



# Engineering Report


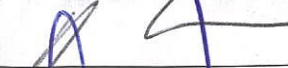



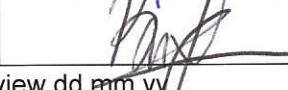
Revision of Determination of Maximum Allowable  
Stagger and Mid Span Offset

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# Document Control

## Document Status

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## Document Amendment Record

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## 1. Introduction

In Determination of Maximum Allowable Stagger (AR-MW-TR-PLN-21720344) the authors adopted a worst case vehicle sway for all instances. The remaining allowable for track offset and cross level variance is consequently conservative in many instances. This document proposes adopting a reduced vehicle sway and increasing the track allowance correspondingly.

## 2. Related Documents

DOCUMENT NAME	DOCUMENT NUMBER
Determination of Maximum Allowable Stagger	AR-MW-TR-PLN-21720344
LORAC waiver	KNet No: 8691315 L98-WAV-003
Vehicle Movements	KNet No: 8522351 3EAM913274

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### 3. Allowance for Rolling Stock

The Determination of Maximum Allowable Stagger AR-MW-TR-PLN-21720344 has, in line with Australian Standards for determination structural clearance, allowed for 208mm displacement for a contact wire height of 5.2m. It has also made a further allowance of 79mm for movements within the vehicle. This gives for a total allowance for rolling stock of 287mm.

Clear Route modelling, document 3EAM913274, shows the anticipated 98.3 percentile sway of the pantograph for a broad gauge vehicle to be a maximum of 190mm, in the worst case thus permitting a possible additional allowance to track of 97mm (i.e. 287-190). A summary of the Clear Route modelling is shown in Table 1 below. Sway is summarised by cross level excess or deficiency as it shows a strong relationship whereas speed and other factors did not.

	Cross level excess, mm- movements towards inside of curve							Level Tangent	Cross level deficiency, mm- movements towards outside of curve				
	130	110	100	75	50	25	12.5		0	12.5	25	50	75
Sway	183	190	181	159	136	91	81	76	89	103	132	156	179

**Table 1 - Summary of Pantograph Sway**

Table 1 shows the worst case sway determined for:

- The range of speeds experienced on the AMPRN
- Tare and Crush conditions
- Inflated and Deflated air bags
- Broad gauge configuration
- A wire height of 5.2m

	Cross level excess, mm- movements towards inside of curve							Level Tangent	Cross level deficiency, mm- movements towards outside of curve				
	130	110	100	75	50	25	12.5		0	12.5	25	50	75
Sway	183	190	181	159	136	91	81	76	89	103	132	156	179
Additional Allowance	104	97	106	128	151	196	206	211	198	184	155	131	108

**Table 2 – Additional Allowance for Management of Track**

Table 2 shows a summary of the additional allowance available to track for the same conditions as Table 1 due to the reduced sway determined from the Clear Route modelling.

At the maximum wire height of 7.1m the Determination of Maximum Allowable Stagger, AR-MW-TR-PLN-21720344, has provided for a total rolling stock allowance of 370mm (83mm more than that allowed for when the wire height is 5.2m) by reducing the applicable maximum mid span offset. Extrapolating the body roll from the Clear Route modelling for the increased wire height shows the additional movement only to be 70mm. Therefore, application of the additional allowance from 5.2m wire heights (shown in Table 2 above) to higher wire situations will subsequently be conservative. As the wire height is nominally 5.2m there would be little advantage to considering further complication.

As with previous analysis no allowance has been added for rail wear or flange way clearance when determining rolling stock movements.

**Allowance for Track**

Table 3 below reproduces values from document AR-MW-TR-PLN-21720344. Consistent with the allowances for rolling stock only the 5.2m high wire is considered. It can be seen that there is an existing allowance of 79mm for track.

Wire Height	5.2	5.5	5.8	7.1
Cross Level Variance	15	15	15	15
Effect of Cross Level Variance at Wire Height	49	52	54	67
Lateral Offset	30	30	30	30
Allowance for track tolerances	79	82	84	97

**Table 3 - Allowance for track tolerances in the determination of Maximum Mid Span Offset**

	Cross level excess, mm- movements towards inside of curve							Level Tangent	Cross level deficiency, mm- movements towards outside of curve				
	130	110	100	75	50	25	12.5		0	12.5	25	50	75
Additional Allowance	104	97	106	128	151	196	206	211	198	184	155	131	108
Existing Allowance	79	79	79	79	79	79	79	79	79	79	79	79	79
Total	183	176	185	207	230	275	285	290	277	263	234	210	187
Proposed Track Allowance	162	157	164	181	200	236	244	248	237	226	203	184	165

**Table 4 – Proposed Track Allowance**

Table 4 combines the total possible track allowance. It is proposed that only 80% of the additional allowance be utilised for track management. Section 5, following, shows how the allowance will be used in practice.

Background: A waiver, L98-WAV-003, approved by the designers to their own standard utilises a reduced body roll, however transfers the balance to increased stagger. The waiver is particular to the stagger over compound turnouts. The waiver recommends that the body roll allowance can be reduced from 2.5 to 1.7 degrees which corresponds to 90mm less movement on the pantograph. The utilised 90mm is 80% of the additional allowance (108mm) that the clear route modelling shows is applicable to the situation.

**4. Management of Track**

The tracks position should be monitored as part of the detailed track inspection. Variances from design shall be classified per Table 5 below.

Tangent		Curve		Response category
Cross Level	Horizontal Offset	Cross Level	Horizontal Offset	
>45	>90	>30	>60	E1
30-44	50-89	20-29	40	P1
25-29	45-50	15-19	35	P2
<25	<45	<15	<35	N

**Table 5 – Classification of Variances from Design.**

\* A speed reduction should not be applied for excess cant geometry defects.

Note: The E1 level in Table 5 corresponds to the proposed track allowance in Table 4. The worst case allowance of cross level excess or deficiency (110mm cant excess) is applied to all curves.

Cross level and horizontal offsets may be combined to a single value (to make a more accurate assessment) as follows:

$$\text{Variance} = \text{Cross Level (mm)} \times \text{Wire Height(mm)} / 1600 + \text{Horizontal Offset}$$

The fault may then be related by using the Table 6

To use Table 6 the actual cant and cant deficiency shall be used. Each shall be rounded up to the next corresponding value in table. The most severe rating, whether it be for excess cross level or deficiency shall be used to categorise the variance.

	Cross level excess, mm- movements towards inside of curve							Tangent	Cross level deficiency, mm- movements towards outside of curve					Response Category
	130	110	100	75	50	25	12.5		0	12.5	25	50	75	
Maximum Variance Value	162	157	164	181	200	236	244	248	237	226	203	184	165	E1
	130	126	131	145	160	189	195	198	190	181	162	147	132	P1
	104	100	105	116	128	151	156	159	152	145	130	118	106	P2

**Table 6 – Detailed Classification of Variance from Design.**

Note: The E1 levels are taken directly from Table 4. P1 level has been set at 80% of E1, and P2 at 80% of P1. A fault may not be down grade to an N.

## 5. Recommendations

That the additional allowance available from conservative rolling stock sway be utilised for the management of track location. For this purpose the values presented in Table 4 are adopted for the management of all track irrespective of wire height.

The practices for management of track outlined in section 5 be adopted.

Revised limits shall not be applied to compound turnouts where the wire stagger has already been increased.

Further it is recommended that taking advantage of further possible conservatism due to factors relating to the OHW design such as;

- the difference between the allowable mid span static offset and the static offset
- a conservative wind rating
- other factors that can be shown to be conservative

, shall not be utilised in the management of track without consultation and approval from the Manager Electrical Engineering. These factors are possibly better used for the management of the OHW's position rather than the track's.

Likewise possible remaining conservatism remaining in rolling stock movements such as deflated air bags shall not be utilised in the management of track without consultation and approval from the Manager Rolling Stock Engineering.

Any evidence of OHW wire contact beyond the carbon strip observed during pantograph inspection shall be reported to the Manager Electrical Engineering.

