8
2500	75.4	75.6	83.2	83.8
3150	72.7	72.7	80.3	80.8
4000	66.7	67.7	74.7	76.6
5000	62.6	63.0	70.1	72.6

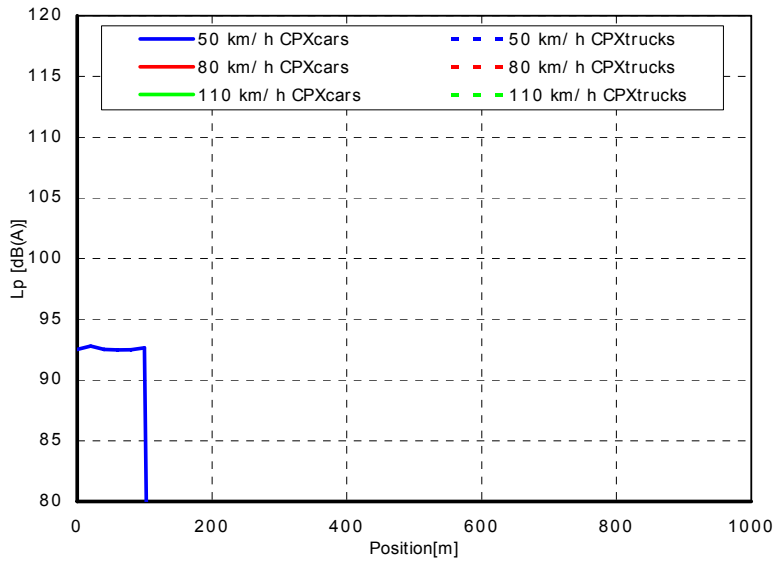


Close Proximity (survey)

(right tyre)

Location	Melhus - SURFACE 5, E6
Road surface type	SMA11 3% 2005
Test section length	100
Direction	North
Date	22.09.2006
Air temperature	20
Road temperature	20

CPX-LEVELS

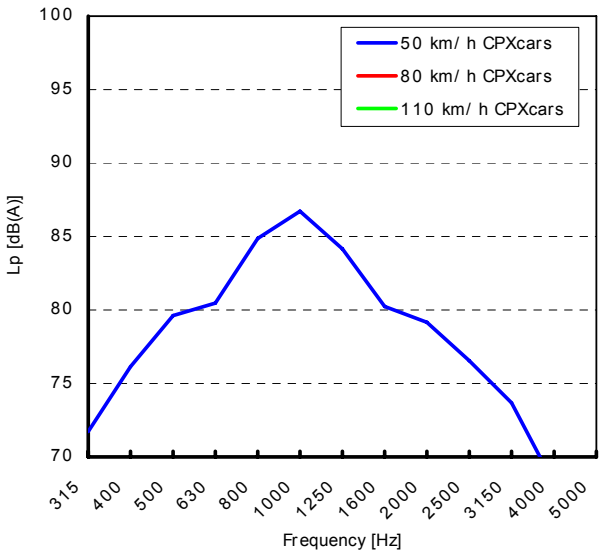


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

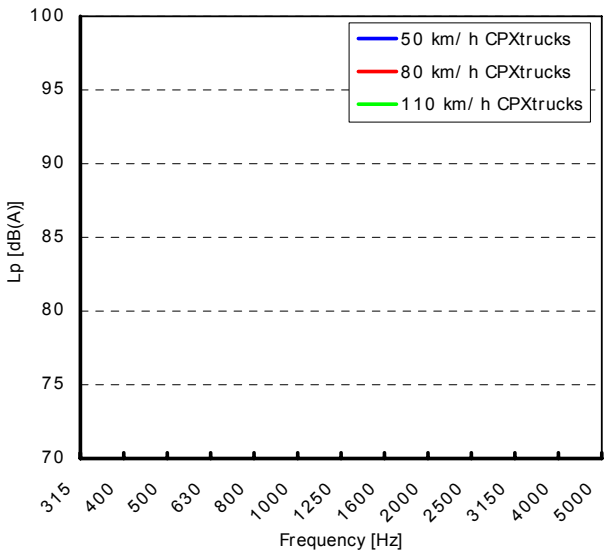
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	92.6	#REF!	#REF!
stand. dev	0.1	####	####
CPX_{trucks} [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	#REF!	#REF!
CPXI [dB(A)]	####	#REF!	#REF!
stand. dev	0.1	####	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 3% 2005

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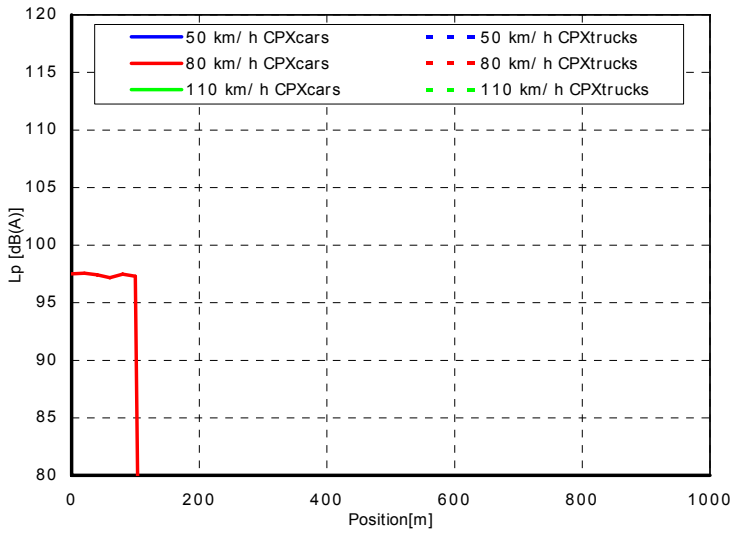
Close Proximity (survey)

(right tyre)

Location	Melhus - SURFACE 5, E6
Road surface type	SMA11 3% 2005
Test section length	80
Direction	North
Date	22.09.2006
Air temperature	20
Road temperature	20

CPX-LEVELS

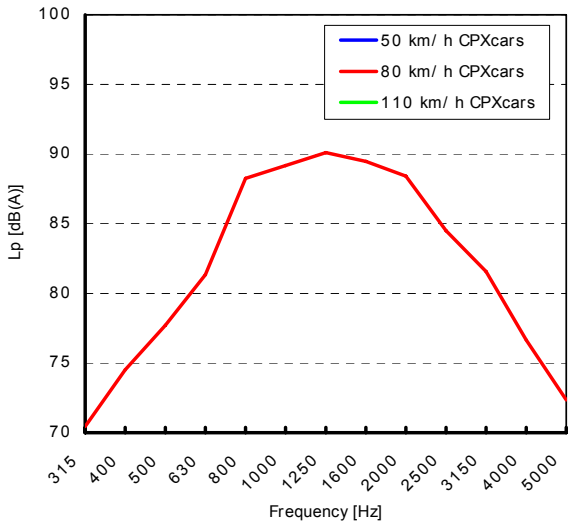


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

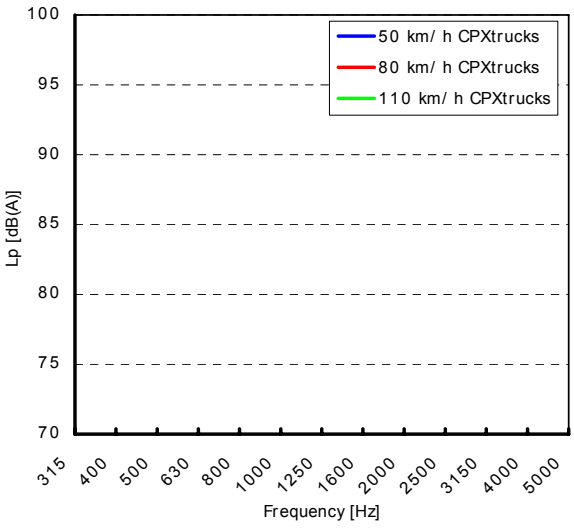
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	#REF!	97.4	#REF!
stand. dev	####	0.2	####
CPX_{trucks} [dB(A)]	#REF!	####	#REF!
stand. dev	#REF!	0.0	#REF!
CPXI [dB(A)]	#REF!	####	#REF!
stand. dev	####	0.1	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: SMA11 3% 2005

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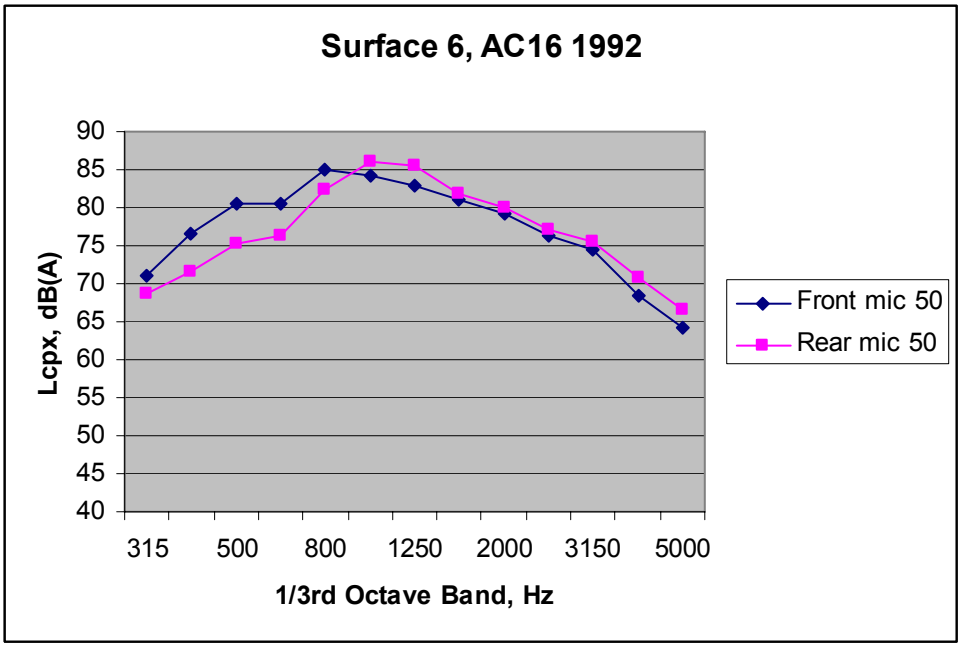
ROAD SURFACE 6: AC16 1992

CXP_{cars} – 1.0 dB(A)

1/3 octave freq.	50 km/h	
	Front mic	Rear mic
Hz	dB(A)	dB(A)
315	71.0	68.6
400	76.7	71.5
500	80.4	75.2
630	80.5	76.3
800	85.0	82.4
1000	84.2	86.0
1250	82.8	85.5
1600	81.1	81.9
2000	79.1	79.9
2500	76.2	77.0
3150	74.4	75.6
4000	68.3	70.9
5000	64.2	66.6

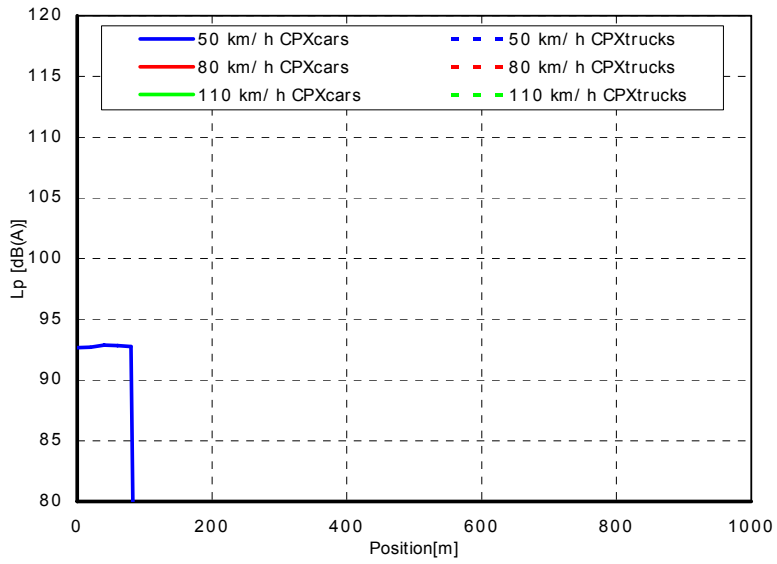


Close Proximity (survey)

(right tyre)

Location	Flakk - SURFACE 6, Rv707
Road surface type	AC16 1992
Test section length	80
Direction	South
Date	22.09.2006
Air temperature	18
Road temperature	17

CPX-LEVELS

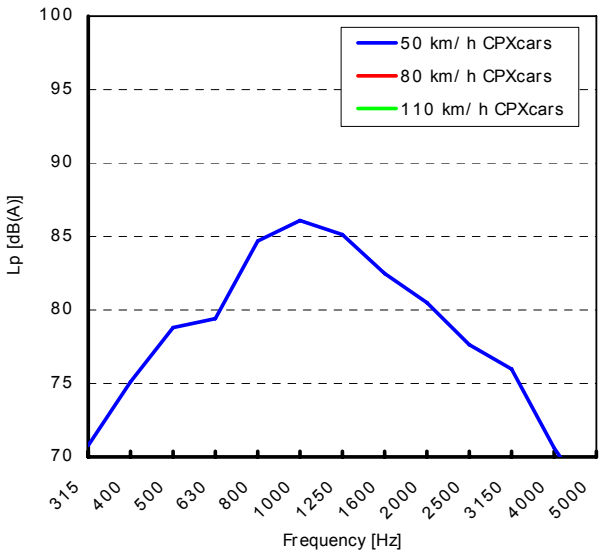


tyre A : ContiEcoContact
tyre D : Dunlop SP Artic

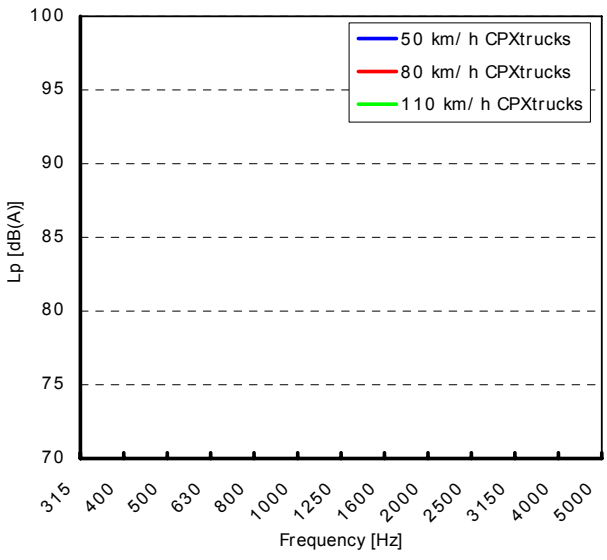
v [km/ h]	50	80	110
CPX_{cars} [dB(A)]	92.8	#REF!	#REF!
stand. dev	0.1	####	####
CPX_{trucks} [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	#REF!	#REF!
CPXI [dB(A)]	####	#REF!	#REF!
stand. dev	0.0	####	####

FREQUENCY-ANALYSIS

1/ 3-octave-band spectrum of CPX_{cars}



1/ 3-octave-band spectrum of CPX_{trucks}



CPX-measurement: AC16 1992

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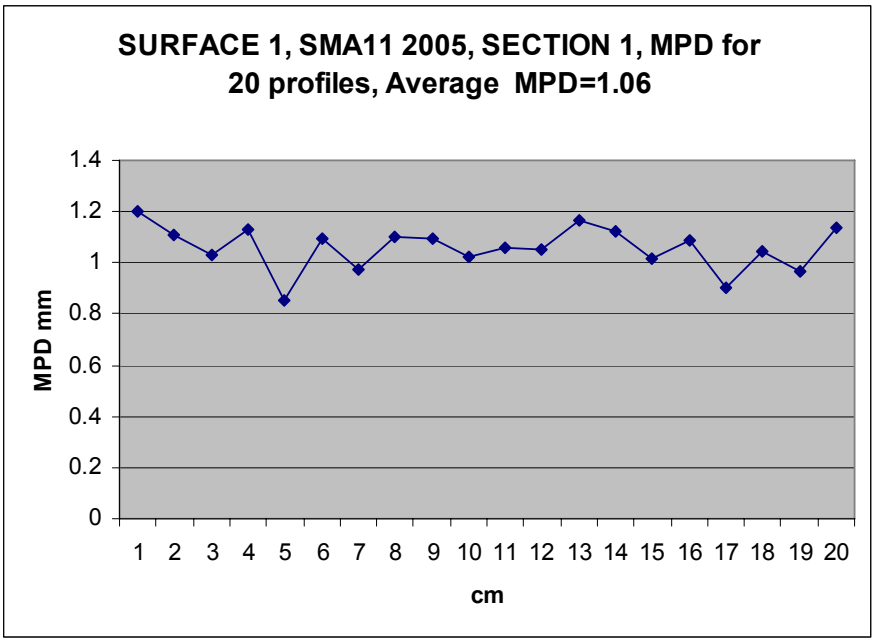
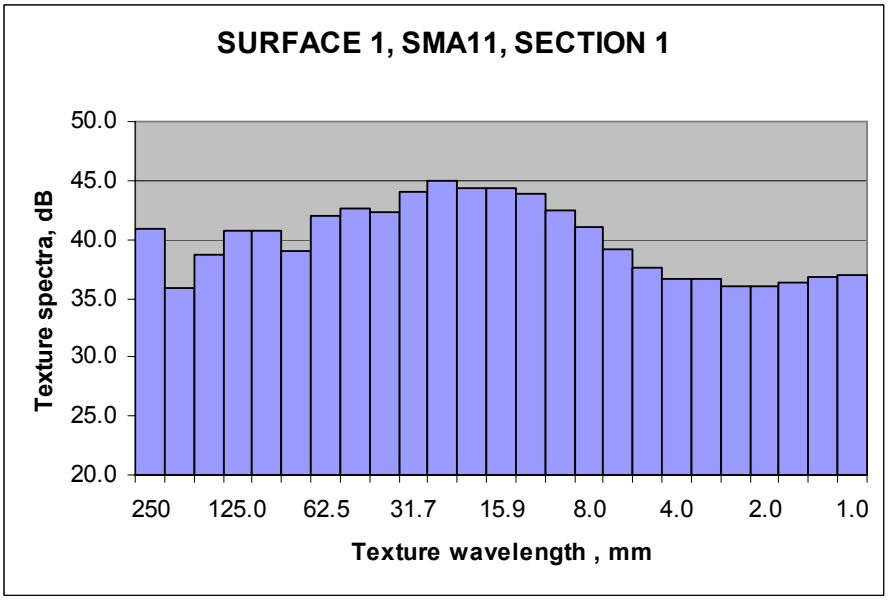
ANNEX B:
TEXTURE MEASUREMENT RESULTS

ROAD SURFACE 1: SMA11 2005

SECTION 1



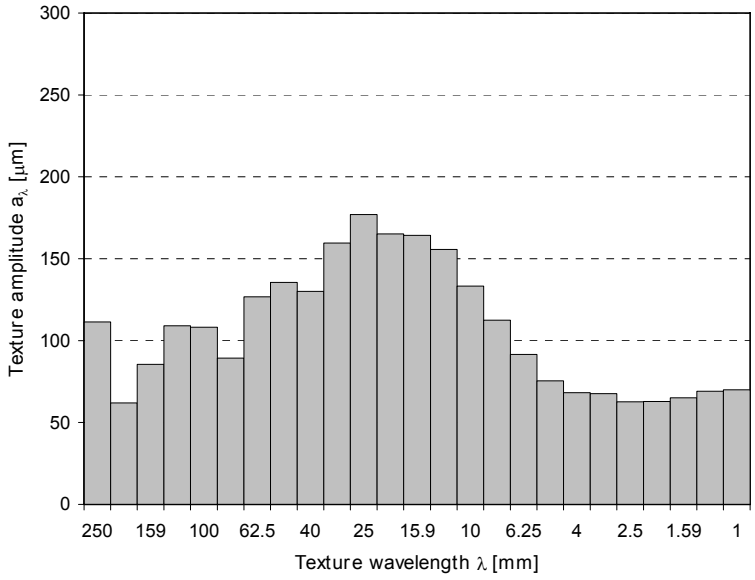


Texture

Location	E6 OMKJVN SURFACE 1
Date	2006-09-14
Test Field	SECTION 1
Position	R, right wheel track
Road Surface	SMA11 2005
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	111	40.9
200	62	35.8
160	86	38.6
125	109	40.8
100	108	40.7
80	89	39.0
63	127	42.1
50	136	42.6
40	130	42.3
32	160	44.1
25	177	45.0
20	165	44.4
16	164	44.3
13	156	43.8
10	133	42.5
8	112	41.0
6.3	92	39.2
5	76	37.6
4	68	36.7
3.2	68	36.6
2.5	63	35.9
2.0	63	36.0
1.6	65	36.3
1.25	69	36.8
1.0	70	36.9



		St. dev. [mm]
MPD **[mm]**	**1.06**	**0.09**
ETD **[mm]**	**1.05**	**0.07**
RMS **[mm]**	**0.50**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 1, Test Field SECTION 1, SMA11 2005

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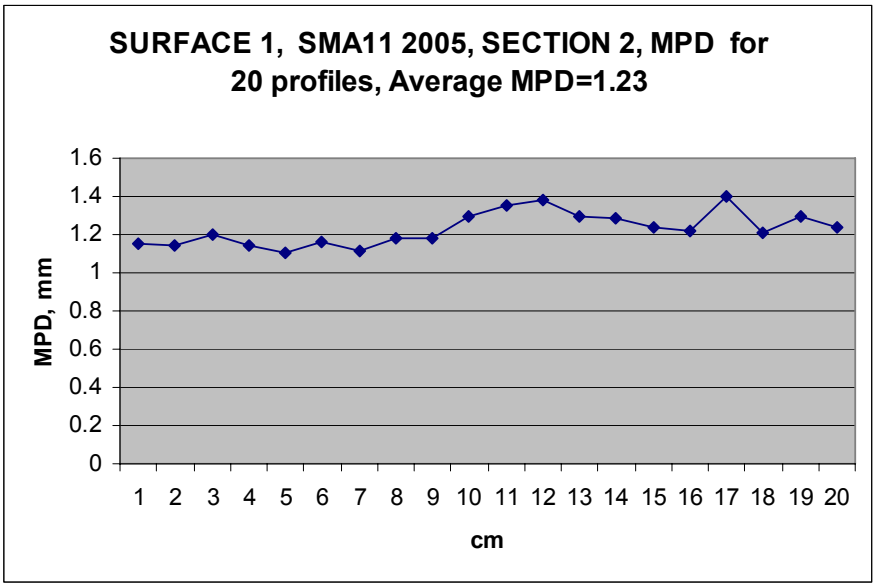
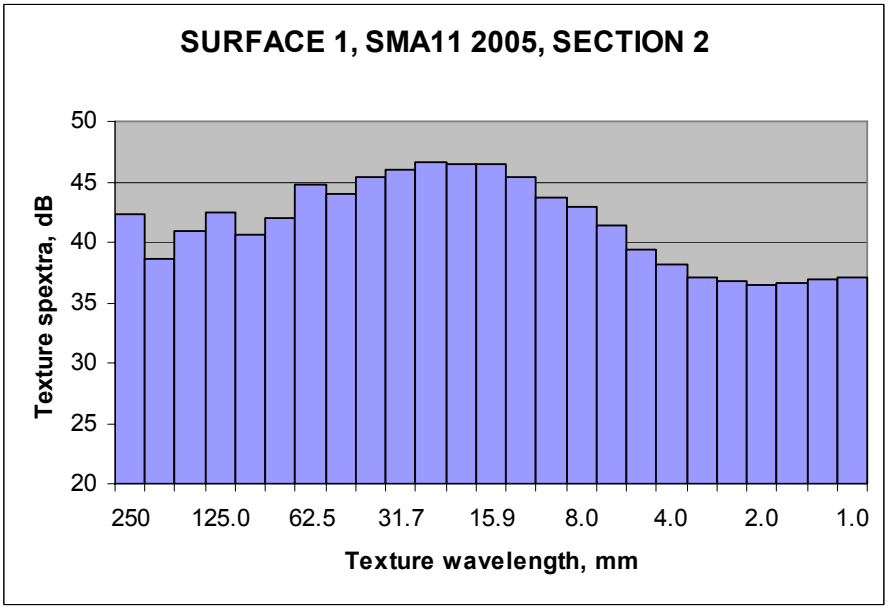
SECTION 2


SURFACE 1, SMA11 2005, SECTION 2, MPD for 20 profiles, Average MPD=1.23
MPD, mm
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
cm

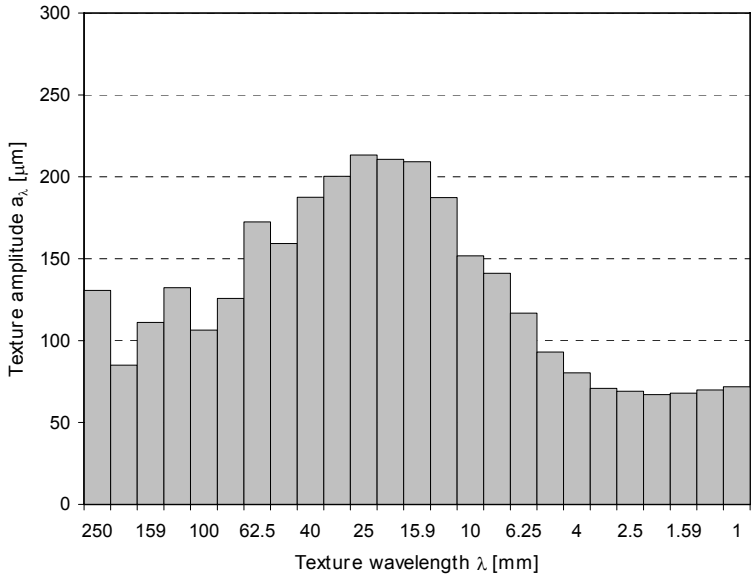

SURFACE 1, SMA11 2005, SECTION 2
Texture spextra, dB
50
45
40
35
30
25
20
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 OMKJVN SURFACE 1
Date	2006-09-14
Test Field	SECTION 2
Position	R, right wheel track
Road Surface	SMA11 2005
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	131	42.3
200	85	38.6
160	111	40.9
125	132	42.4
100	106	40.5
80	126	42.0
63	172	44.7
50	159	44.0
40	187	45.5
32	200	46.0
25	213	46.6
20	211	46.5
16	209	46.4
13	187	45.5
10	152	43.6
8	141	43.0
6.3	117	41.3
5	93	39.4
4	80	38.1
3.2	71	37.0
2.5	69	36.8
2.0	67	36.5
1.6	68	36.7
1.25	70	36.9
1.0	72	37.1



		St. dev. [mm]
MPD **[mm]**	**1.23**	**0.09**
ETD **[mm]**	**1.18**	**0.07**
RMS **[mm]**	**0.61**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 1, Test Field SECTION 2, SMA11 2005

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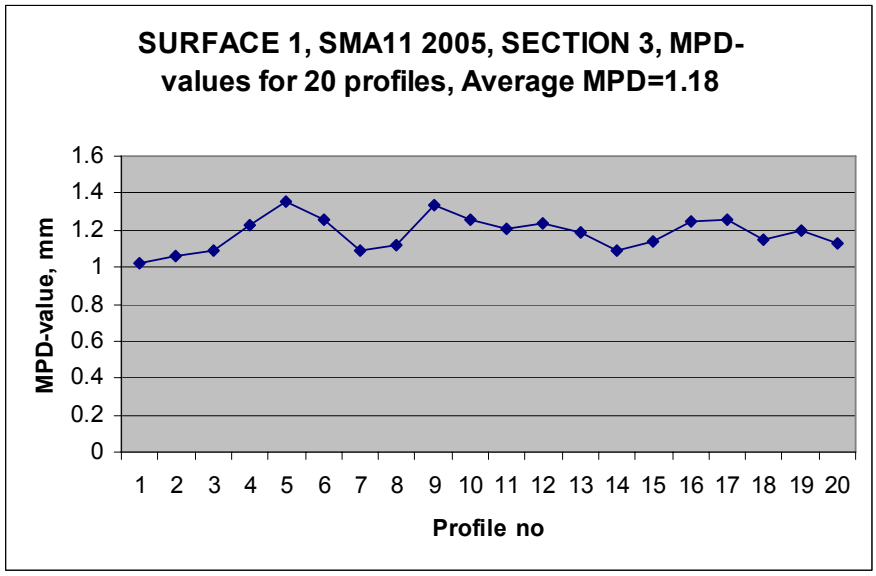
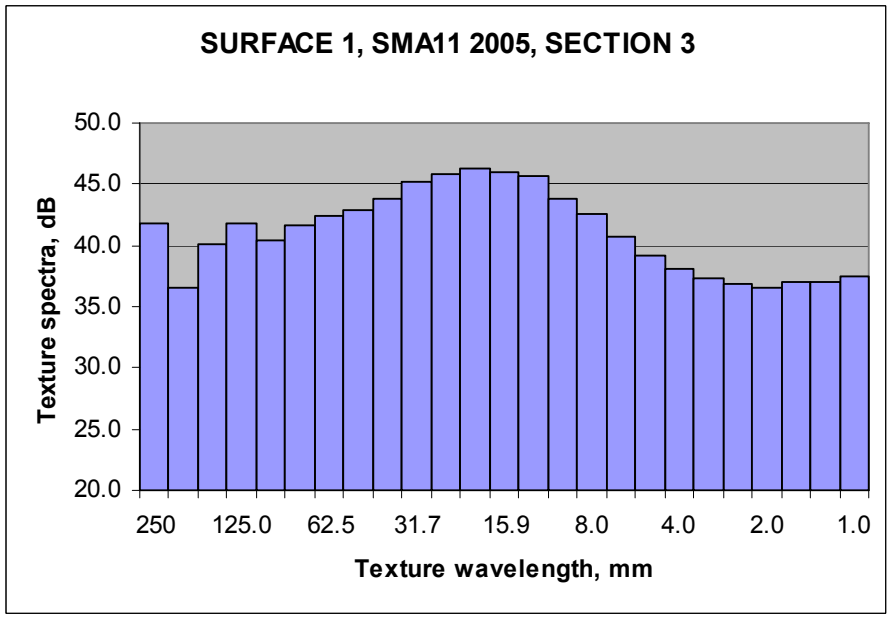
SECTION 3


SURFACE 1, SMA11 2005, SECTION 3, MPD-values for 20 profiles, Average MPD=1.18
MPD-value, mm
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Profile no

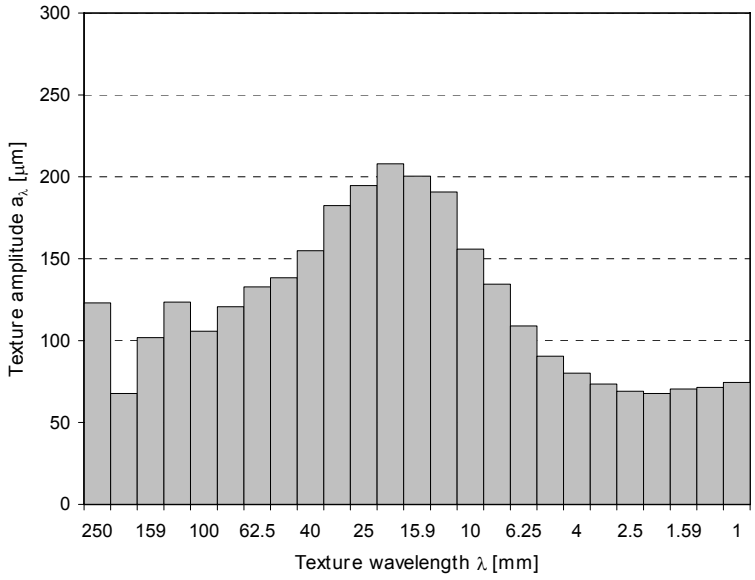

SURFACE 1, SMA11 2005, SECTION 3
Texture spectra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 OMKJVN SURFACE 1
Date	2006-09-14
Test Field	SECTION 3
Position	R, right wheel track
Road Surface	SMA11 2005
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	123	41.8
200	68	36.6
160	102	40.2
125	123	41.8
100	106	40.5
80	121	41.6
63	133	42.5
50	138	42.8
40	155	43.8
32	182	45.2
25	195	45.8
20	208	46.4
16	200	46.0
13	191	45.6
10	156	43.9
8	134	42.6
6.3	109	40.7
5	91	39.1
4	80	38.1
3.2	73	37.3
2.5	69	36.8
2.0	68	36.6
1.6	71	37.0
1.25	71	37.1
1.0	75	37.4



		St. dev. [mm]
MPD **[mm]**	**1.18**	**0.09**
ETD **[mm]**	**1.15**	**0.07**
RMS **[mm]**	**0.56**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 1, Test Field SECTION 3, SMA11 2005

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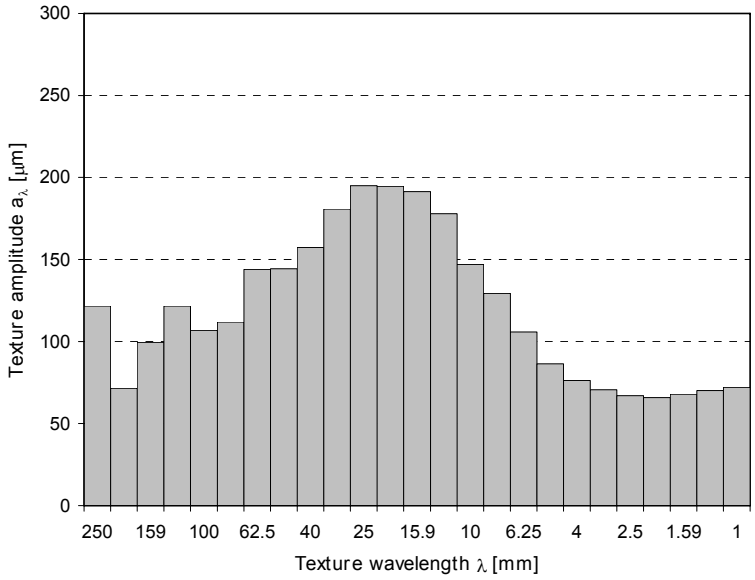
ROAD SURFACE 1, AVERAGE OF SECTION 1, 2 AND 3:

Texture

Location	E6 OMKJVN SURFACE 1
Date	2006-09-14
Test Field	SECTION 1 + 2 + 3
Position	R, right wheel track
Road Surface	SMA11 2005
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	122	41.7
200	72	37.1
160	100	40.0
125	122	41.7
100	107	40.6
80	112	41.0
63	144	43.2
50	144	43.2
40	157	43.9
32	181	45.1
25	195	45.8
20	195	45.8
16	191	45.6
13	178	45.0
10	147	43.3
8	129	42.2
6.3	106	40.5
5	86	38.7
4	76	37.6
3.2	71	37.0
2.5	67	36.5
2.0	66	36.4
1.6	68	36.6
1.25	70	36.9
1.0	72	37.2



		St. dev. [mm]
MPD **[mm]**	**1.16**	**0.11**
ETD **[mm]**	**1.13**	**0.09**
RMS **[mm]**	**0.56**	**0.07**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 1, Test Field SECTION 1 + 2 + 3, SMA11 2005

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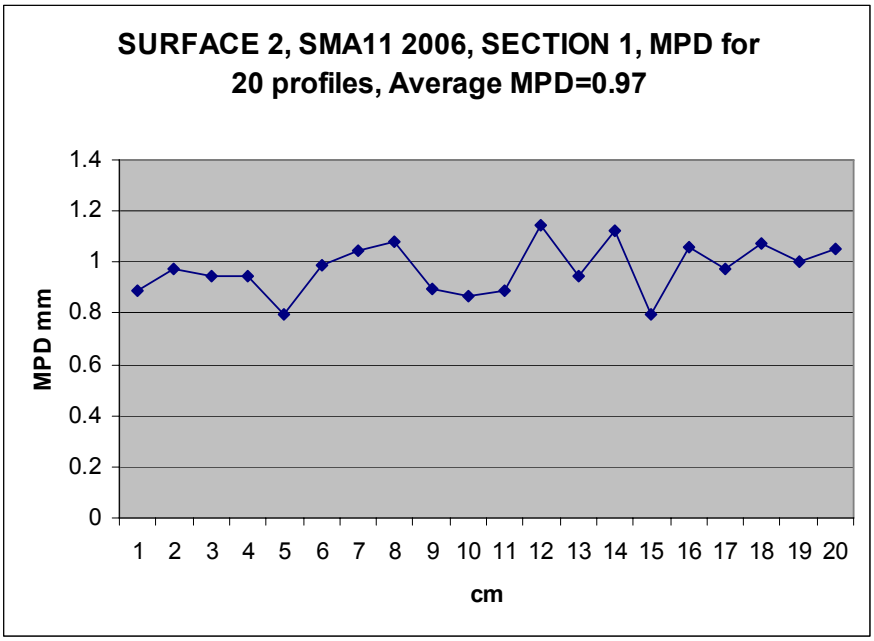
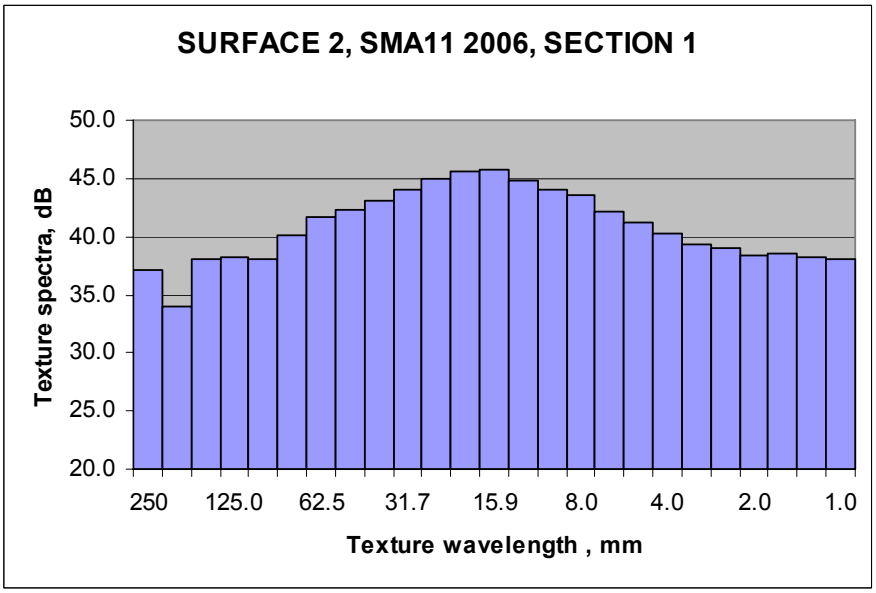
ROAD SURFACE 2: SMA11 2006

SECTION 1:



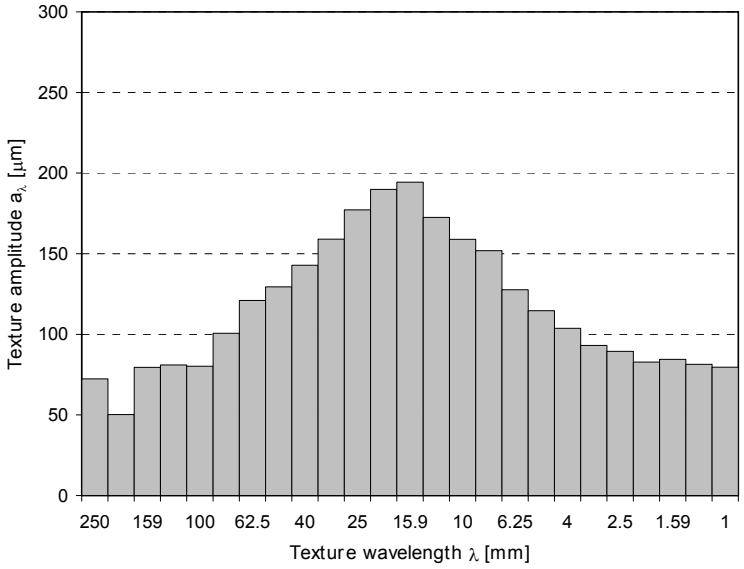


Texture

Location	E6 OMKJVN SURFACE 2
Date	2006-09-14
Test Field	SECTION 1
Position	R, right wheel track
Road Surface	SMA11 2006
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	72	37.2
200	50	34.0
160	79	38.0
125	81	38.2
100	80	38.1
80	101	40.1
63	121	41.7
50	129	42.2
40	143	43.1
32	159	44.0
25	177	45.0
20	190	45.6
16	194	45.8
13	173	44.7
10	159	44.0
8	152	43.6
6.3	128	42.1
5	115	41.2
4	104	40.3
3.2	93	39.4
2.5	89	39.0
2.0	83	38.4
1.6	84	38.5
1.25	81	38.2
1.0	80	38.0



		St. dev. [mm]
MPD [mm]	0.97	0.10
ETD [mm]	0.98	0.08
RMS [mm]	0.55	0.05

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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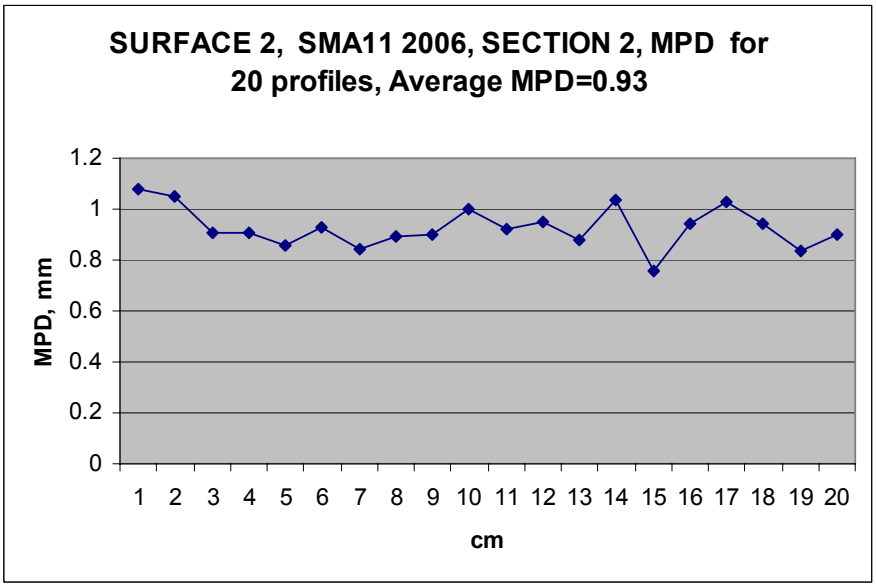
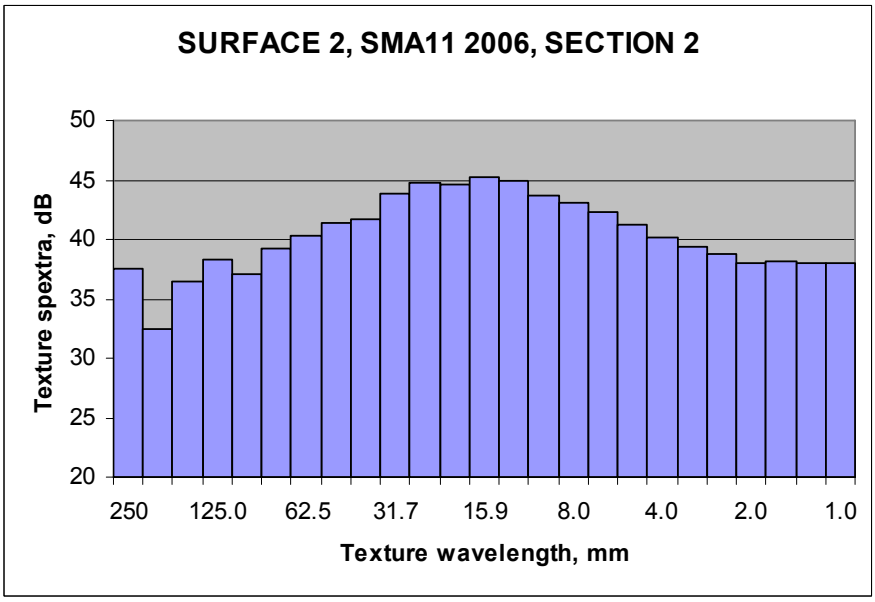
SECTION 2:


SURFACE 2, SMA11 2006, SECTION 2, MPD for 20 profiles, Average MPD=0.93
MPD, mm
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
cm

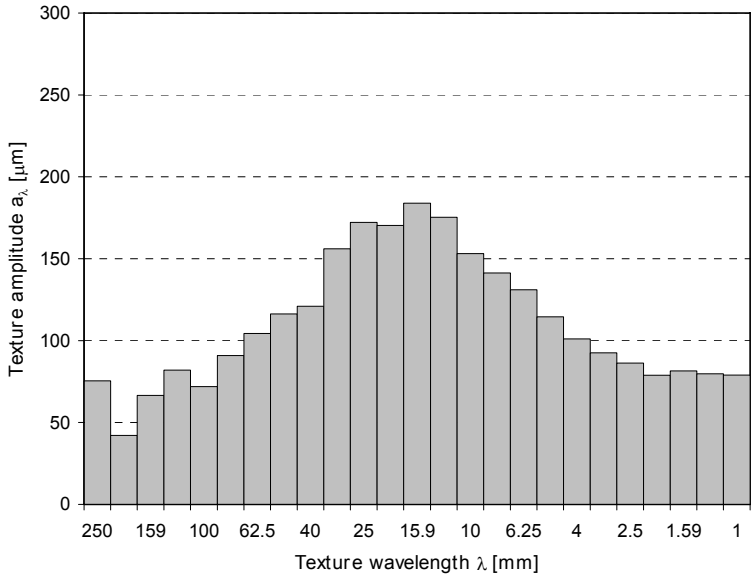

SURFACE 2, SMA11 2006, SECTION 2
Texture spextra, dB
50
45
40
35
30
25
20
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 OMKJVN SURFACE 2
Date	2006-09-14
Test Field	SECTION 2
Position	R, right wheel track
Road Surface	SMA11 2006
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	76	37.6
200	42	32.5
160	67	36.5
125	82	38.3
100	72	37.1
80	91	39.2
63	104	40.4
50	116	41.3
40	121	41.7
32	156	43.9
25	172	44.7
20	170	44.6
16	184	45.3
13	175	44.9
10	153	43.7
8	141	43.0
6.3	131	42.3
5	115	41.2
4	101	40.1
3.2	93	39.3
2.5	86	38.7
2.0	79	37.9
1.6	82	38.2
1.25	80	38.0
1.0	79	38.0



		St. dev. [mm]
MPD **[mm]**	**0.93**	**0.08**
ETD **[mm]**	**0.94**	**0.06**
RMS **[mm]**	**0.54**	**0.04**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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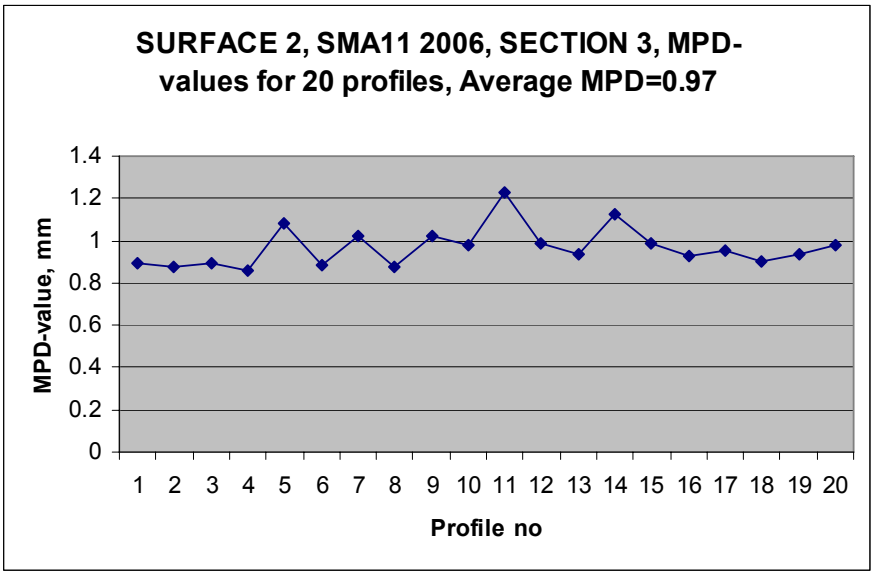
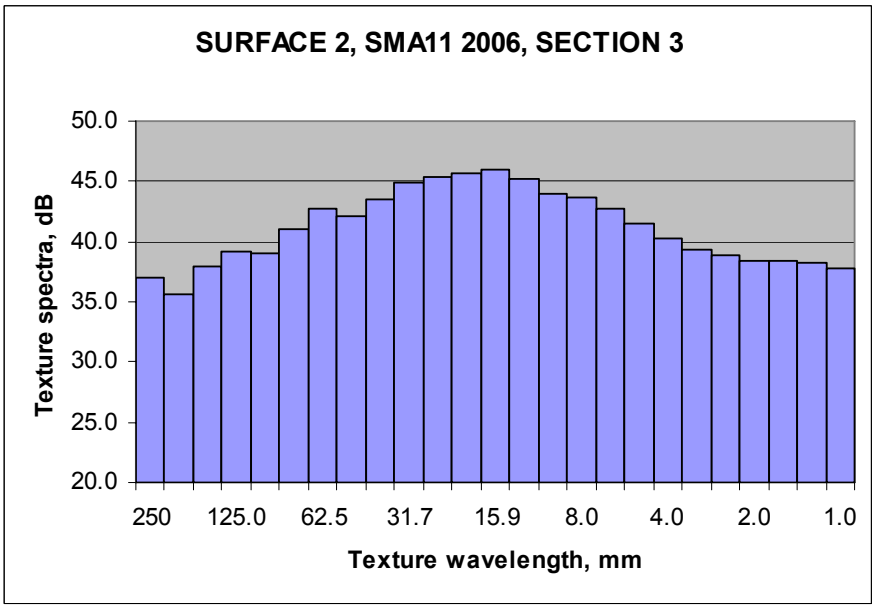
SECTION 3:


SURFACE 2, SMA11 2006, SECTION 3, MPD-values for 20 profiles, Average MPD=0.97
MPD-value, mm
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Profile no

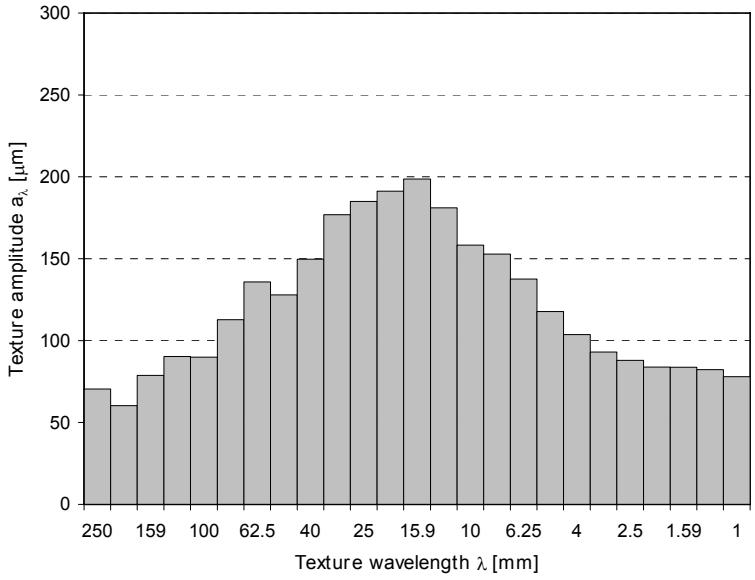

SURFACE 2, SMA11 2006, SECTION 3
Texture spectra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 OMKJVN SURFACE 2
Date	2006-09-14
Test Field	SECTION 3
Position	R, right wheel track
Road Surface	SMA11 2006
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	70	37.0
200	60	35.6
160	79	37.9
125	90	39.1
100	90	39.1
80	113	41.0
63	136	42.7
50	128	42.1
40	150	43.5
32	177	45.0
25	185	45.3
20	191	45.6
16	199	46.0
13	181	45.2
10	158	44.0
8	153	43.7
6.3	138	42.8
5	118	41.4
4	104	40.3
3.2	93	39.4
2.5	88	38.9
2.0	84	38.5
1.6	84	38.5
1.25	82	38.3
1.0	78	37.8



		St. dev. [mm]
MPD **[mm]**	**0.97**	**0.09**
ETD **[mm]**	**0.97**	**0.08**
RMS **[mm]**	**0.59**	**0.04**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 2, Test Field SECTION 3, SMA11 2006

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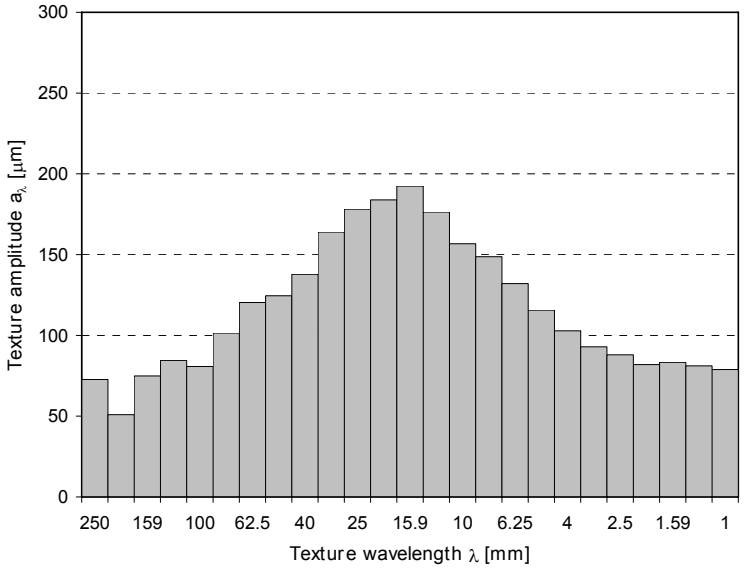
ROAD SURFACE 2, AVERAGE OF SECTION 1, 2 AND 3:

Texture

Location	E6 OMKJVN SURFACE 2
Date	2006-09-14
Test Field	SECTION 1 + 2 + 3
Position	R, right wheel track
Road Surface	SMA11 2006
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	73	37.2
200	51	34.1
160	75	37.5
125	84	38.5
100	81	38.1
80	101	40.1
63	120	41.6
50	125	41.9
40	138	42.8
32	164	44.3
25	178	45.0
20	184	45.3
16	192	45.7
13	176	44.9
10	157	43.9
8	149	43.4
6.3	132	42.4
5	116	41.3
4	103	40.2
3.2	93	39.4
2.5	88	38.9
2.0	82	38.3
1.6	83	38.4
1.25	81	38.2
1.0	79	37.9



		St. dev. [mm]
MPD [mm]	**0.96**	**0.09**
ETD [mm]	**0.97**	**0.07**
RMS [mm]	**0.56**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 2, Test Field SECTION 1 + 2 + 3, SMA11 2006

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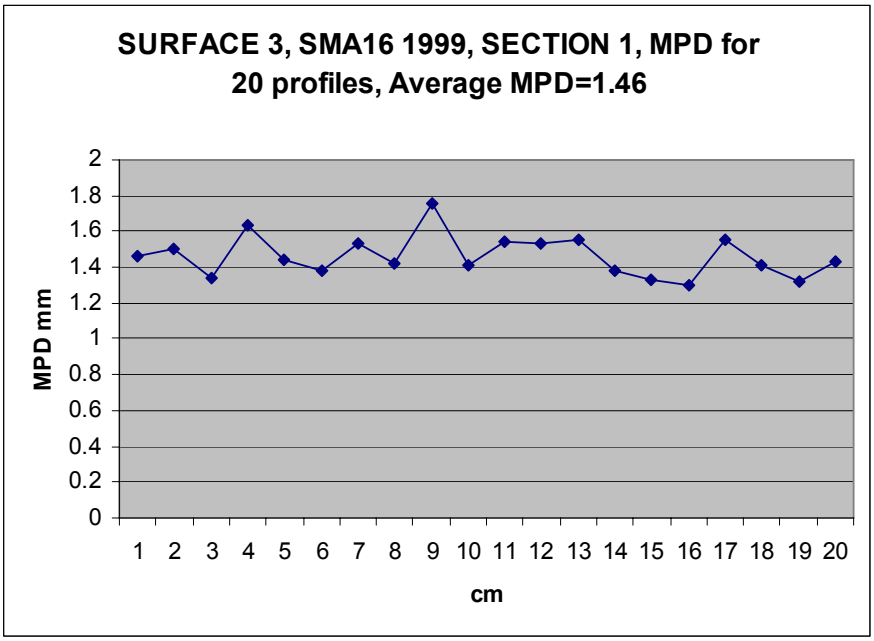
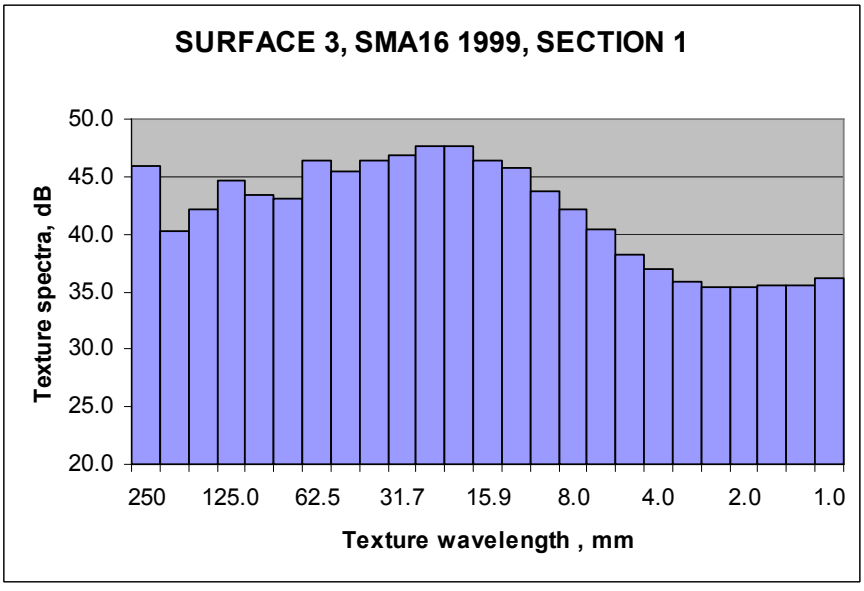
ROAD SURFACE 3: SMA16 1999

SECTION 1:



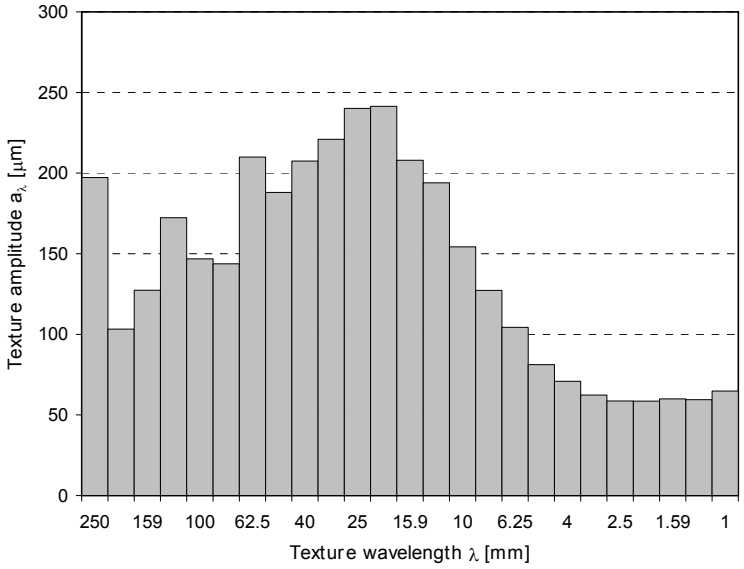


Texture

Location	E6 OMKJVN SURFACE 3
Date	2006-09-14
Test Field	SECTION 1
Position	R, right wheel track
Road Surface	SMA16 1999
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	197	45.9
200	103	40.3
160	127	42.1
125	172	44.7
100	147	43.3
80	144	43.1
63	210	46.4
50	188	45.5
40	208	46.3
32	221	46.9
25	240	47.6
20	241	47.7
16	208	46.4
13	194	45.8
10	154	43.8
8	127	42.1
6.3	104	40.4
5	81	38.2
4	71	37.0
3.2	62	35.9
2.5	59	35.4
2.0	59	35.4
1.6	60	35.6
1.25	59	35.5
1.0	65	36.2

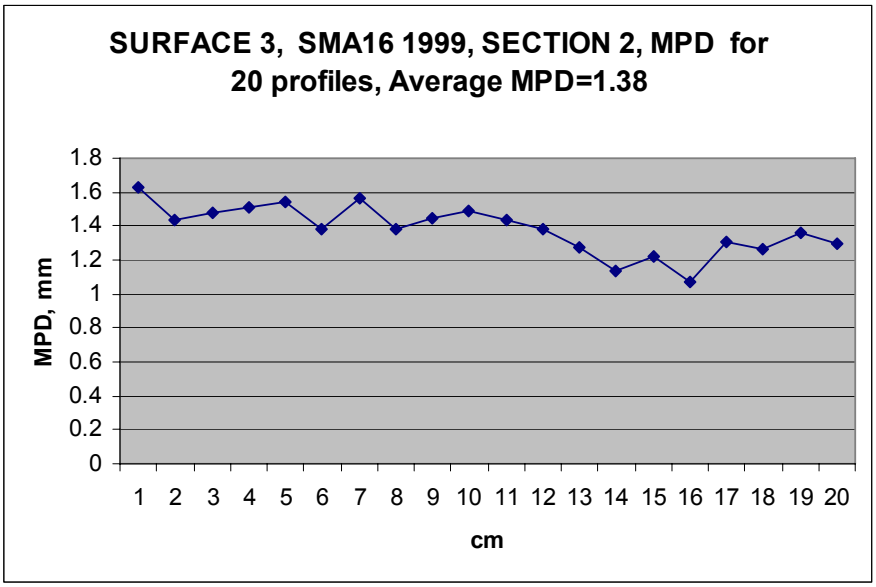


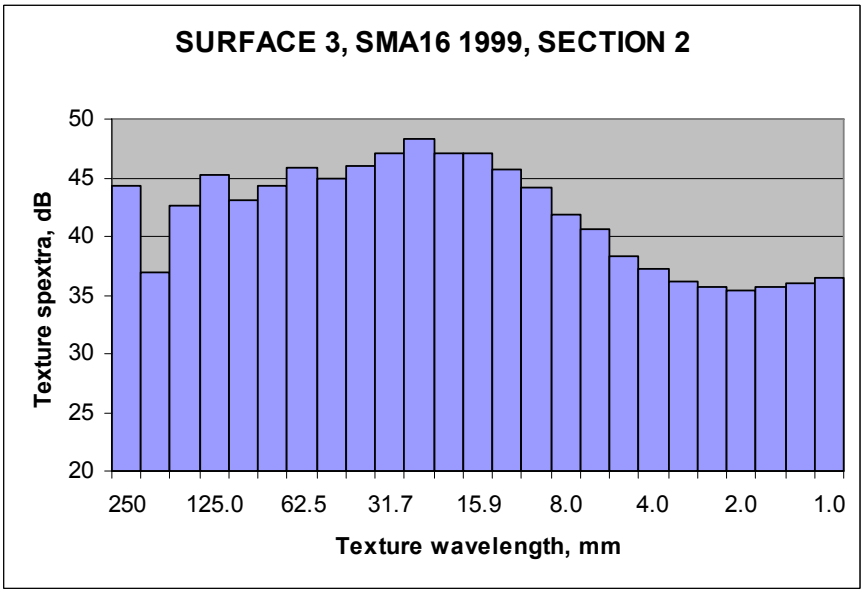
		St. dev. [mm]
MPD **[mm]**	**1.46**	**0.11**
ETD **[mm]**	**1.37**	**0.09**
RMS **[mm]**	**0.67**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

M+P Raadgevende ingenieurs b.v.
Vught (NL) 073-6589050

SECTION 2:


SURFACE 3, SMA16 1999, SECTION 2, MPD for 20 profiles, Average MPD=1.38
MPD, mm
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
cm

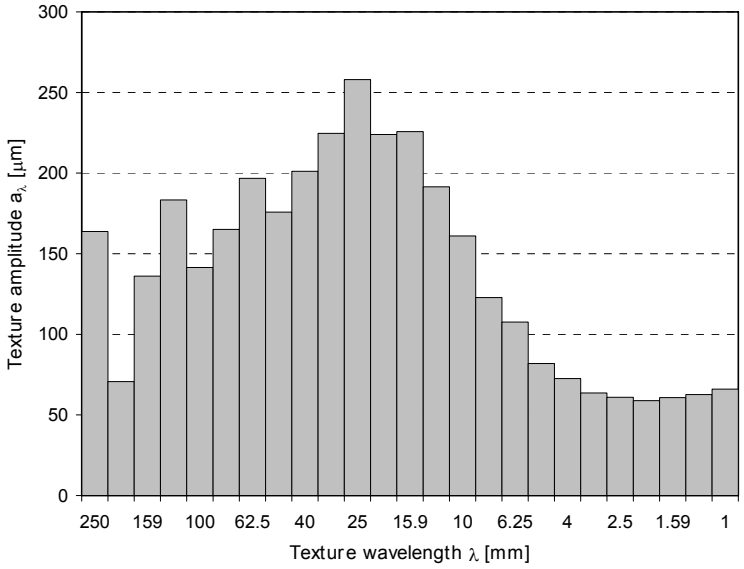

SURFACE 3, SMA16 1999, SECTION 2
Texture spextra, dB
50
45
40
35
30
25
20
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 OMKJVN SURFACE 3
Date	2006-09-14
Test Field	SECTION 2
Position	R, right wheel track
Road Surface	SMA16 1999
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	164	44.3
200	71	37.0
160	136	42.7
125	183	45.3
100	142	43.0
80	165	44.4
63	197	45.9
50	176	44.9
40	201	46.1
32	225	47.0
25	258	48.2
20	224	47.0
16	226	47.1
13	191	45.6
10	161	44.1
8	123	41.8
6.3	108	40.6
5	82	38.3
4	73	37.2
3.2	64	36.1
2.5	61	35.7
2.0	59	35.4
1.6	61	35.7
1.25	63	35.9
1.0	66	36.4



		St. dev. [mm]
MPD [mm]	1.38	0.14
ETD [mm]	1.30	0.11
RMS [mm]	0.68	0.09

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 3, Test Field SECTION 2, SMA16 1999

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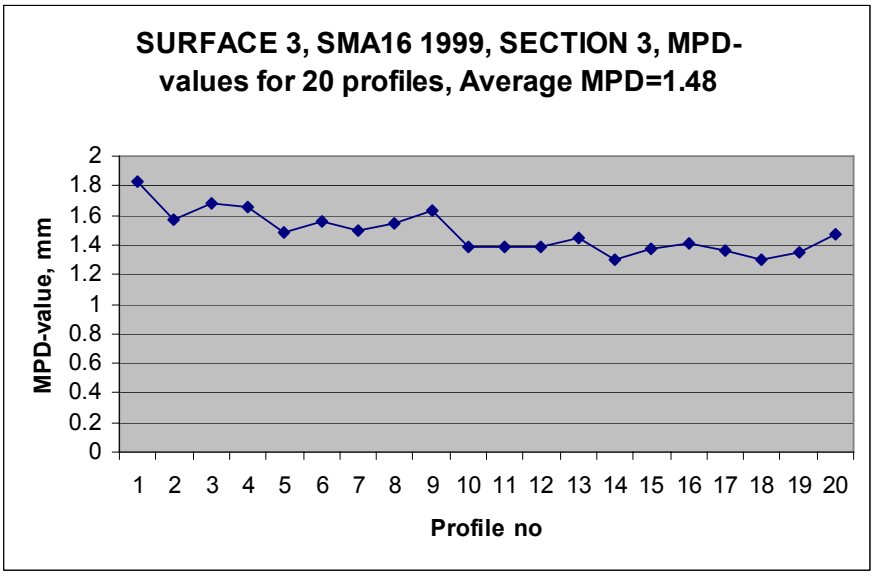
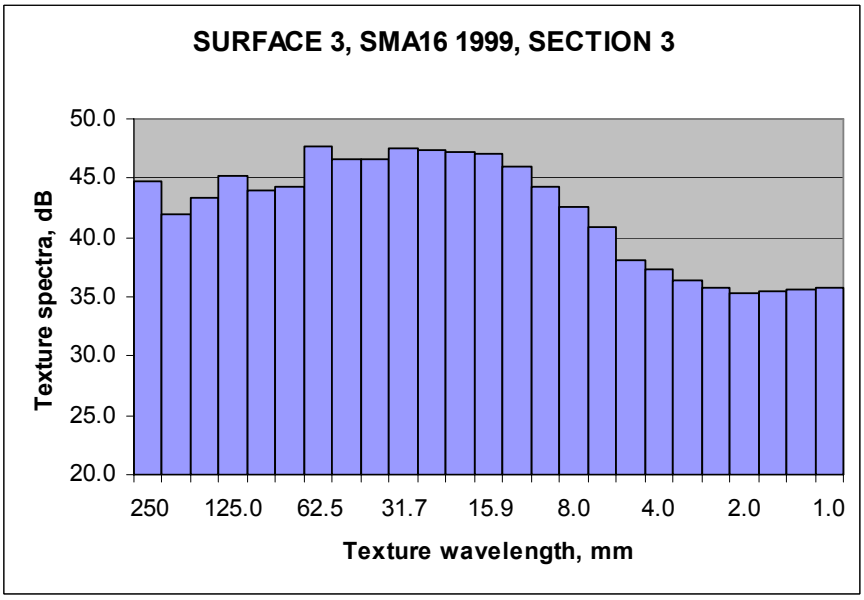
SECTION 3:


SURFACE 3, SMA16 1999, SECTION 3, MPD-values for 20 profiles, Average MPD=1.48
MPD-value, mm
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Profile no

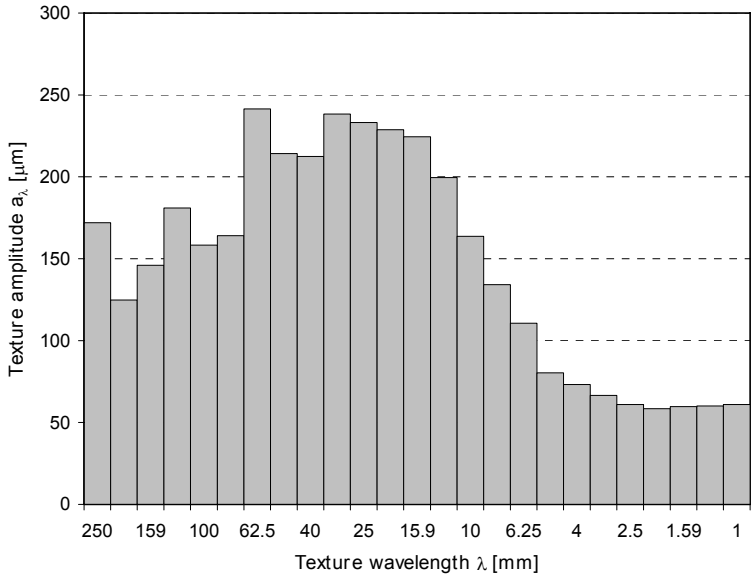

SURFACE 3, SMA16 1999, SECTION 3
Texture spectra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 OMKJVN SURFACE 3
Date	2006-09-14
Test Field	SECTION 3
Position	R, right wheel track
Road Surface	SMA16 1999
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	172	44.7
200	125	41.9
160	146	43.3
125	181	45.2
100	158	44.0
80	164	44.3
63	241	47.7
50	214	46.6
40	213	46.5
32	238	47.5
25	233	47.4
20	229	47.2
16	225	47.0
13	200	46.0
10	164	44.3
8	134	42.6
6.3	111	40.9
5	80	38.1
4	73	37.3
3.2	67	36.5
2.5	61	35.7
2.0	58	35.3
1.6	60	35.5
1.25	60	35.6
1.0	61	35.7



		St. dev. [mm]
MPD **[mm]**	**1.48**	**0.14**
ETD **[mm]**	**1.39**	**0.11**
RMS **[mm]**	**0.73**	**0.10**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 OMKJVN SURFACE 3, Test Field SECTION 3, SMA16 1999

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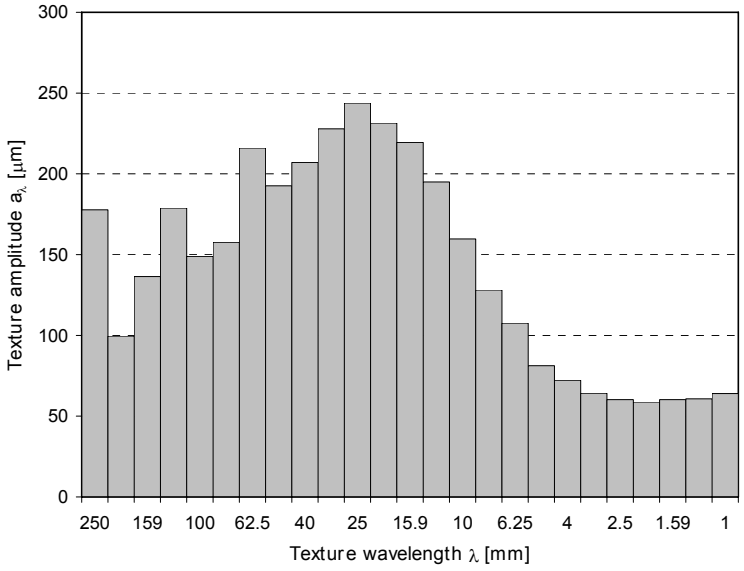
ROAD SURFACE 3, AVERAGE OF SECTION 1, 2 AND 3:

Texture

Location	E6 OMKJVN SURFACE 3
Date	2006-09-14
Test Field	SECTION 1 + 2 + 3
Position	R, right wheel track
Road Surface	SMA16 1999
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	178	45.0
200	100	40.0
160	136	42.7
125	179	45.1
100	149	43.5
80	158	44.0
63	216	46.7
50	193	45.7
40	207	46.3
32	228	47.2
25	244	47.7
20	231	47.3
16	219	46.8
13	195	45.8
10	160	44.1
8	128	42.2
6.3	108	40.6
5	81	38.2
4	72	37.2
3.2	64	36.2
2.5	60	35.6
2.0	59	35.4
1.6	60	35.6
1.25	61	35.7
1.0	64	36.1

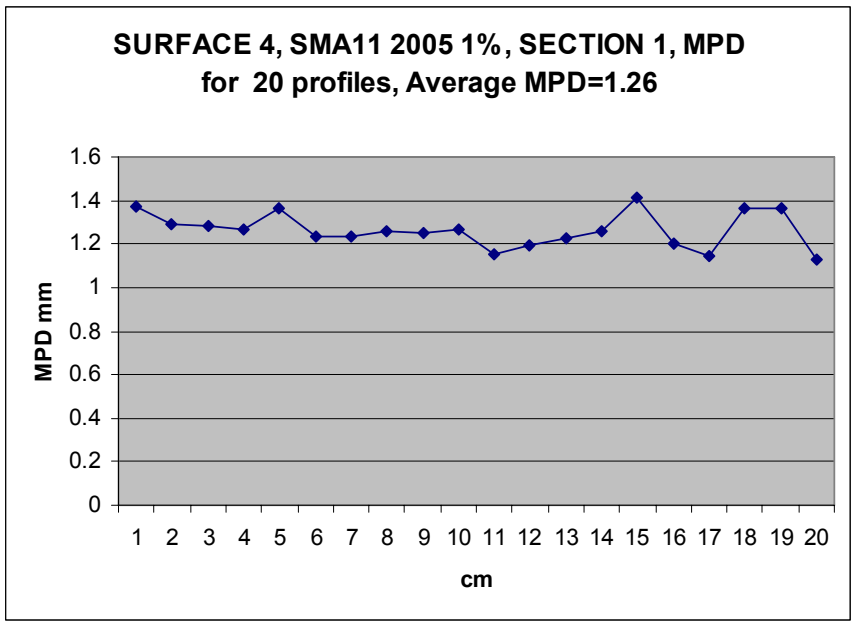


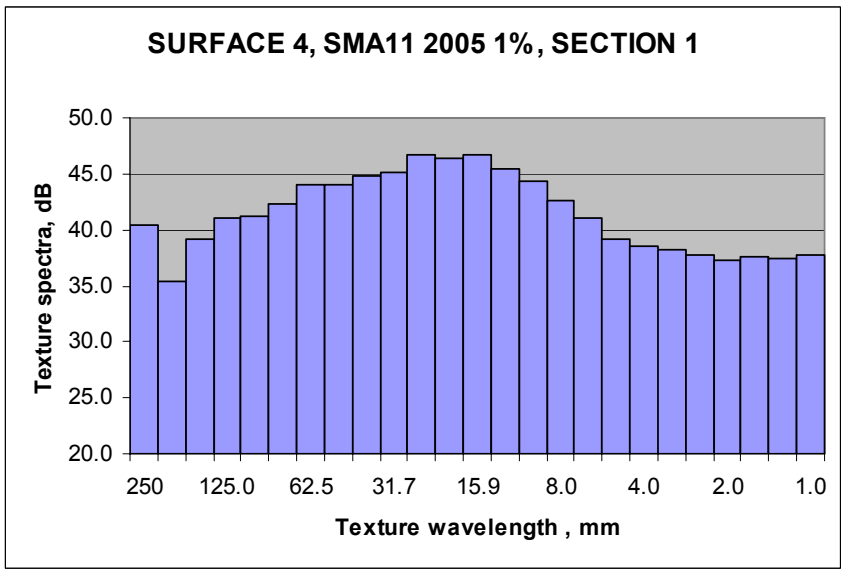
		St. dev. [mm]
MPD **[mm]**	**1.44**	**0.14**
ETD **[mm]**	**1.35**	**0.11**
RMS **[mm]**	**0.69**	**0.09**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

ROAD SURFACE 4: SMA11 2005 (1% Rubber)

SECTION 1:



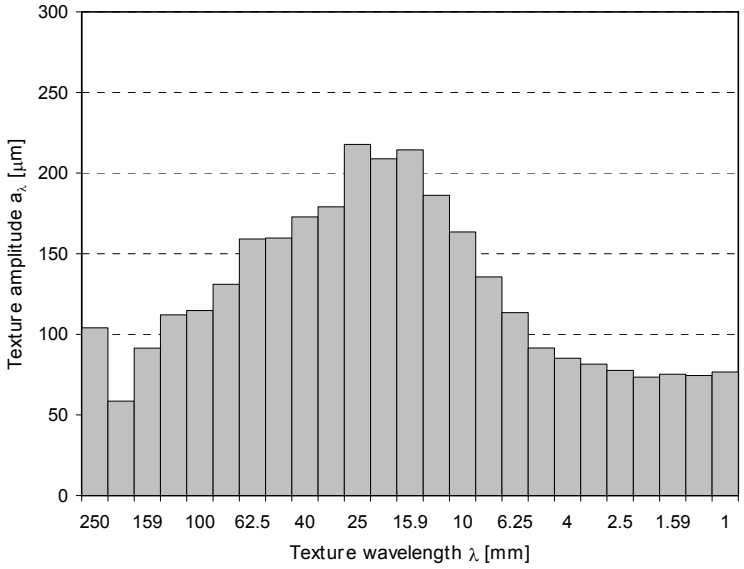


Texture

Location	E6 Melhus SURFACE 4
Date	2006-09-14
Test Field	SECTION 1
Position	R, right wheel track
Road Surface	SMA11 2005, 1% Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	104	40.4
200	59	35.3
160	91	39.2
125	112	41.0
100	115	41.2
80	131	42.3
63	159	44.0
50	160	44.1
40	173	44.8
32	179	45.1
25	218	46.8
20	209	46.4
16	214	46.6
13	186	45.4
10	163	44.3
8	136	42.6
6.3	114	41.1
5	92	39.2
4	85	38.6
3.2	81	38.2
2.5	78	37.8
2.0	73	37.3
1.6	75	37.5
1.25	75	37.4
1.0	77	37.7



		St. dev. [mm]
MPD **[mm]**	**1.26**	**0.08**
ETD **[mm]**	**1.21**	**0.06**
RMS **[mm]**	**0.60**	**0.04**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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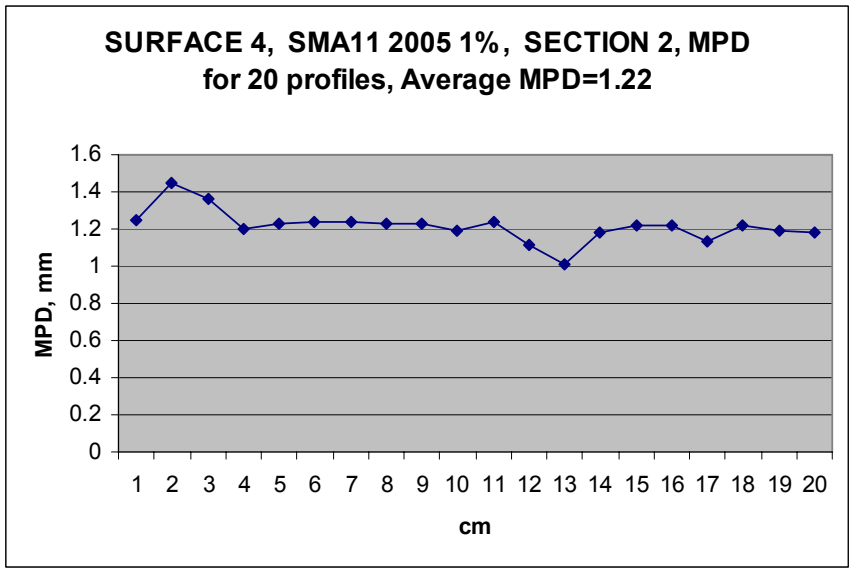
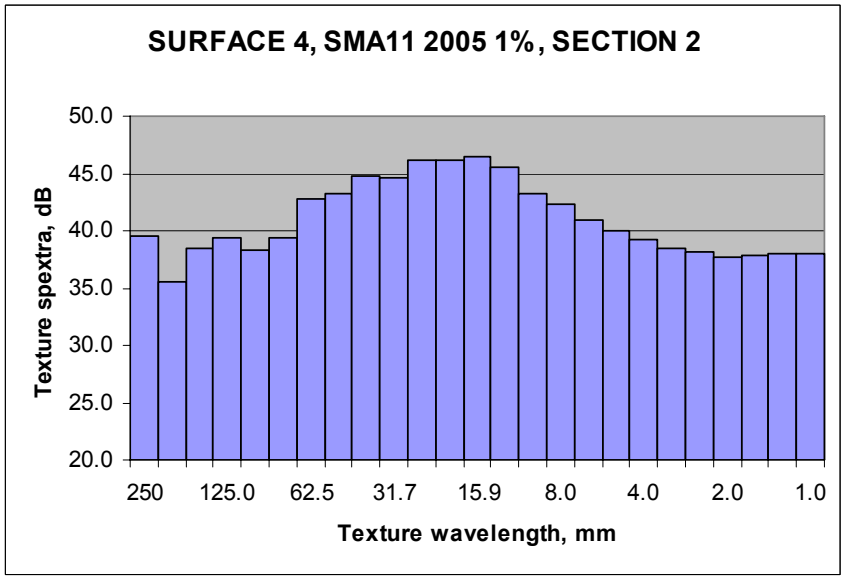
SECTION 2:


SURFACE 4, SMA11 2005 1%, SECTION 2, MPD
for 20 profiles, Average MPD=1.22
MPD, mm
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
cm

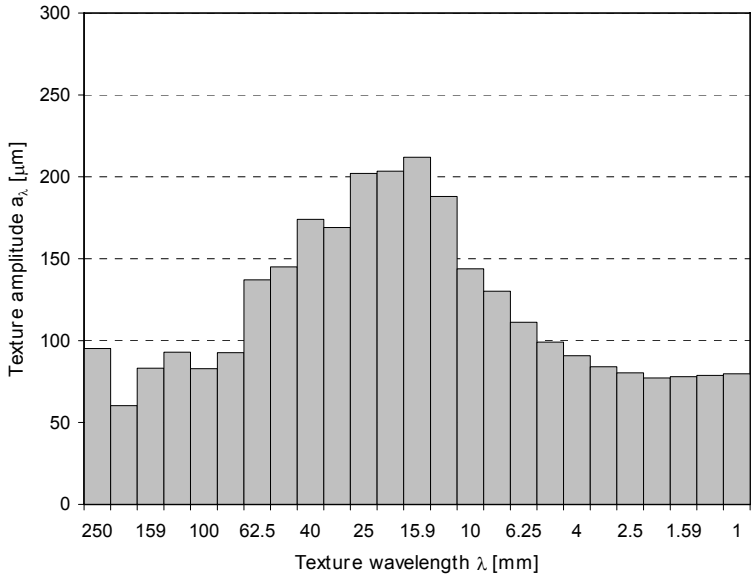

SURFACE 4, SMA11 2005 1%, SECTION 2
Texture spextra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 Melhus SURFACE 4
Date	2006-09-14
Test Field	SECTION 2
Position	R, right wheel track
Road Surface	SMA11 2005, 1% Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	95	39.6
200	60	35.6
160	83	38.4
125	93	39.4
100	83	38.4
80	93	39.3
63	137	42.7
50	145	43.2
40	174	44.8
32	169	44.6
25	202	46.1
20	203	46.2
16	212	46.5
13	188	45.5
10	144	43.2
8	130	42.3
6.3	111	40.9
5	99	39.9
4	91	39.2
3.2	84	38.5
2.5	80	38.1
2.0	77	37.8
1.6	78	37.8
1.25	79	37.9
1.0	80	38.0



		St. dev. [mm]
MPD **[mm]**	**1.22**	**0.09**
ETD **[mm]**	**1.17**	**0.07**
RMS **[mm]**	**0.58**	**0.06**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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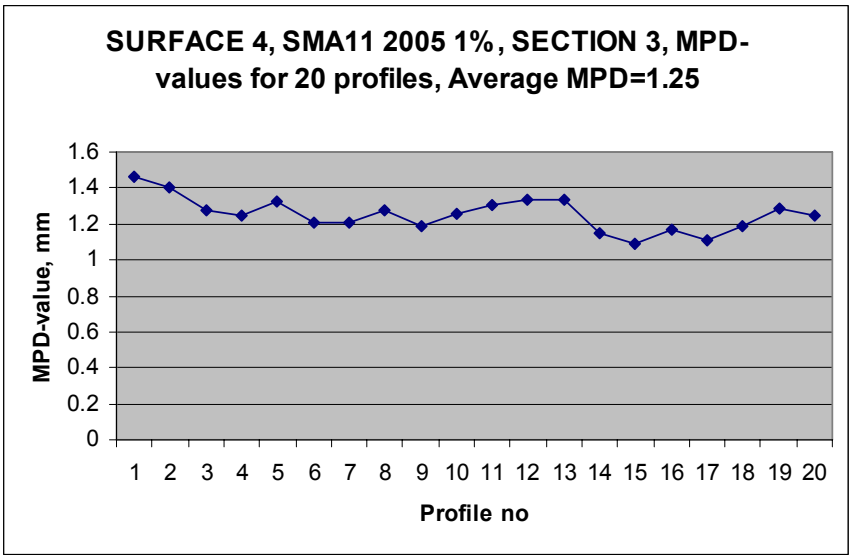
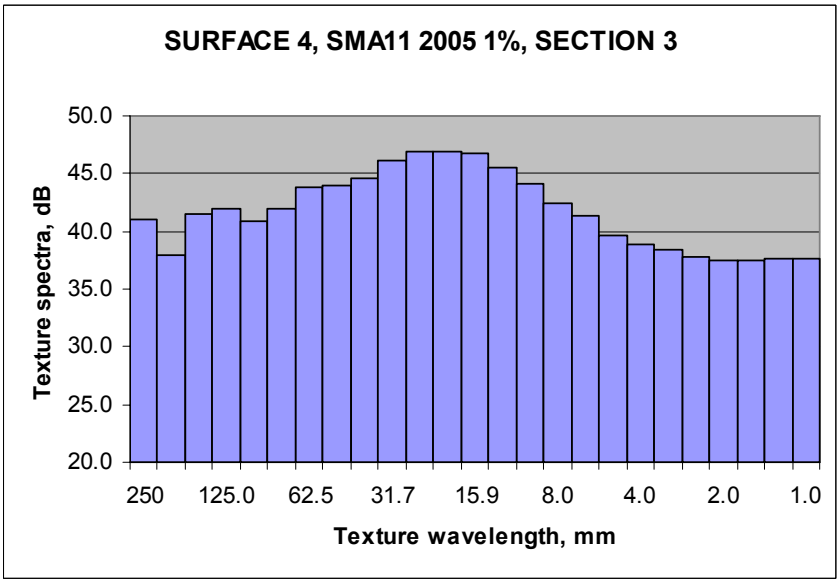

SURFACE 4, SMA11 2005 1%, SECTION 3, MPD-values for 20 profiles, Average MPD=1.25
MPD-value, mm
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Profile no

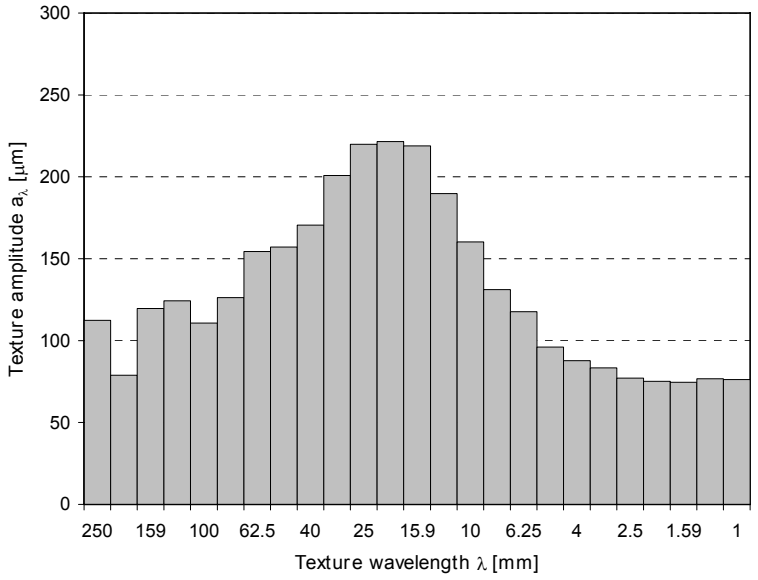

SURFACE 4, SMA11 2005 1%, SECTION 3
Texture spectra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 Melhus SURFACE 4
Date	2006-09-14
Test Field	SECTION 3
Position	R, right wheel track
Road Surface	SMA11 2005, 1% Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	112	41.0
200	79	37.9
160	120	41.6
125	124	41.9
100	111	40.9
80	126	42.0
63	154	43.8
50	157	43.9
40	171	44.6
32	201	46.1
25	220	46.8
20	221	46.9
16	219	46.8
13	190	45.6
10	160	44.1
8	131	42.4
6.3	118	41.4
5	96	39.6
4	88	38.9
3.2	83	38.4
2.5	77	37.7
2.0	75	37.5
1.6	75	37.5
1.25	77	37.7
1.0	76	37.6



		St. dev. [mm]
MPD **[mm]**	**1.25**	**0.09**
ETD **[mm]**	**1.20**	**0.08**
RMS **[mm]**	**0.63**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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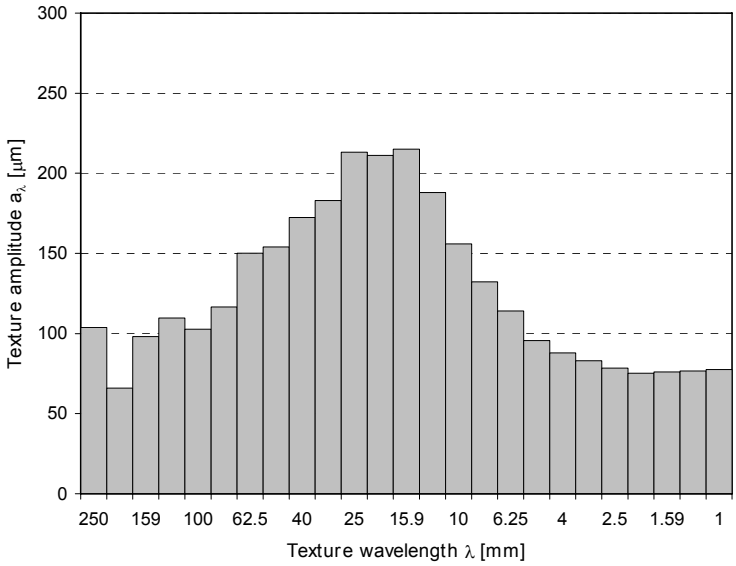
ROAD SURFACE 4, AVERAGE OF SECTION 1, 2 AND 3:

Texture

Location	E6 Melhus SURFACE 4
Date	2006-09-14
Test Field	SECTION 1 + 2 + 3
Position	R, right wheel track
Road Surface	SMA11 2005. 1 % Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	104	40.3
200	66	36.4
160	98	39.8
125	110	40.8
100	103	40.2
80	117	41.3
63	150	43.5
50	154	43.8
40	172	44.7
32	183	45.2
25	213	46.6
20	211	46.5
16	215	46.7
13	188	45.5
10	156	43.9
8	132	42.4
6.3	114	41.1
5	96	39.6
4	88	38.9
3.2	83	38.4
2.5	78	37.9
2.0	75	37.5
1.6	76	37.6
1.25	77	37.7
1.0	78	37.8



		St. dev. [mm]
MPD **[mm]**	**1.24**	**0.09**
ETD **[mm]**	**1.20**	**0.07**
RMS **[mm]**	**0.60**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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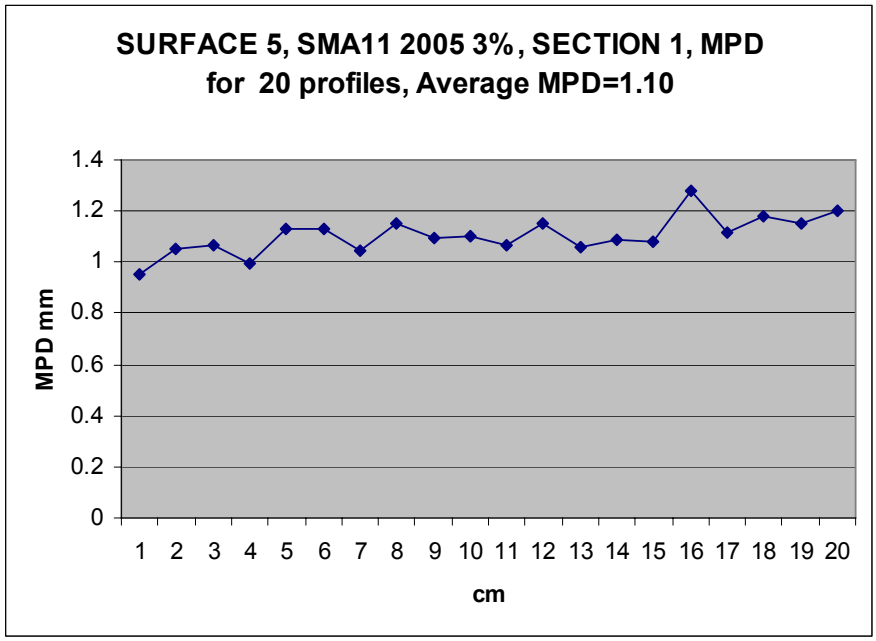
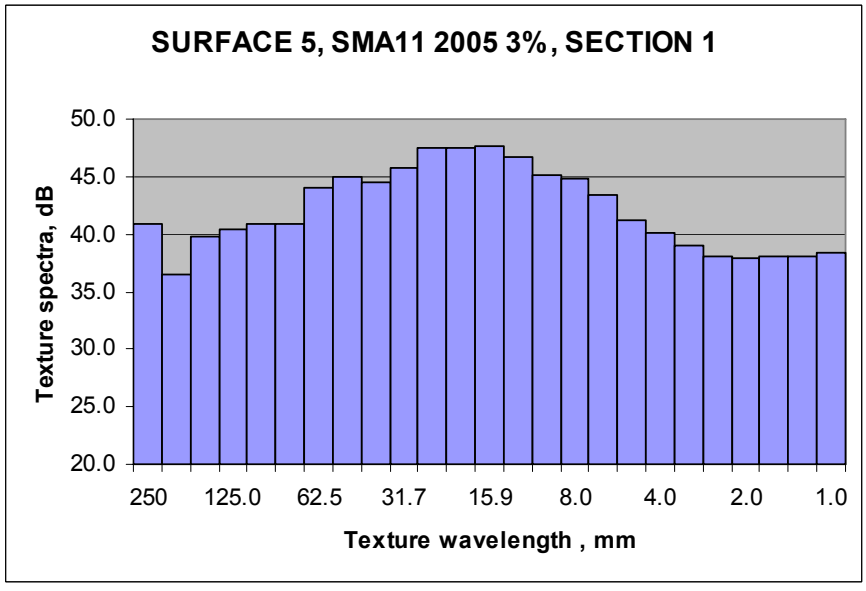
ROAD SURFACE 5: SMA11 2005 (3% Rubber)

SECTION 1:



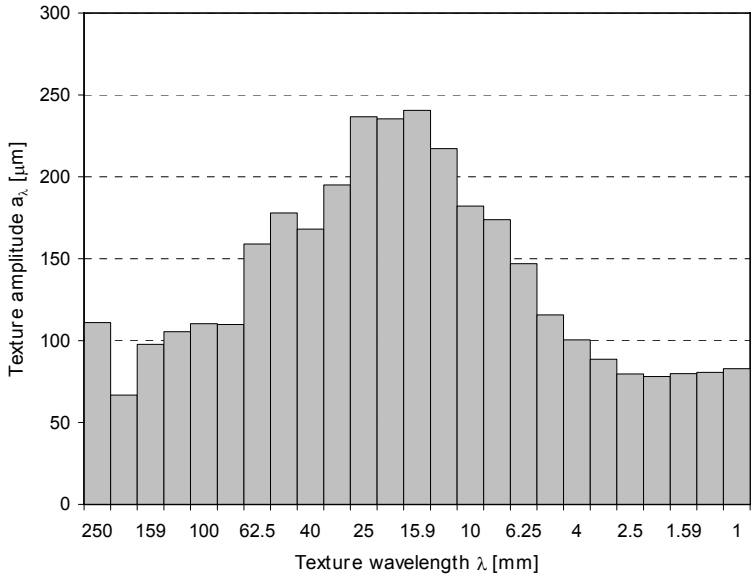


Texture

Location	E6 Melhus SURFACE 5
Date	2006-09-14
Test Field	SECTION 1
Position	R, right wheel track
Road Surface	SMA11 2005, 3% Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	111	40.9
200	67	36.5
160	98	39.8
125	105	40.5
100	110	40.9
80	110	40.8
63	159	44.0
50	178	45.0
40	168	44.5
32	195	45.8
25	237	47.5
20	235	47.4
16	241	47.6
13	217	46.7
10	182	45.2
8	174	44.8
6.3	147	43.3
5	116	41.3
4	100	40.0
3.2	89	39.0
2.5	80	38.0
2.0	78	37.9
1.6	80	38.1
1.25	81	38.1
1.0	83	38.4



		St. dev. [mm]
MPD **[mm]**	**1.10**	**0.07**
ETD **[mm]**	**1.08**	**0.06**
RMS **[mm]**	**0.67**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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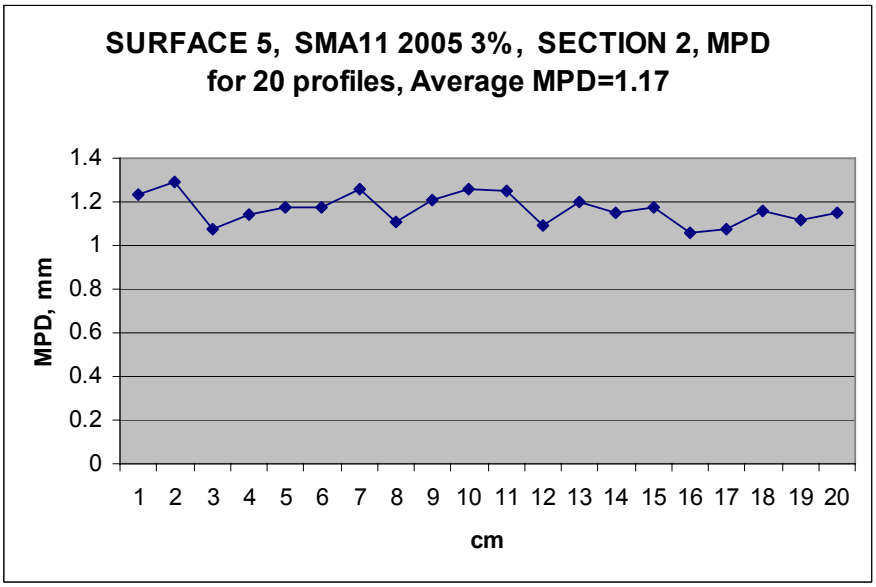
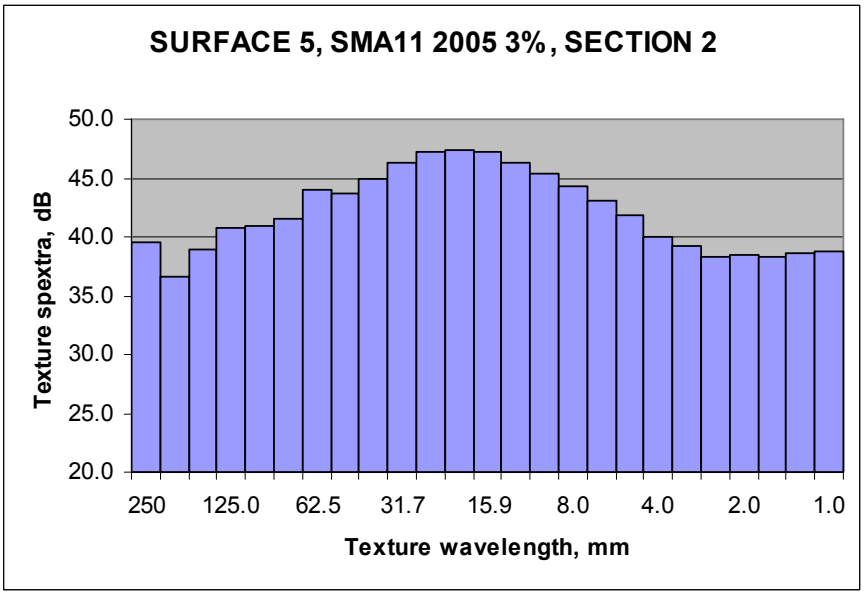
SECTION 2:


SURFACE 5, SMA11 2005 3%, SECTION 2, MPD
for 20 profiles, Average MPD=1.17
MPD, mm
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
cm

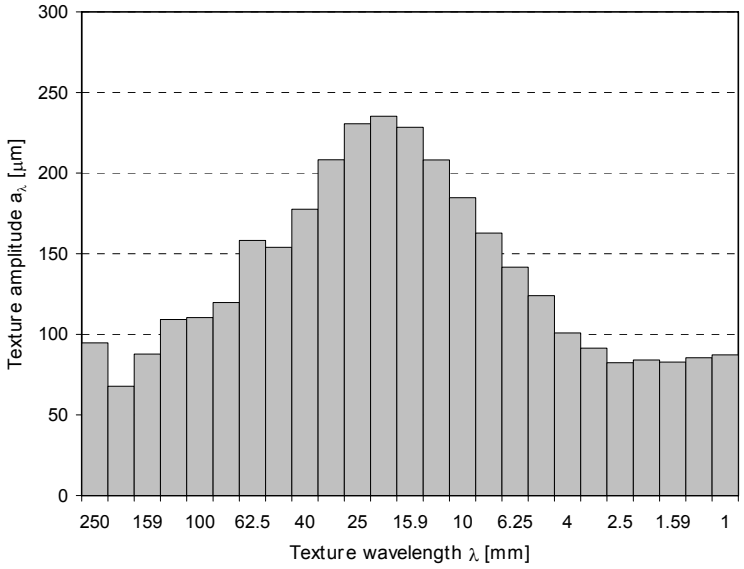

SURFACE 5, SMA11 2005 3%, SECTION 2
Texture spextra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 Melhus SURFACE 5
Date	2006-09-14
Test Field	SECTION 2
Position	R, right wheel track
Road Surface	SMA11 2005, 3% Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

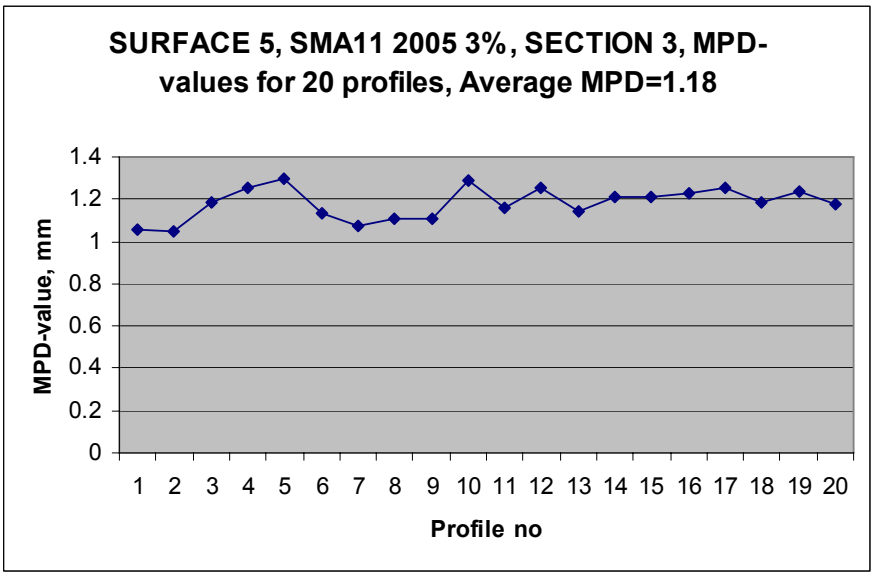
λ [mm]	a_λ [µm]	L_{tx} [dB]
250	95	39.5
200	68	36.6
160	88	38.9
125	109	40.8
100	110	40.9
80	120	41.6
63	158	44.0
50	154	43.8
40	178	45.0
32	208	46.4
25	231	47.3
20	235	47.4
16	228	47.2
13	208	46.4
10	185	45.3
8	163	44.2
6.3	142	43.0
5	124	41.9
4	101	40.1
3.2	91	39.2
2.5	82	38.3
2.0	84	38.5
1.6	83	38.4
1.25	86	38.6
1.0	87	38.8

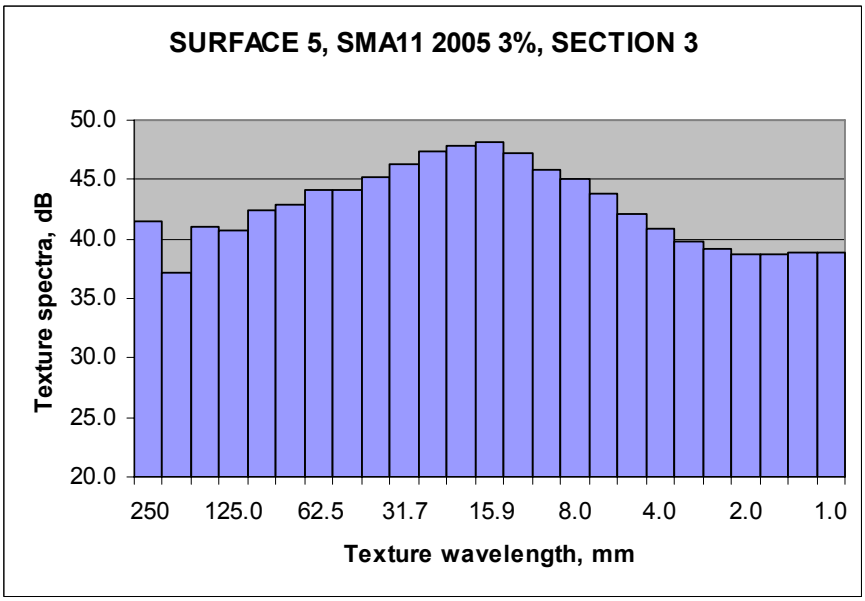


		St. dev. [mm]
MPD **[mm]**	**1.17**	**0.07**
ETD **[mm]**	**1.13**	**0.05**
RMS **[mm]**	**0.68**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

SECTION 3:


SURFACE 5, SMA11 2005 3%, SECTION 3, MPD-values for 20 profiles, Average MPD=1.18
MPD-value, mm
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Profile no

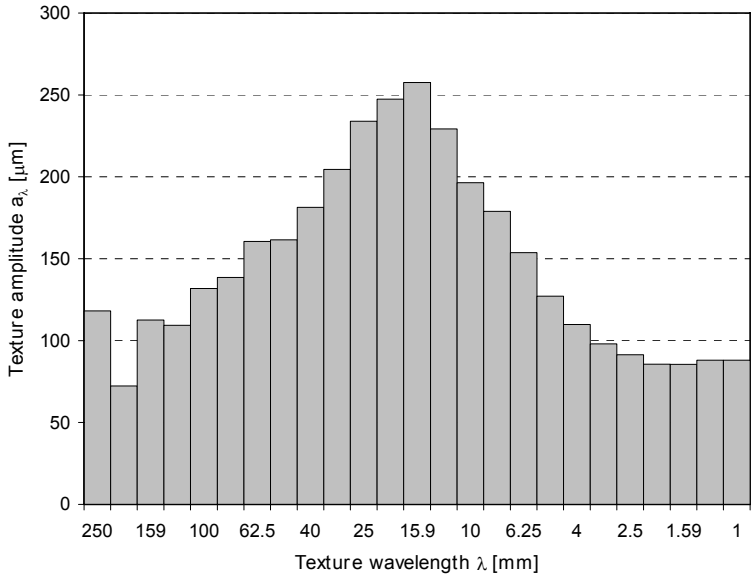

SURFACE 5, SMA11 2005 3%, SECTION 3
Texture spectra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	E6 Melhus SURFACE 5
Date	2006-09-14
Test Field	SECTION 3
Position	R, right wheel track
Road Surface	SMA11 2005, 3% Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	118	41.4
200	72	37.2
160	113	41.0
125	109	40.8
100	132	42.4
80	139	42.8
63	161	44.1
50	162	44.2
40	181	45.2
32	205	46.2
25	234	47.4
20	247	47.9
16	258	48.2
13	229	47.2
10	196	45.9
8	179	45.1
6.3	154	43.7
5	127	42.1
4	110	40.8
3.2	98	39.8
2.5	91	39.2
2.0	86	38.7
1.6	86	38.6
1.25	88	38.9
1.0	88	38.9



		St. dev. [mm]
MPD **[mm]**	**1.18**	**0.08**
ETD **[mm]**	**1.14**	**0.06**
RMS **[mm]**	**0.69**	**0.04**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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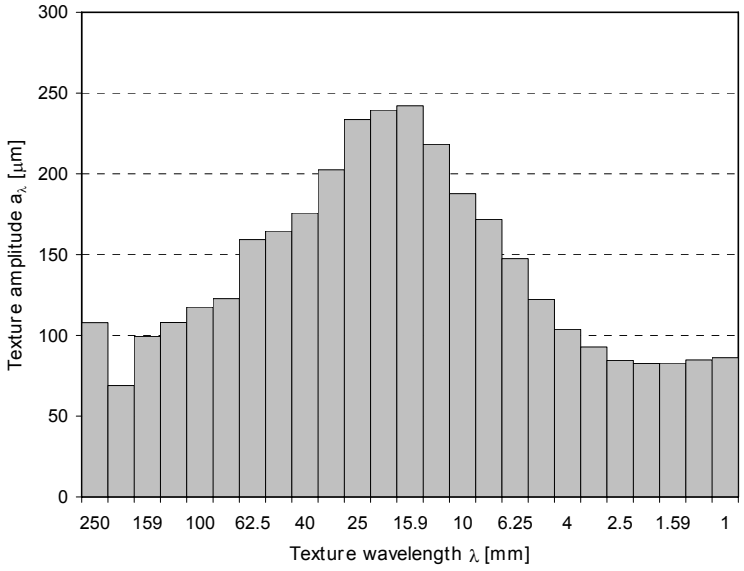
ROAD SURFACE 5, AVERAGE OF SECTION 1, 2 AND 3:

Texture

Location	E6 Melhus SURFACE 5
Date	2006-09-14
Test Field	SECTION 1 + 2 + 3
Position	R, right wheel track
Road Surface	SMA11 2005. 3 % Rubber
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	108	40.7
200	69	36.8
160	99	39.9
125	108	40.7
100	117	41.4
80	123	41.8
63	159	44.0
50	165	44.3
40	176	44.9
32	203	46.1
25	234	47.4
20	239	47.6
16	242	47.7
13	218	46.8
10	188	45.5
8	172	44.7
6.3	147	43.4
5	122	41.7
4	104	40.3
3.2	93	39.3
2.5	84	38.5
2.0	83	38.3
1.6	83	38.4
1.25	85	38.6
1.0	86	38.7



		St. dev. [mm]
MPD [mm]	**1.15**	**0.08**
ETD [mm]	**1.12**	**0.06**
RMS [mm]	**0.68**	**0.05**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

E6 Melhus SURFACE 5, Test Field SECTION 1 + 2 + 3, SMA11 2005. 3 % Rubber

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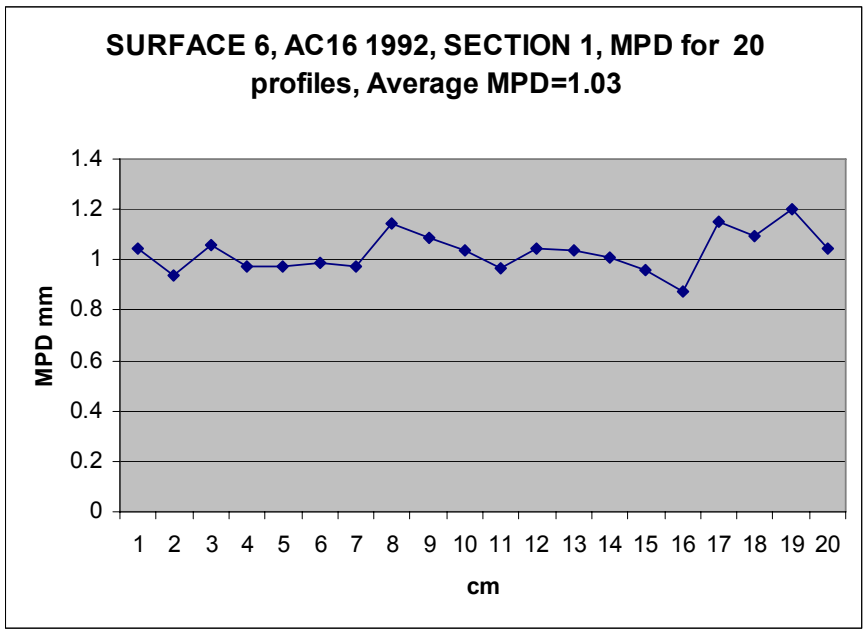
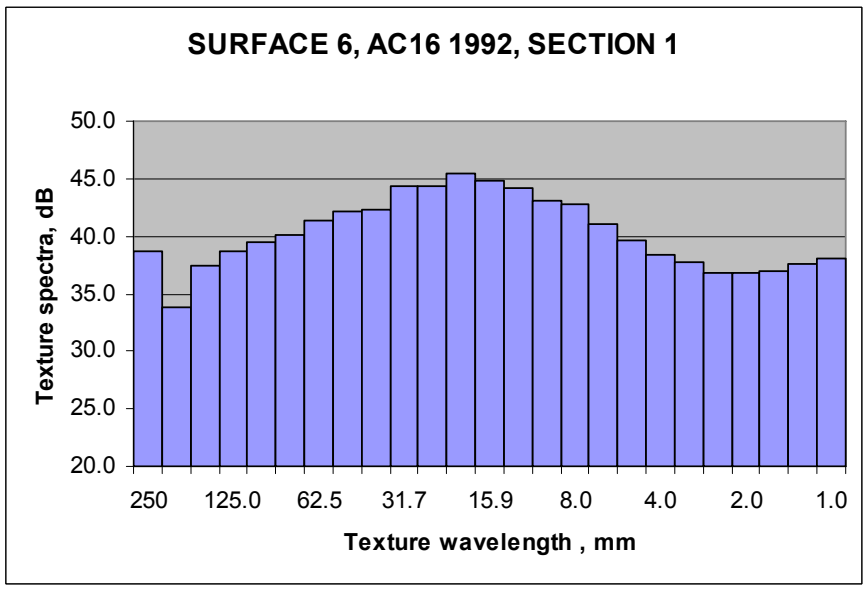
ROAD SURFACE 6: AC16 1992:

SECTION 1:



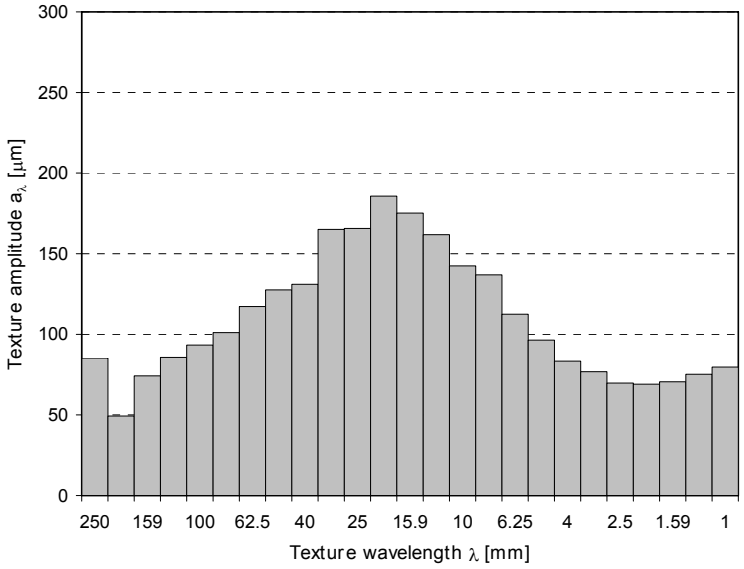


Texture

Location	Rv707 Flakk SURFACE 6
Date	2006-09-14
Test Field	SECTION 1
Position	R, right wheel track
Road Surface	AC16 1992
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	85	38.6
200	49	33.9
160	74	37.4
125	86	38.7
100	93	39.4
80	101	40.1
63	117	41.4
50	128	42.1
40	131	42.3
32	165	44.4
25	166	44.4
20	186	45.4
16	175	44.9
13	162	44.2
10	142	43.1
8	137	42.7
6.3	113	41.0
5	96	39.7
4	83	38.4
3.2	77	37.7
2.5	70	36.9
2.0	69	36.8
1.6	71	37.0
1.25	75	37.5
1.0	80	38.0



		St. dev. [mm]
MPD **[mm]**	**1.03**	**0.08**
ETD **[mm]**	**1.02**	**0.06**
RMS **[mm]**	**0.53**	**0.04**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

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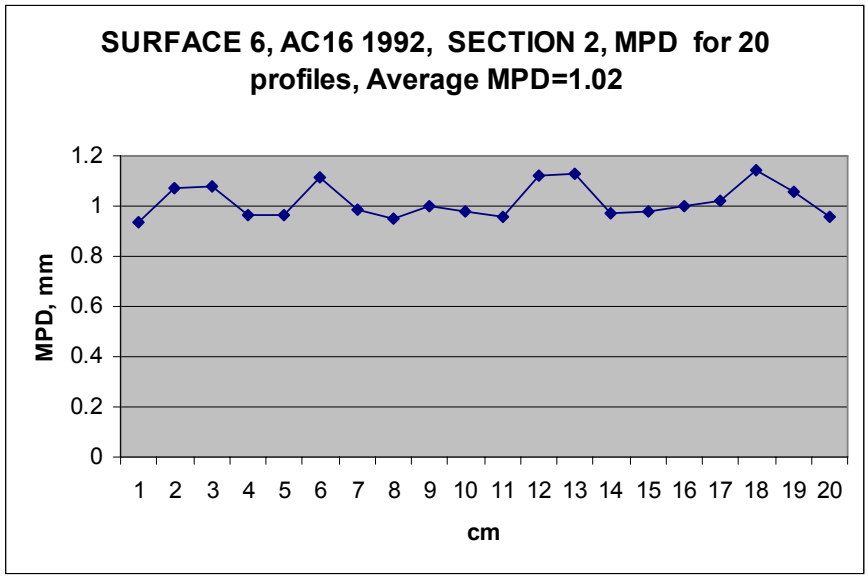
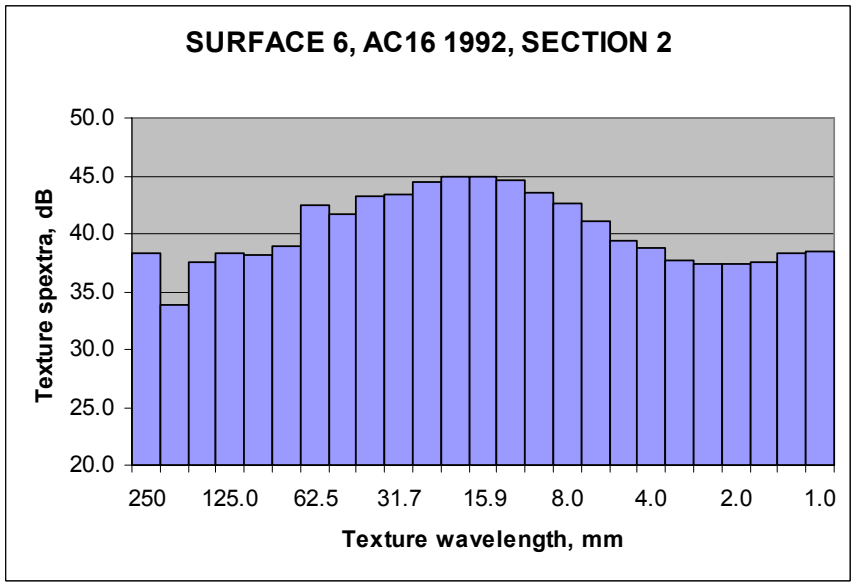
SECTION 2:


SURFACE 6, AC16 1992, SECTION 2, MPD for 20 profiles, Average MPD=1.02
MPD, mm
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
cm

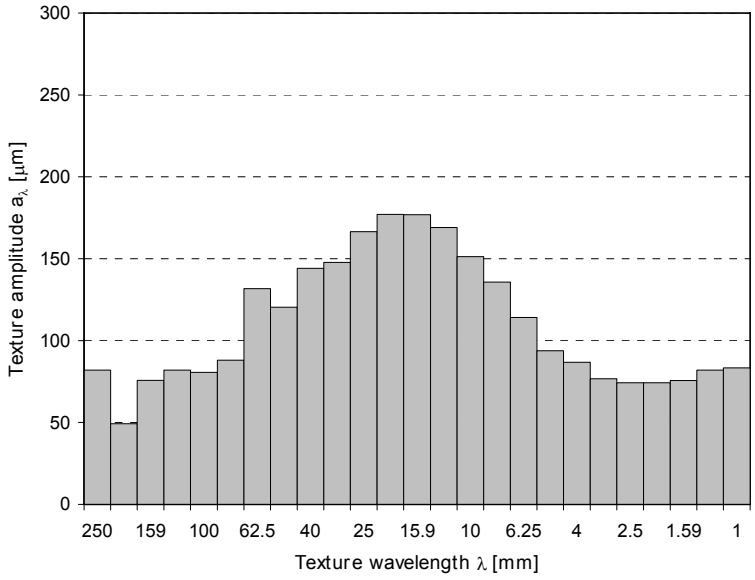

SURFACE 6, AC16 1992, SECTION 2
Texture spextra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	Rv707 Flakk SURFACE 6
Date	2006-09-14
Test Field	SECTION 2
Position	R, right wheel track
Road Surface	AC16 1992
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	82	38.3
200	49	33.8
160	76	37.6
125	82	38.3
100	81	38.1
80	88	38.9
63	132	42.4
50	120	41.6
40	144	43.2
32	148	43.4
25	167	44.4
20	177	45.0
16	177	45.0
13	169	44.6
10	151	43.6
8	136	42.7
6.3	114	41.1
5	94	39.4
4	87	38.8
3.2	77	37.7
2.5	74	37.4
2.0	74	37.4
1.6	76	37.6
1.25	82	38.3
1.0	83	38.4



		St. dev. [mm]
MPD **[mm]**	**1.02**	**0.07**
ETD **[mm]**	**1.02**	**0.05**
RMS **[mm]**	**0.52**	**0.03**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

Rv707 Flakk SURFACE 6, Test Field SECTION 2, AC16 1992

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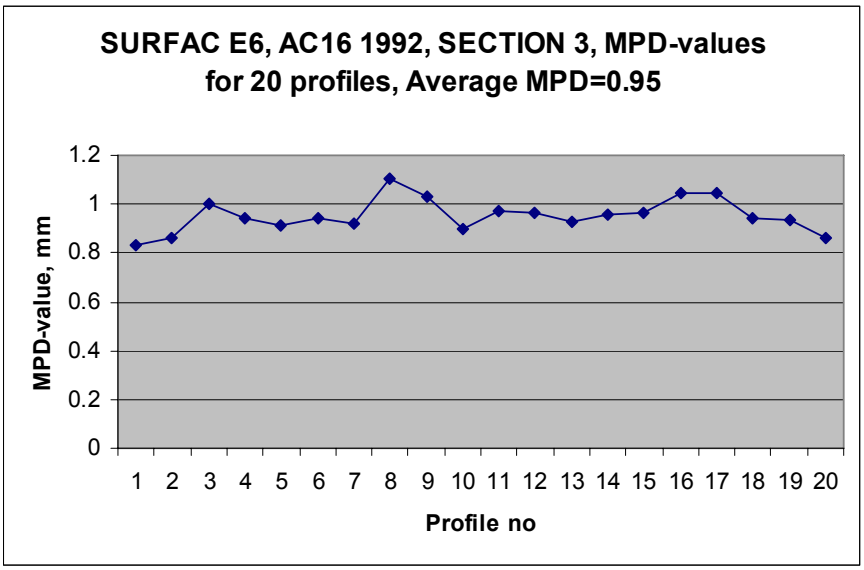
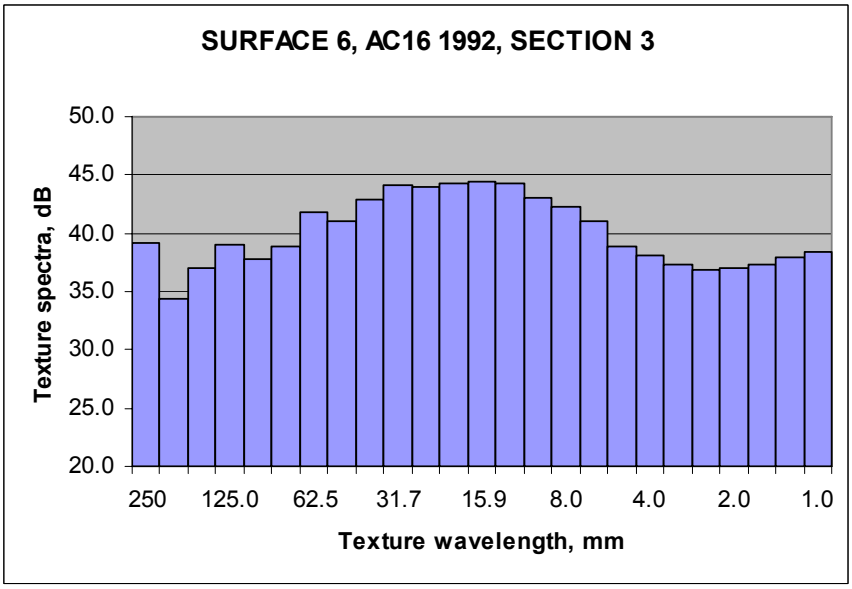
SECTION 3:


SURFAC E6, AC16 1992, SECTION 3, MPD-values
for 20 profiles, Average MPD=0.95
MPD-value, mm
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Profile no

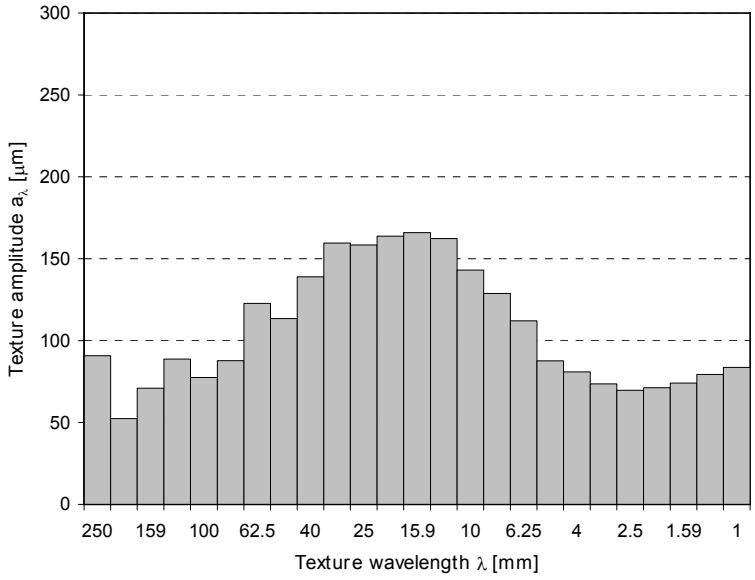

SURFACE 6, AC16 1992, SECTION 3
Texture spectra, dB
50.0
45.0
40.0
35.0
30.0
25.0
20.0
250 125.0 62.5 31.7 15.9 8.0 4.0 2.0 1.0
Texture wavelength, mm

Texture

Location	Rv707 Flakk SURFACE 6
Date	2006-09-14
Test Field	SECTION 3
Position	R, right wheel track
Road Surface	AC16 1992
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{tx} [dB]
250	91	39.2
200	52	34.4
160	71	37.0
125	89	39.0
100	77	37.8
80	88	38.9
63	123	41.8
50	114	41.1
40	139	42.9
32	160	44.1
25	158	44.0
20	164	44.3
16	166	44.4
13	162	44.2
10	143	43.1
8	129	42.2
6.3	112	41.0
5	88	38.9
4	81	38.2
3.2	74	37.3
2.5	70	36.9
2.0	71	37.0
1.6	74	37.4
1.25	79	38.0
1.0	84	38.5



		St. dev. [mm]
MPD **[mm]**	**0.95**	**0.07**
ETD **[mm]**	**0.96**	**0.05**
RMS **[mm]**	**0.50**	**0.02**

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

Rv707 Flakk SURFACE 6, Test Field SECTION 3, AC16 1992

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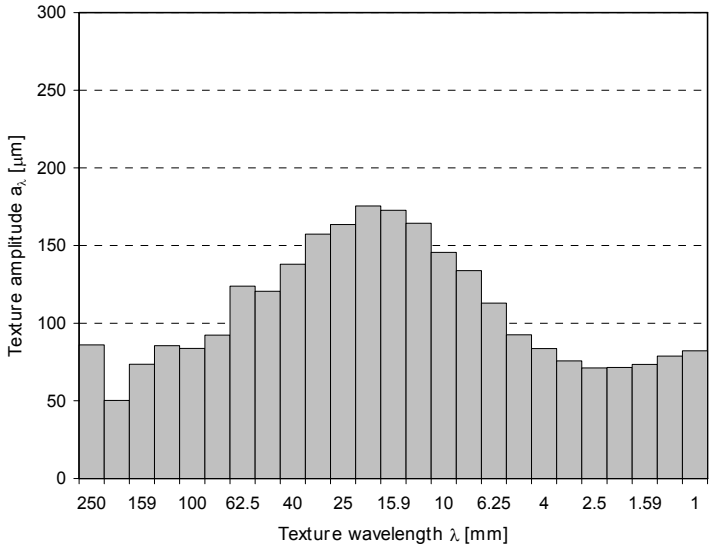
ROAD SURFACE 6, AVERAGE OF SECTION 1, 2 AND 3:

Texture

Location	Rv707 Flakk SURFACE 6
Date	2006-09-14
Test Field	SECTION 1 + 2 + 3
Position	R, right wheel track
Road Surface	AC16 1992
Report Number	

1/ 3-OCTAVE SPECTRUM OF SURFACE TEXTURE

λ [mm]	a_λ [µm]	L_{ox} [dB]
250	86	38.7
200	50	34.0
160	74	37.3
125	85	38.6
100	84	38.5
80	92	39.3
63	124	41.9
50	121	41.6
40	138	42.8
32	157	43.9
25	164	44.3
20	176	44.9
16	173	44.7
13	164	44.3
10	146	43.3
8	134	42.5
6.3	113	41.1
5	93	39.3
4	84	38.5
3.2	76	37.6
2.5	71	37.1
2.0	71	37.1
1.6	73	37.3
1.25	79	37.9
1.0	82	38.3



		St. dev. [mm]
MPD [mm]	1.00	0.08
ETD [mm]	1.00	0.06
RMS [mm]	0.52	0.04

Measurement length [m]	1.5
Scanresolution [samples/ mm]	5
Number of traces	20
Distance between traces [mm]	10

Rv707 Flakk SURFACE 6, Test Field SECTION 1 + 2 + 3, AC16 1992

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