

4 September 2019

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Dear Greg
Masterton chipseal trial tyre/road noise measurements**1 Introduction**

Chipseal trials were laid on SH2 north of Masterton in March 2019 to investigate the performance of different binders. Three difference chipseal types were constructed, with two binder variations at each site (see Table 1 for details). The trial sections were constructed separate to the on-going tyre/road noise investigations.

Tyre/road noise measurements were taken in August 2019 using the NZ Transport Agency CPX trailer. The CPX measurements were taken over approximately 15 km of State highway. The measurement details for the full CPX test section are documented below, however, only the results from the chipseal trial sections are presented.

All of the CPX measurement data has been stored in the CPX database for future use.

Table 1 Details of the chipseal trial sections

Seal	Pre-treatment	Trial section	Binder	Rs	Start	End
Grade 2 (single-coat)	None	1a	80-100 + 3pph kero + adhesion agent 2.15 L/m ²	002-0858	10,606 m	10,826 m
		1b	130-150 + 2pph kero + adhesion agent 2.15 L/m ²	002-0858	10,826 m	11,112 m
Grade 2/4 (racked)	None	2a	80-100 + 3pph kero + adhesion agent 2.15 L/m ²	002-0873	1,777 m	2,270 m
		2b	130-150 + 2pph kero + adhesion agent 2.15 L/m ²	002-0873	2,270 m	2,777 m
Grade 2/4 (two-coat)	CQ60 and Grade 6 for coarse areas	3a	80-100 + 3pph kero + adhesion agent 2.1 L/m ²	002-0873	8,197 m	8,556 m
		3b	130-150 + 2pph kero + adhesion agent 2.1 L/m ²	002-0873	8,556 m	8,922 m

2 Measurement details

General information	
<i>Date</i>	28 August 2019, 1130h to 1500h
<i>Operator / organisation</i>	John Bull (Altissimo Consulting) with assistance from Richard Jackett and Tiffany Lester (WSP).
<i>Purpose</i>	General survey

Type of measuring equipment	
<i>Test vehicle</i>	NZ Transport Agency CPX trailer
<i>Test tyres</i>	Reference tyres P1 (set #1) and H1 (set #5).
<i>Noise measuring system</i>	National Instruments controller (NI cDAQ-9132) with IEPE microphone input (NI 9234). Microphone 1: GRAS 146AE (S/N 357200), 46.75 mV/Pa Microphone 2: GRAS 146AE (S/N 357201), 44.93 mV/Pa
<i>Calibration equipment</i>	Casella 120/1 (last calibrated 08/07/2019)
<i>Speed measuring equipment</i>	Trimble BD970 GPS receiver
<i>Meteorology equipment</i>	National Instruments NI 745690-K002 (K-type thermocouple)
<i>Microphones used</i>	Positions 1 and 2
<i>Certification of test vehicle</i>	February 2018, refer to NZ Transport Agency report "Road surface noise research 2016-2018".

Information relating to the location and appearance of the test site	
<i>Location of the test site</i>	SH2 north of Masterton, between Fourth and Kiriwhakapapa Rd.
<i>Posted speed limit</i>	100 km/h
<i>Longitudinal gradient</i>	Varies, generally level through chipseal trial sections.
<i>Crossfall</i>	Varies
<i>Site plan</i>	Refer to Figure 1
<i>Total distance measured</i>	14,660 m
<i>Start position (southbound run)</i>	002-0858/07.60-B
<i>End position (southbound run)</i>	002-0873/08.94-B
<i>Lateral measurement position on the road</i>	L1 and R1 (left lanes, both directions), left wheel track only.

Information relating to the type and construction of the tested surface	
<i>Type of surface and its design parameters</i>	Chipseal, various types (refer to Table 1).

Information concerning condition of the tested surface and environmental factors	
<i>Age of surface and state of maintenance</i>	6 months (constructed March 2019)
<i>Any notes regarding the homogeneity of the surface</i>	Site 1 exhibiting significant stripping of chip for both binder variations, with large patches of road having minimal chip coverage.
<i>Number of days since the latest precipitation</i>	2 days before measurements (surface is non-porous).
<i>Average air and road surface temperature over the test section</i>	19°C (air) and 29°C (road)
<i>Temperature correction coefficient used</i>	-0.092 (both tyres)

Test tyre and other test conditions	
<i>Test tyre used, identification of tyre and date of manufacture</i>	Tyre P1 (NZ Transport Agency set #1) Tyre H1 (NZ Transport Agency set #5)
<i>Rubber hardness of test tyres (no more than three months old)</i>	Tyre P1: 71.9 (measured 01/03/2019)* Tyre H1: 68.9 (measured 01/03/2019)* * more than three months as test vehicle and tyres away from CAPTIF.
<i>Reference speed used</i>	80 km/h
<i>Number of runs on which the L_{CPX} is based</i>	Tyre P1 <ul style="list-style-type: none"> - northbound direction: 3 runs - southbound direction: 4 runs Tyre H1 <ul style="list-style-type: none"> - northbound direction: 1 run - southbound direction: 1 run

Others	
<i>Speed correction, B, used for speed corrections</i>	30
<i>Details of special provisions taken to ensure conformity with ISO 11819-2</i>	None



Figure 1 Location of chipseal trial sites and extent of CPX measurement runs

3 Results

Table 2 below summarises the results for the three chipseal trial sites. Each site has two binder variations (six test sections in total). The one-third octave band results are included in Figure 2 and Figure 3 for the P1 and H1 tyres, respectively.

ISO 11819-2:2017 does not provide guidance on combining data from measurements on multiple lanes and/or directions. The procedure used for calculating the $L_{CPX,t,80}$ and s_t (acoustic variability) values is included here for reference.

Calculation of $L_{CPX,t,80}$:

1. The 20 metre segments within each run are arithmetically averaged. This gives a separate L_{CPX} value for each run in each direction.
2. The resulting values are arithmetically averaged, thus combining the results for both directions.

Calculation of s_t (acoustic variability):

1. The standard deviation of the 20 metre segment L_{CPX} values is calculated for each run. This gives a separate s_t value for each run in each direction.
2. The resulting values are arithmetically averaged, thus combining the results for both directions.

Table 2 L_{CPX} and acoustic variability (s_t) for each test section

Surface	Site	P1 tyre		H1 tyre ⁺		Test section length
		$L_{CPX:P1,80}$	S_{P1}	$L_{CPX:H1,80}$	S_{H1}	
Grade 2* (single coat)	1a	102.3 dB	0.4 dB	100.5 dB	0.5 dB	200 m
	1b	102.3 dB	0.3 dB	100.0 dB	0.3 dB	260 m
Grade 2/4 (racked)	2a	102.1 dB	0.4 dB	100.2 dB	0.2 dB	480 m
	2b	102.1 dB	0.4 dB	100.2 dB	0.3 dB	480 m
Grade 2/4 (two coat)	3a	101.6 dB	0.5 dB	99.9 dB	0.3 dB	340 m
	3b	101.7 dB	0.5 dB	100.0 dB	0.4 dB	340 m

* Significant stripping of chip present at Site 1 (Grade 2, single coat).

⁺ Only one measurement run performed in each direction using the H1 tyre.

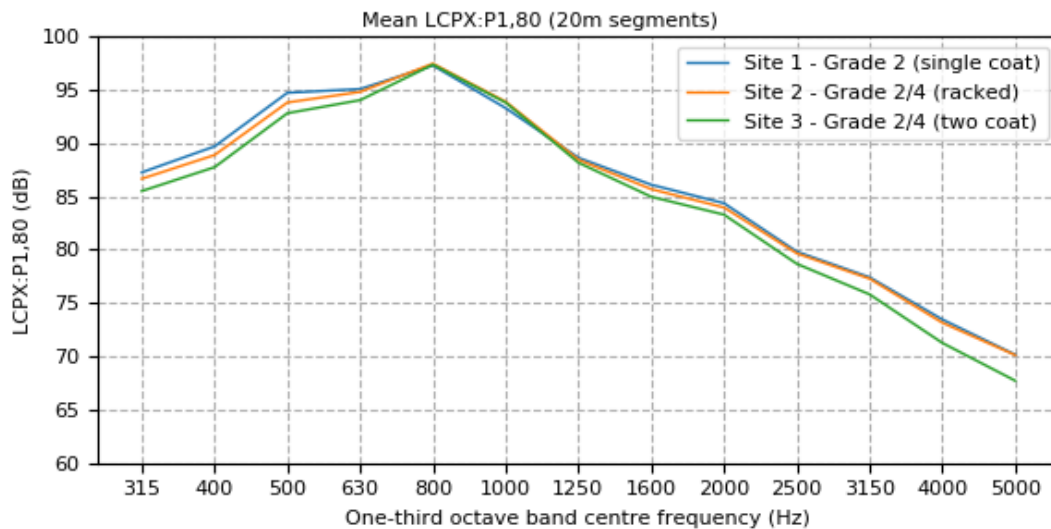


Figure 2 One-third octave band $L_{CPX:P1,80}$

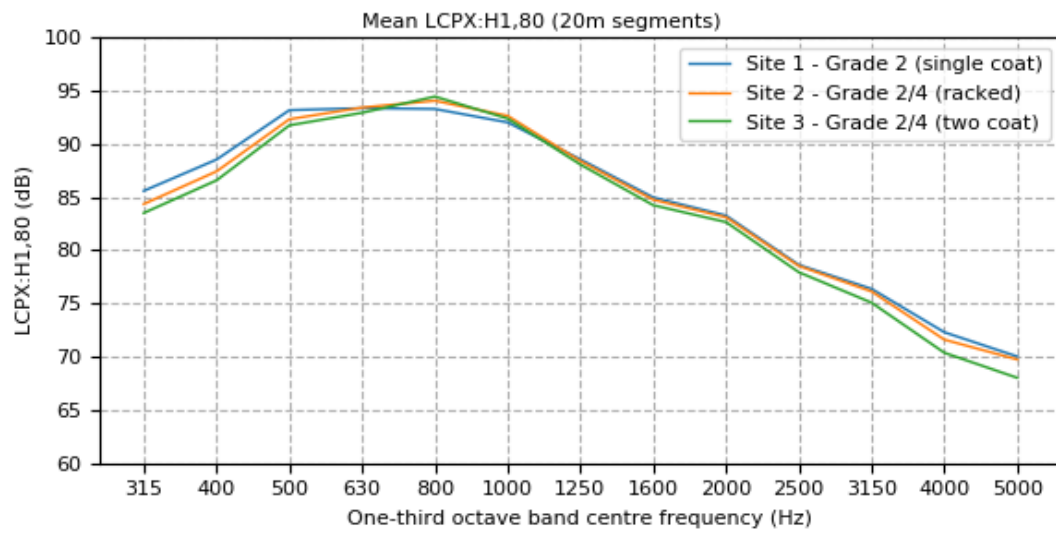


Figure 3 One-third octave band $L_{CPX:H1,80}$

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