

APPENDIX 6Q

**APM Groundborne
Noise Assessment**

Item	Description	Unit	Value	Remark
1	Establishment of Typical APM Vib Level			
1.1	RMS Vel Level for a typical AMP pass by event (ref 1×10^{-9} m/s)	dB	75	Inside Motor Control Centre in basement at 2.5m from existing APM track. A total of 13 APM events were observed. APM speed at 24kph. The 75dB vibration level is the highest event for a very conservative assessment.
1.2	Ref vibration level in in/s	in/s	1.00E-05	
1.3	RMS vib level (re to 1×10^{-6} in/s)	dB	47	
1.4	Speed correction	dB	8	
1.5	Corrected vibration level (re to 1×10^{-5} in/s)	dB	55	
2	Vehicle Parameters (no additive, apply greatest value only)			
2.1	Vehicle with stiff primary suspension	dB	8	According to Table 10.1 of Ref [1], a correction of 8dB shall be applied for vehicles with stiff primary suspension. This should have been incorporated during the measurement but are still included for a conservative assessment.
2.2	Resilient wheels	dB	0	
2.3	Worn wheels or wheels with flats	dB	10	
2.4	Subtotal for Item 2	dB	10	
3	Track Conditions (not additive, apply greatest value only)			
3.1	Worn or corrugated track	dB	10	Table 10.1 of Ref [1] suggests a 10dB correction for worn wheels and track. This is however not applicable for the APM's guide wheels. For very conservative assessment, this corr is included in the assessment.
3.2	Special trackform	dB	10	
3.3	Joint track or uneven road surface	dB	5	Table 10.1 of Ref [1] suggests a 5dB correction for rough roads.
3.4	Subtotal for Item 3	dB	10	
4	Track Elements (not additive, apply greatest value only)			
4.1	Floating slab trackbed	dB	0	Table 10.1 of Ref [1] recommends -15dB correction. However, this is not applicable to APM.
4.2	Ballast mats	dB	0	
4.3	High resilience fasteners	dB	0	
4.4	Resiliently supported ties	dB	0	
4.5	Subtotal for item 4	dB	0	
5	Correction for Distance & Geological Conditions			
5.1	Distance from future APM to receiver	m	20	Horizontal separation from future APM to the receiver is 5m. Only horizontal distance is considered for conservative assessment
5.2	Corr factor for distance attenuation and geological conditions	dB	0	
5.3	Geological conditions	dB	4	The measurements were conducted in connected concrete slab and hence has included an efficient vibration transfer. For a conservative assessment, a +4dB correction is included to account for the propagation in rock layer for a distance of 33m (or 100ft)
5.3	Subtotal for Item 5	dB	4	
6	Other Correction Factors			
6.1	Resiliently supported ties	dB	0	APM is actually on inflated wheels and only the side guide wheels would generate limited vibration. This factor should have been incorporated during the measurement.
6.3	Coupling for building foundation	dB	0	
6.4	Floor-to-Floor Attenuation	dB	-2	According to Table 10.1 of Ref [1], a correction factor of 1 - 2dB /floor is appropriate. Since the nearest receiver is on the 1/F, a 2dB correction is applied.
6.5	Amplification of floors etc	dB	6	
6.6	Safety Factor	dB	3	See Table 10.1 of Ref [1]
6.6	Subtotal for Item 6	dB	7	
7	Correction Factors for Noise Levels			
7.1	Vibration level	dB	86	Measurement reveals that the peak freq is from 30 - 60Hz. Hence, according to Table 10.1 of Ref [1], correction factor is -35dB
7.2	Conversion factor from rms vib level to SPL	dB	-35	
7.4	Corr factor for train frequency	dB(A)	11	
7.5	Corr factor for 2 simultaneous pass-by	dB(A)	3	
7.6	Corr for 30 mins	dB(A)	-23	
7.7	Total L_{eq} 30 min at receiver	dB(A)	43	
7.7	Future headway of 13 / direction / 30 mins There would be 2 tunnel tubes for the future APM. For a 62 kph (17m/s) speed and a total car length of 39m, the time for pass by is about 6 sec. Taking into account of the noise before the train arrives and leaves, it is very conservative to assume a total period of 10s. Hence the correction is $10 \log(10 / 30 \times 60)$.			
8	Total Noise Impacts on Receivers			
8.1	Criterion - Daytime	dB(A)	60	Comply with daytime criterion
8.2	Exceedance - Daytime	dB(A)	0	
8.3	Criterion - Night-time	dB(A)	50	Comply with night-time criterion (NB daytime headway is assumed for night-time for conservative assessment)
8.4	Exceedance - Night-time	dB(A)	0	

Ref [1] US Federal Transit Administration "Transit Noise and Vibration Impact Assessment", Table 10.1. Adjustment Factors for Generalised Predictions of Ground-borne Vibration and Noise

Note for Existing APM

- Inflated wheels with rubber type guide wheels
- 4-car arrangement (fixed), total length of about 39m
- A total weight of about 52 tonne (net car weight). With passengers, the total weight would be up to 76 tonne.
- max operating speed = 62kph