Measuring the Effect of Audio Tactile Profiled Roadmarkings

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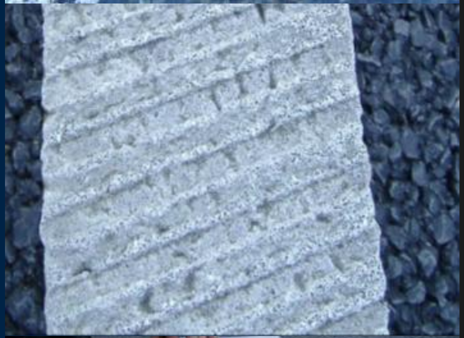
Why are we doing this?

- But how big is big enough?
- Which dimensions are important and which ones can be ignored?
- Current assessment of end of life, quality and new designs are uncertain – we don’t know bounds of *effectiveness*
- Is there a simpler and less expensive way to assesess and approve new innovative markings



Aim

- Establish a cheap, repeatable performance measure using 2 models that separately link the dimensions and shape of the ATP roadmarking to sound response and vibration response
- Allow industry to ensure roadmarkings are established and maintained at dimensions which ensure maximum effectiveness
- Further stages of this work will relate sound and vibration effects to subjective response of drivers
- This will allow innovative markings to be quickly assessed without extensive and difficult testing of response.
- 2 Year LTNZ funded project

Previous Tests On Real Markings were Variable

- Lots of variation in sound and vibration levels in the car
- Lots of variation in block profile
- Next step: control variation in individual block profile by using test blocks

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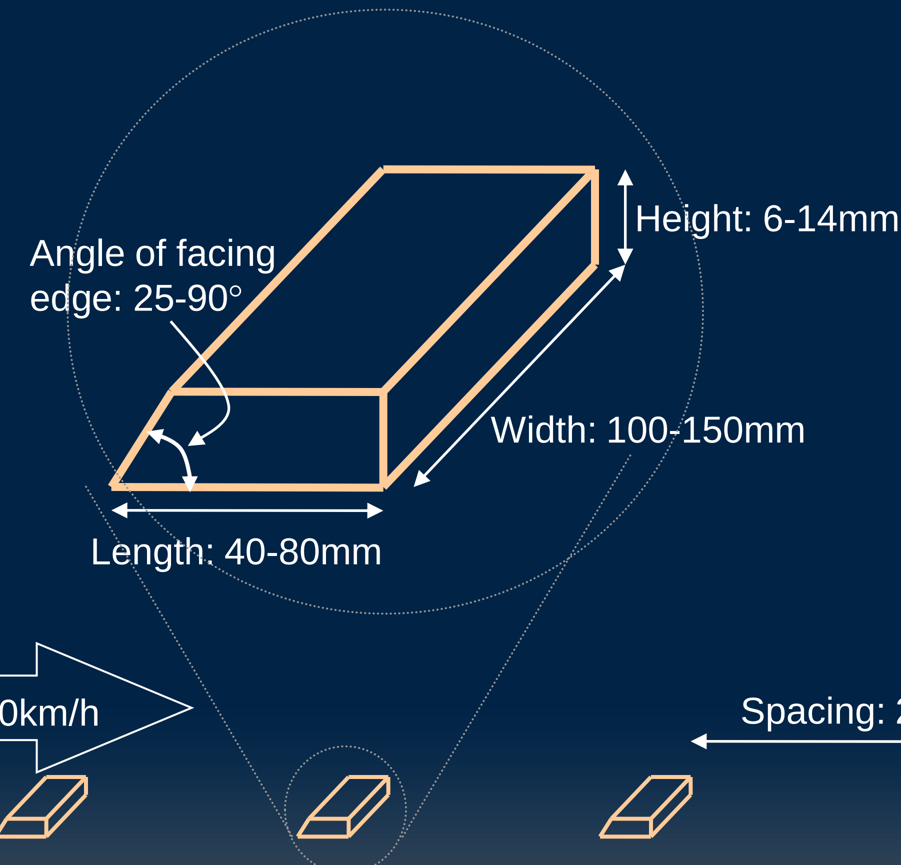
Method

- Simulate ATPs with blocks of wood to control variation
- Measure sound and vibration in a car that is driving over the wooden blocks
- Model the relationship between block size/shape and sound/vibration
- Later a social scientist in the team will relate this to driver response

Simulated Profiled Markings



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Measuring Sound and Vibration

- Noise meter mounted behind the driver's ear to measure Sound
- Tri-axial accelerometer mounted in passenger foot-well to measure vibration – failed to log properly
- Logged data in manually triggered 2 s bursts at 12 500 Hz
- Driver and passenger assess validity of each run qualitatively

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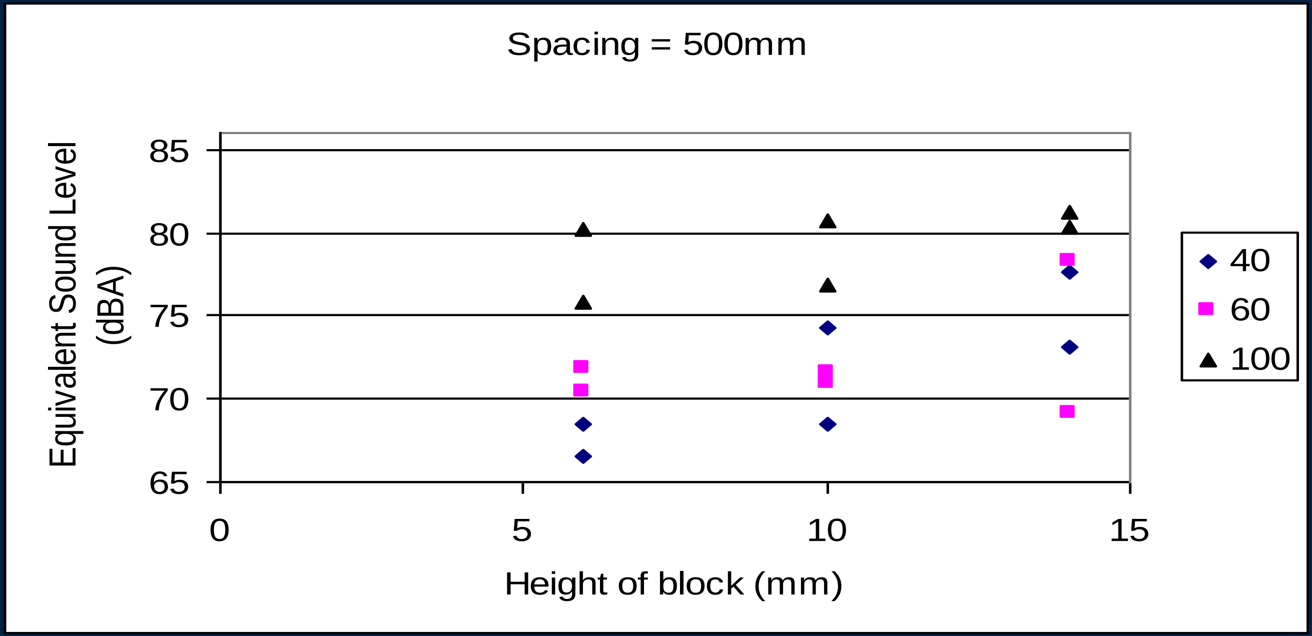
Simulation Sites

Manfield Racetrack

Taxiway at Paraparaumu airport

- Level, even road surface safely lay markings and drive over them at 100km/h

Does block height affect Sound?



- General trend of higher sound with higher blocks
- Masked by high variation in runs at same block height
- Can we tell anything from this data?

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Future (2008): Focus on Consistency

- The high variability between runs makes it hard to find relationships between marking profile and driver experience
- More runs over same blocks to reduce statistical uncertainty
- Much wider blocks to ensure clean hit
  - No longer simulating real road markings but focus on consistency
- Measurements outside car a possible alternative if being inside the car induced excess variability.

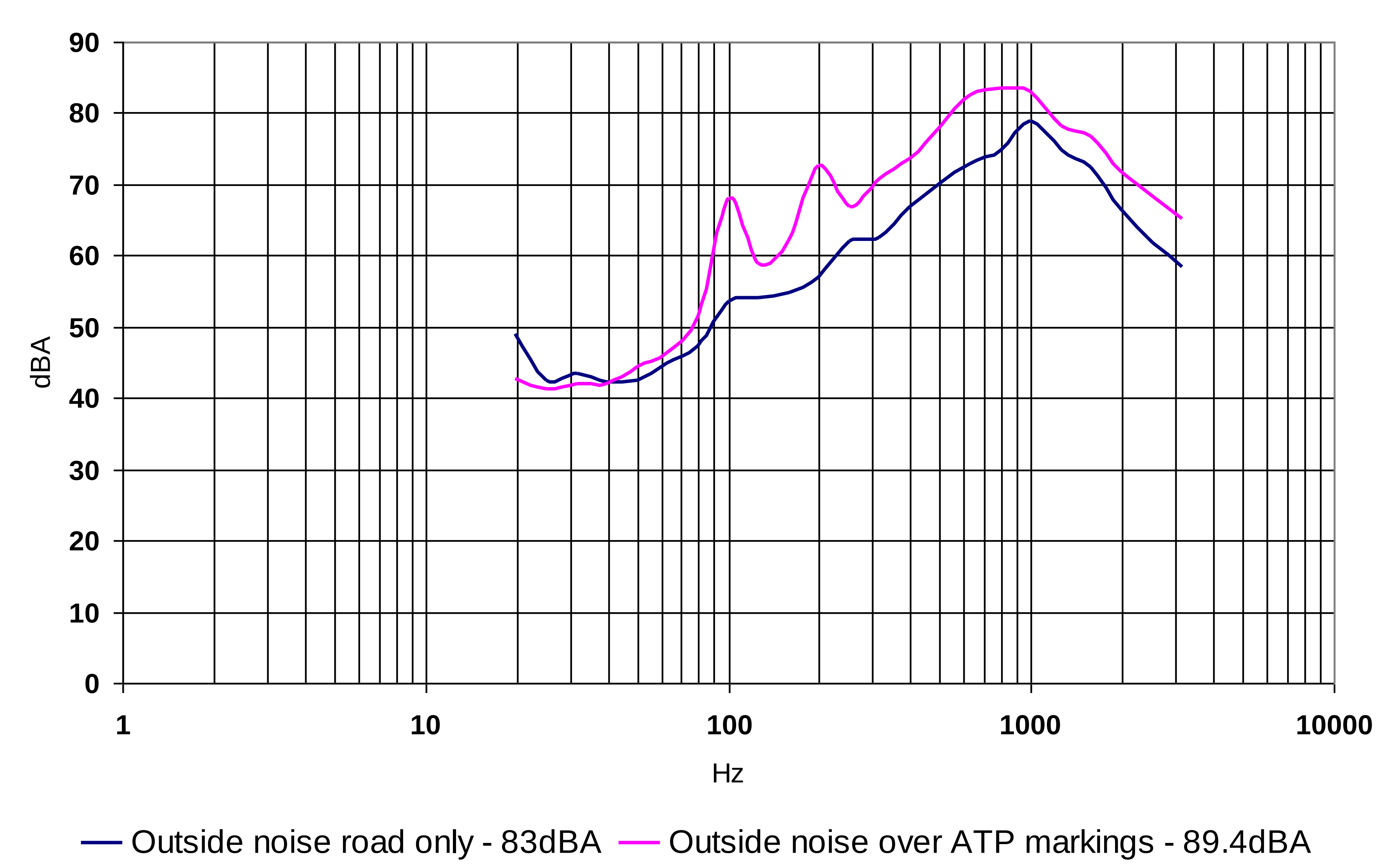
Testing variability on very wide lines with multiple runs

Line width (mm)	Speed(kmph)	Spacing (mm)	Average Noise Level (dBA)	Range (dBA)
200	60	250	67.4	2.3
		500	65.7	1.8
	100	250	74.4	4.4
		500	73.3	4.9
250	60	250	66.0	2.9
		500	65.3	4.9
	100	250	74.9	7.2
		500	71.4	1.3
300	60	250	68.9	3.9
		500	66.2	0.7
	100	250	71.9	3.8
		500	73.3	3.5

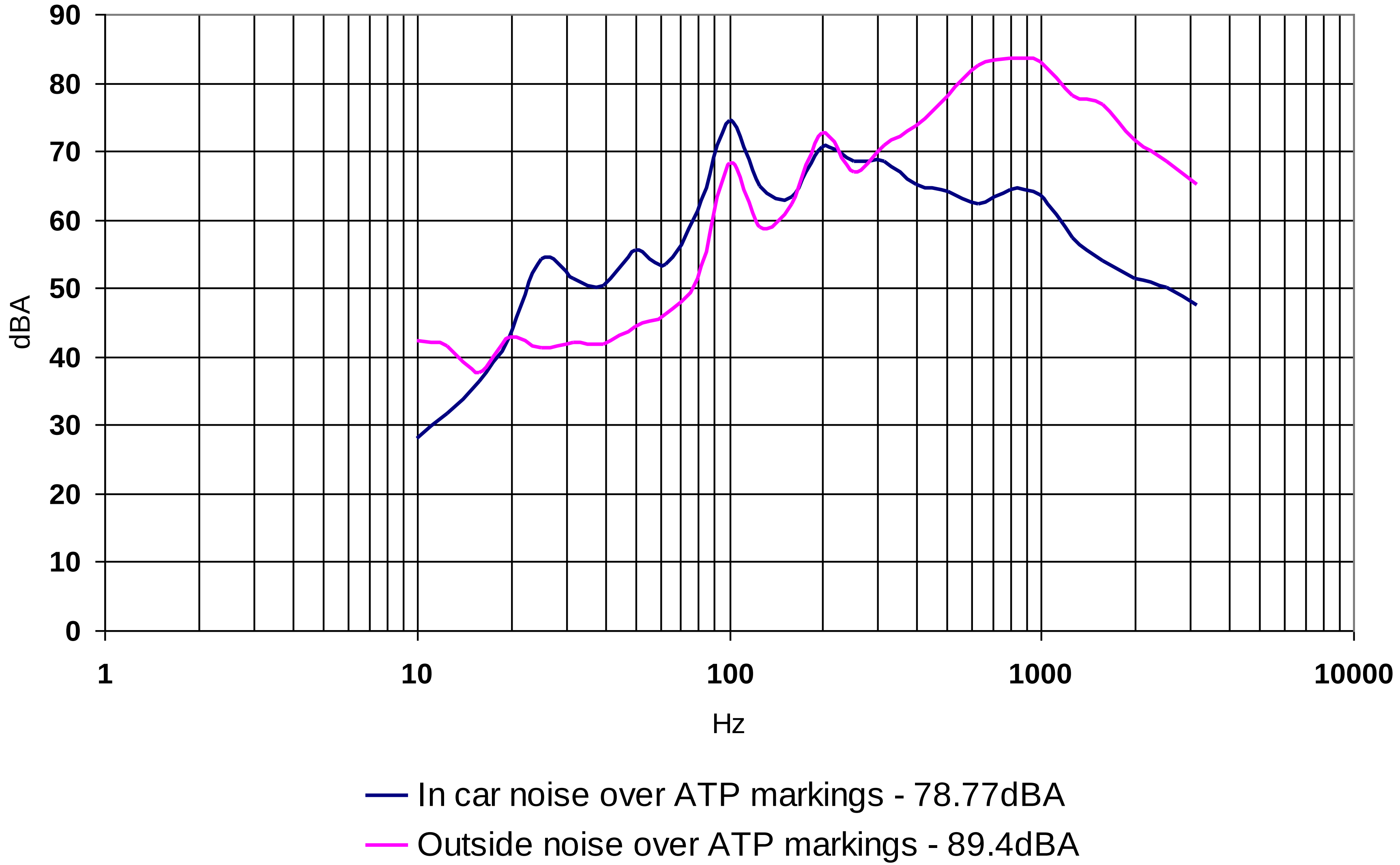
Inside v outside: Range of 10 runs

		outside	inside
Range	ATP	6.2	5.4
	Road	1.5	0.7
Standard deviation	ATP	1.79	1.30
	Road	0.49	0.22
Total noise (dBA)	ATP	89.4	78.8
	Road	83.0	72.7

Measuring outside the vehicle



Noise inside car v outside the car



In-situ investigation of ATP markings

- Large texture of #2 chip resulted in profiles of reduced height
- Multiple measurements on ATP over #2 and #6 chip, also subjective assessment by two testers
- Second issue of truck drivers complaints of noise and vibration investigated.

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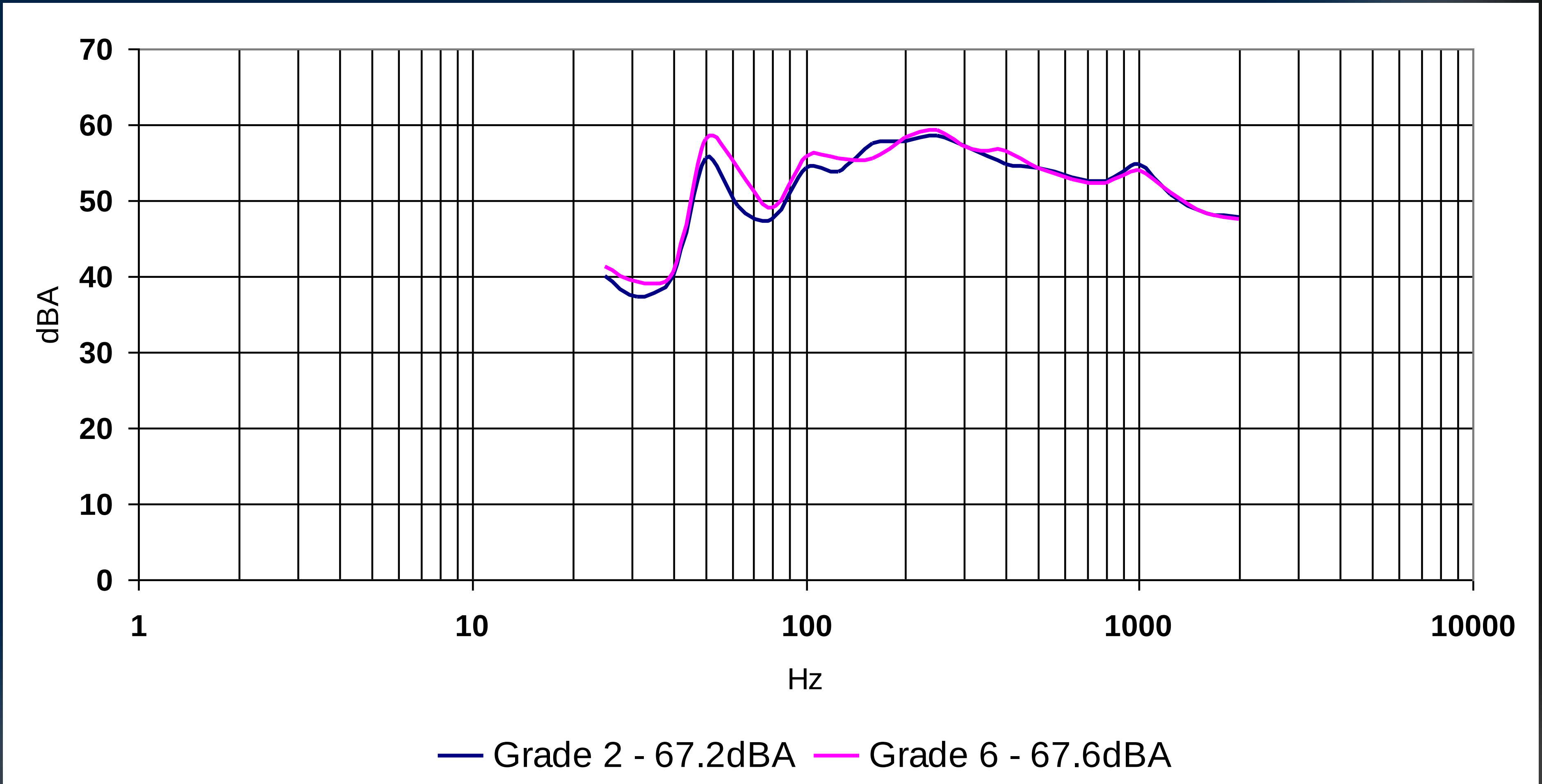
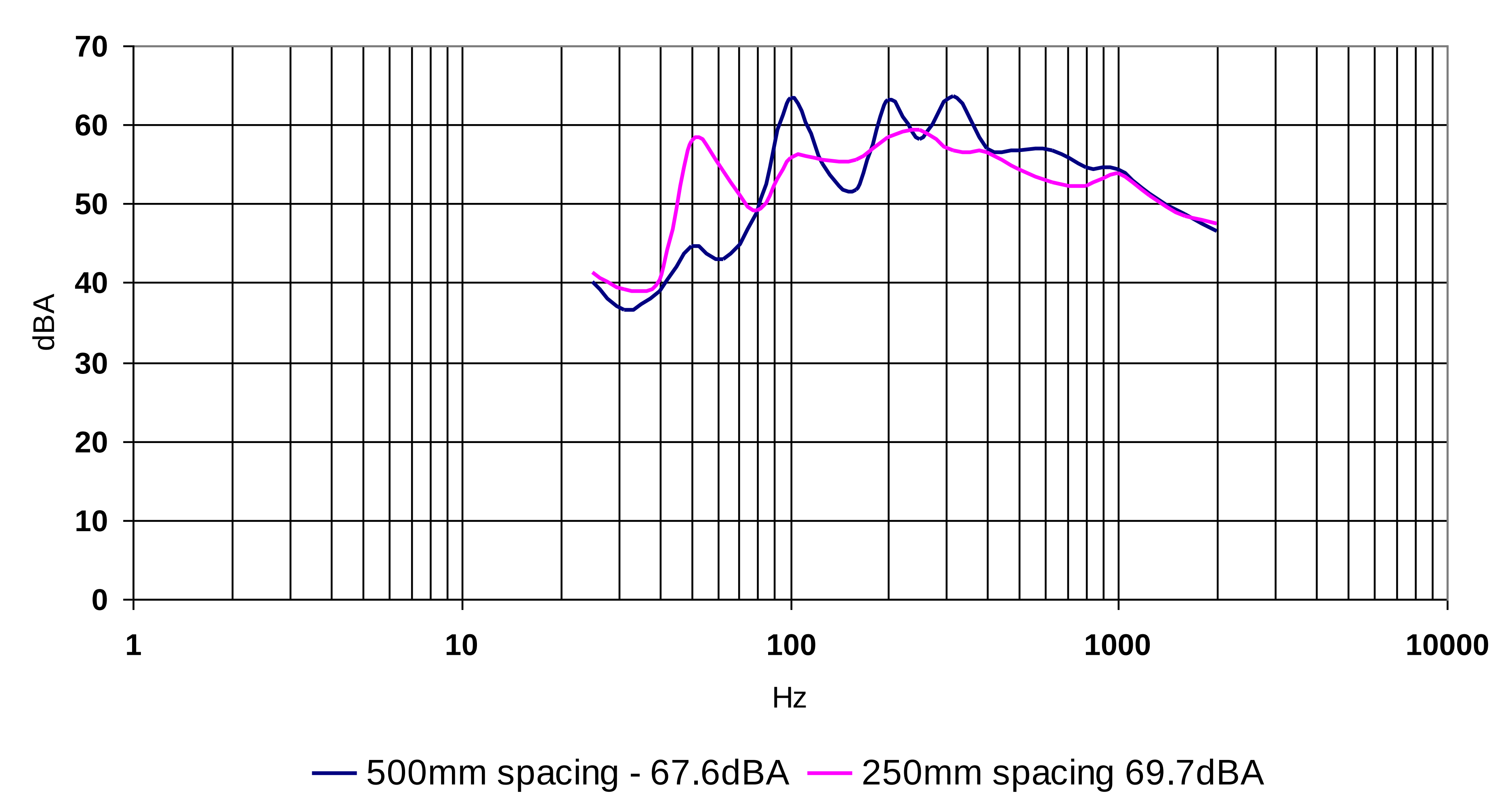
Car on ATP marking over #2 and #6 chip



Effect of spacing: 250mm v 500mm over #6 chip



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Noise level differences of ATP markings #2 and #6 chip

		Underlying Road Surface		Distance between ATP markings
		Grade 2 500mm	Grade 6 500mm	Grade 6 250mm
100 km/hr	ATP markings	67.2	67.6	69.7
	Road only	64.7	63.5	62.4
	Increase in total noise (dBA)	+2.5 dBA	+4.1 dBA	+7.3 dBA
80 km/hr	ATP markings	66.7	66.4	67.5
	Road only	62.2	61.2	61.2
	Increase in total noise (dBA)	+4.5 dBA	+5.2 dBA	+6.3 dBA

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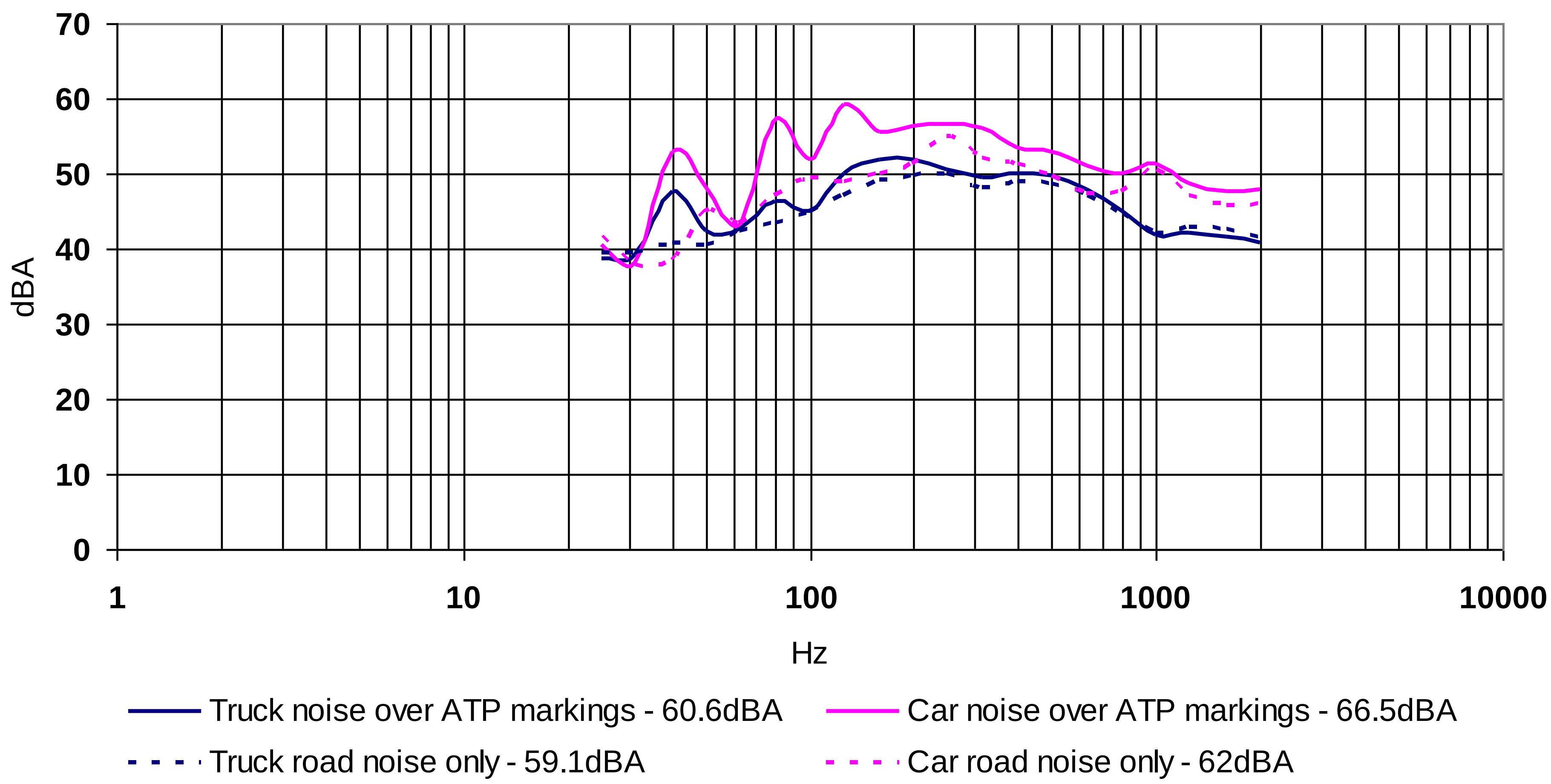
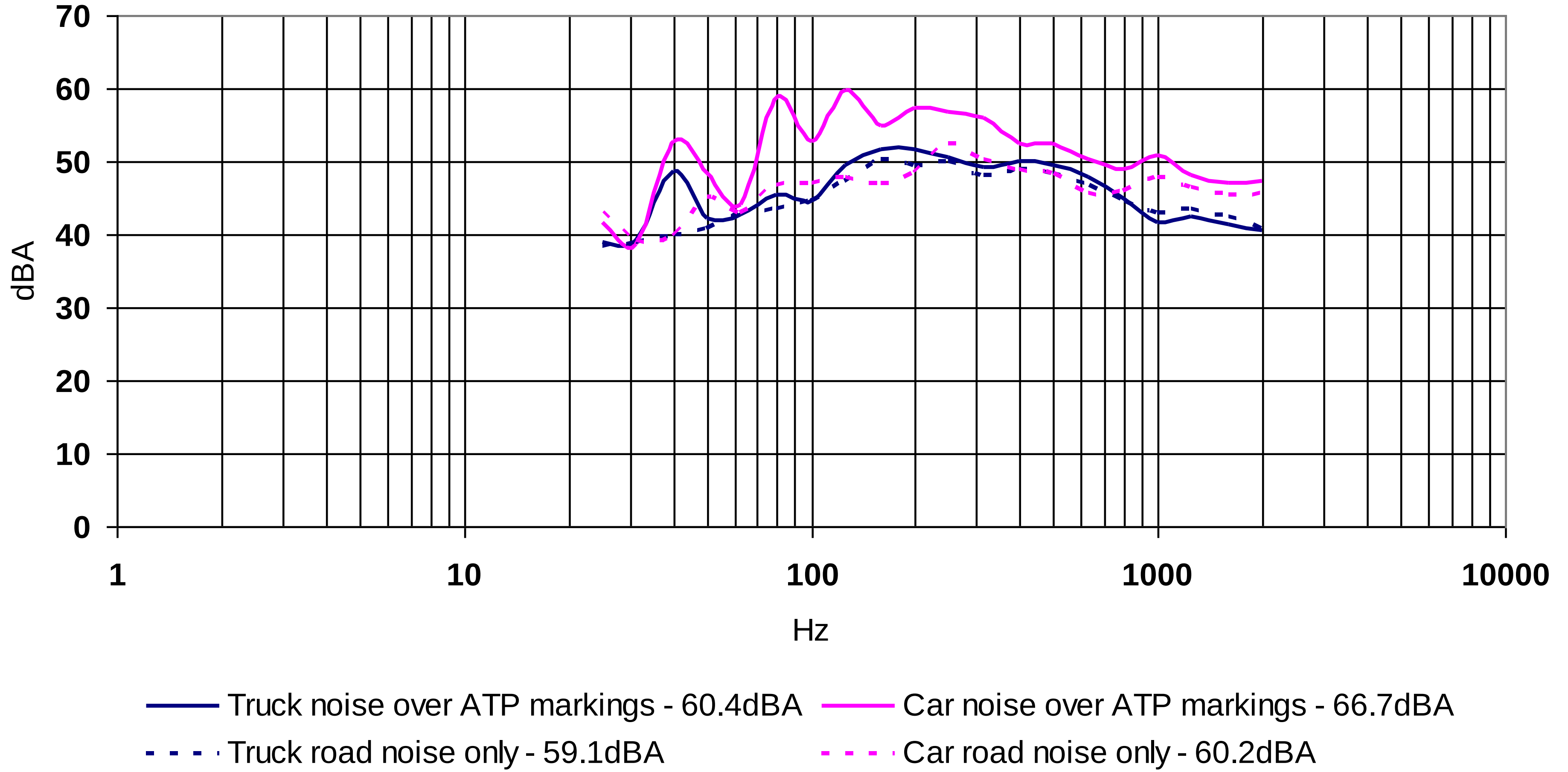
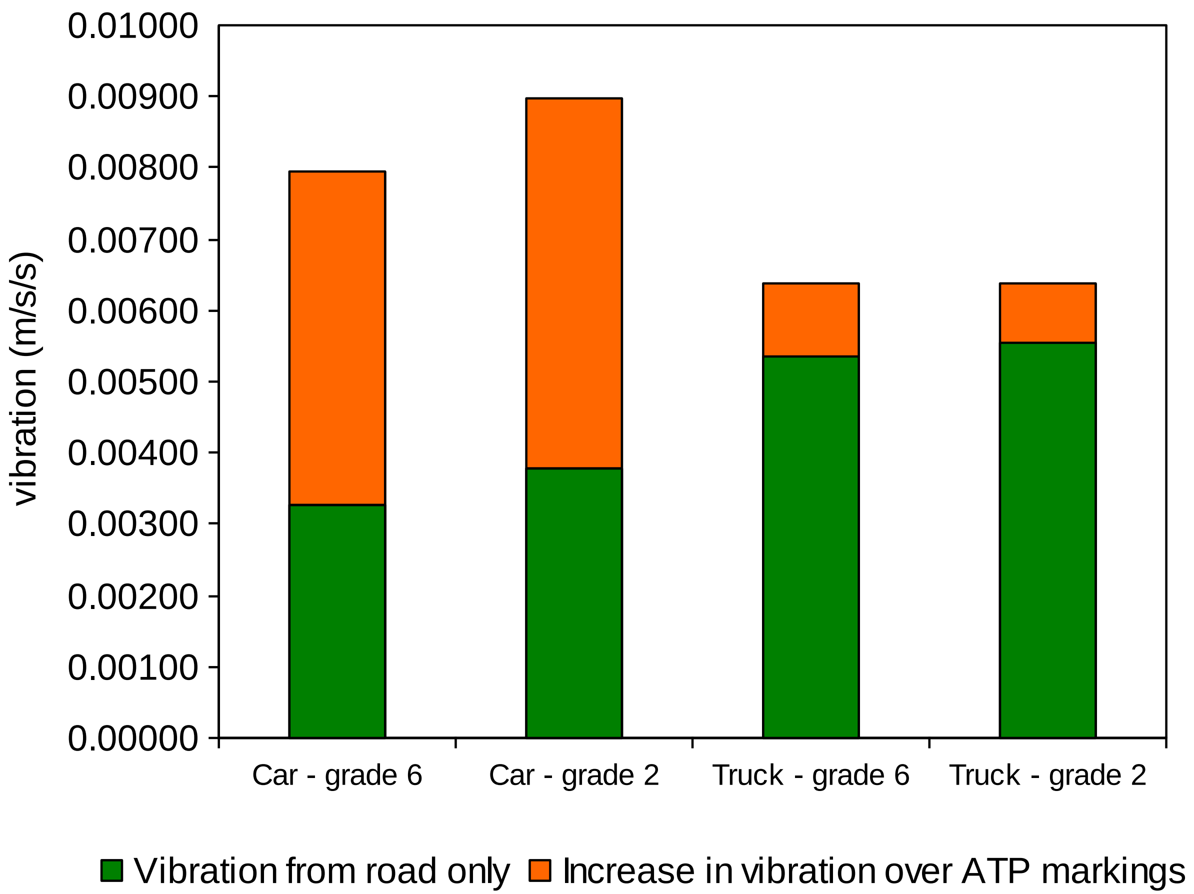
Truck and car on ATP marking over #2 Chip



Truck and car on ATP marking over # 6 Chip



Vibration levels car v truck on ATP markings



Truck and car on ATP markings

		Grade 2	Grade 6
Car	ATP markings	66.5	66.7
	Road only	62.0	60.2
	Increase in total noise (dBA)	**+4.4 dBA**	**+6.5 dBA**
Truck	ATP markings	60.6	60.4
	Road only	59.1	59.1
	Increase in total noise (dBA)	**+1.5 dBA**	**+1.3 dBA**

Driver response

- Although we can obtain a reliable average result with multiple runs, and drivers are responding to a single imperfect hit of the line.
- Our research was based on a Dose/ Response approach; more noise would give more effect.
- Now about to use a Threshold approach; what is the minimum noise that drivers can reliably detect. Extra noise not much benefit.
- This stage in progress to establish if threshold approach is valid, thereafter probably revise research.