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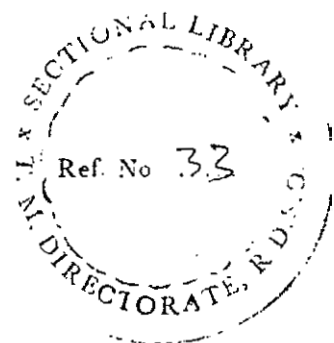


**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

**Research Designs and Standards Organisation
LUCKNOW**

**STUDY OF
ALIGNMENT PARAMETER
UNDER
FLOATING AND LOADED CONDITION**

TECHNICAL REPORT NO. TM - 33



TRACK MACHINES & MONITORING DIRECTORATE

DECEMBER 2000

08077

This report is based on study made by the Track Machines and Monitoring Dte. of RDSO. Although, every care has been taken in analysing it objectively, the views expressed in this report are subject to modifications from time to time in the light of fresh data. Further, they do not necessarily represent the views of the Ministry of Railways (Railway Board), Government of India.

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B.P. Awasthi,
Director/TM-VII

Dharm Singh,
Exec. Director/TM

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**STUDY OF ALIGNMENT PARAMETER UNDER FLOATING AND
LOADED CONDITION**

1.0 Introduction :

- 1.1 In 1967, an effort was made to prescribe the track tolerances in the form of peak exceedences for the operation of WDM4 locomotives and ICF All - Coil coaching stock at a maximum speed of 120 kmph. These tolerances are prescribed in RDSO's report No. C&M-1 (Vol-I) and are known as C&M-1 tolerances. Initially, these tolerances were prescribed for a speed of 120 kmph, but afterward the same have been extended for Rajdhani/Shatabdi routes having maximum permissible speed upto 140 kmph. Though track certification for clearance of a rolling stock is being done on the basis of RDSO's Report No. C&M-1 (Vol.-I), these tolerances were not made mandatory and have been used by the engineering officials for their guidance in deciding the standard of maintenance of track in addition to the oscillation trials for clearance of rolling stock.
- 1.2 The subject of fixing service tolerances for Indian Railways on comfort criteria was discussed by Railway Board (ME) with CCRS in Board's office on 29-07-99 and it was decided that C&M-1 tolerances should be incorporated in the relevant para of Indian Railway Permanent Way Manual (IRPWM).
- 1.3 While finalising the draft correlation slip to IRPWM in this regard, it has been observed from para 9.8.1 of C&M-1 (Vol-I) report that the alignment defects used in the correlation study undertaken in 1967 were recorded under floating condition over the whole length of the test section by ground measurement of the versine on the track as it was not possible to measure alignment with Track Recording Car under dynamic condition. Track monitoring on Indian Railways has undergone substantial change and Track Recording Cars have been measuring alignment in dynamic condition. As such, it is considered

essential that tolerances for alignment as measured under loaded condition by track recording cars are prescribed so that dynamic effect in the measured value is also accounted for.

- 1.4 As per Railway Board's (ME) directives, a study on correlation between alignment measured in floating and loaded condition was conducted on Lucknow-Kanpur section of Northern Railway. Report No. TM-17 was issued in this regard and the same was sent by Board (ME) to CCRS for his comments.
- 1.5 CCRS was of the opinion that correlation between floating and loaded measurement as arrived at in RDSO's report No. TM-17 appears to be valid only in lower ranges i.e. upto 5 mm, as in the data analysed, there were relatively few peaks of alignment above 5 mm (Annexure-1). It was suggested that more field data should be collected specially for alignment peaks above 5mm and further study should be done.
- 1.6 In present report, an effort has been made to arrive at limiting peak exceedence values for alignment measured with track recording car by correlating it with the measurement taken in floating condition. The limiting values so arrived at are recommended for adoption on all the routes where C&M-1 tolerances (now para 607(2) of IRPWM) are to be observed.

2.0 Field investigation :

- 2.1 The data presented in this report is based on alignment defects measured by track recording car No. 225, 2500 & 7973 (ICF all coil coaches). Field investigation and collection of data has been done on various sections of Northern Railway and Central Railway as under.

S.No	Railway	Section	Kilometer		Month of recording/ Measurement
			From	To	
1.	N. Rly.	LKO-CNB	6	35	Jan.' 2000
		ALD-CNB	873	919	Feb.'2000
		MGS-ALD	677	721	} Feb.'2000
			725	819	
		ALD-MGS	820	725	} Feb.'2000
			721	677	
2.	C. Rly.	NDLS-JHS	1386	1345	Jan.' 2000

From the TRC results, locations with alignment peaks above 5 mm were listed. These were subsequently investigated at site to measure the alignment in floating condition. The data collected is tabulated in Annexure – 3/1 to 3/4.

3.0 Analysis of data :

3.1 The alignment data from TRC recording in loaded condition was concurrently analysed with the data obtained from physical ground measurement in floating condition. Alignment defects recorded on test sections by two methods, i.e. by TRC and ground measurement were plotted. The best-fit line was drawn on the graph (Annexure-2). Although, there is some scatter in data but the trend and relationship between the two is well established. For relevant alignment peaks in floating condition corresponding values in loaded condition have been obtained from this graph / relationship and are listed below :

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Alignment peak value

Floating	Loaded
3	7.09
4	7.94
5	8.79
6	9.64
7	10.49
8	11.34
9	12.19
10	13.04

3.2 In the study report TM-17 corresponding values to 5 mm, 7 mm and 10 mm alignment peaks in floating condition were found to be 6.8 mm, 9.7 mm and 14.0 mm respectively in loaded condition. In the present study, corresponding values obtained are 8.8 mm, 10.5 mm and 13.04 mm respectively.

3.3 The peak values in loaded condition differ from those in floating condition, as condition of track components viz. ballast, fastenings, etc., change the geometry in dynamic condition. Earlier in 1974, some studies were conducted in RDSO and dynamic track geometry was related with static geometry recorded in "floating" (no load) track on other than PRC sleeper track. This study also exhibited some scatter in the data collected. The relationship between the dynamic alignment peak and floating alignment peak was found to be as under:

$$AL. (loaded) = 1.26 * AL. (floating) + 3.20$$

(*Paper – "Future Track Tolerances for Indian Railways" by M. Mani & S.K. Kundu).

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From this study the various relevant values arrived at are as under :

Alignment (mm)

Floating	Loaded
5	9.5
7	12.02
10	15.8

The higher values were perhaps obtained on account of lighter track structure compared to present PRC track on which the correlation study has been conducted.

3.4 Also in the study done by Transmark for Indian Railways in 1997 the peak exceedences arrived at for speeds of 120 – 140 kmph for alignment parameters on 7.2 m chord were 13 mm for urgent level and 17 mm as maximum level (Annexure-4).

3.5 Based upon above analysis and discussion, the trend of relationship for alignment parameter in floating and loaded condition is well established. The limiting values obtained in this report are more or less matching with the limiting values of Report No. TM-17. But considering the fact that field staff should not become complacent, these values may be kept on conservative side and following tolerances may be adopted :

Alignment peak (mm)

Floating	Loaded
5	8 mm
7	10 mm
10	12 mm

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4.0 Recommendation :

4.1 On the basis of above analysis, it is recommended that limits of alignment parameters prescribed in para 12.1(i) of RDSO's Report C&M-1 (Vol.I) and para 607(2) (i) of IRPWM-1986 (Reprint 1999) may be revised as under :

(i) Alignment defects (versine measurement on 7.5 m chord under loaded condition).

(a) On straight track : 8 mm, values upto 12 mm could be tolerated at few isolated locations.

(b) On curves : \pm 8 mm over the average versine. Values upto \pm 10 mm could be tolerated at few isolated locations.

Total change of versine from chord to chord should not exceed 10 mm.

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LIST OF ANNEXURES


Annex. No.	Description	No. of Pages
1.	Rly. Bd. Letter no. 94/Track-III/TK/23 Vol.II. Dated 3.2.2000	3
2.	Alignment peaks – TRC vs Ground Measurement Graph	1
3 / 1 to 3 / 4	Data Tables of TRC and Ground measurements	14
4.	Recommendations of M/s Transmark	2

22
18/2/2000

संशोधन विभाग
पारसी एवं पत्रक अनुभाग
रेल्वी पत्र दफ्तरो...
दिनांक.....

03/2/16

20/1/17

Draft copy
by 14-11-17


GOVERNMENT OF INDIA,
MINISTRY OF RAILWAY,
RAILWAY BOARD.

By Fax

No.94/Track-III/TK/23 Vol.II.

New Delhi, Dated:03.02.2000.

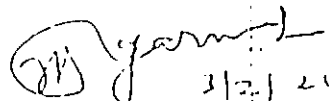
The Director General (Track Machines),
R.D.S.O.,
Manak Nagar,
Lucknow.

(Kind Attn.: Shri Dharam Singh, Executive Director/Track(MC).

Sub: Track Tolerances for High Speed Routes as per C&M-1
Report -Draft Correction Slip to Para 607 of IRPWM.

The views expressed by CCRS/Lucknow in the enclosed D.O. letter
addressed to Member Engineering may kindly be commented upon on priority.

18080


3/2/2000

(V.K. AGARWAL)
Executive Director Track Machines,
Railway Board.

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1009/130000/1994 Vol II

DR. M. MATHI
CHIEF COMMISSIONER OF RAILWAY SAFETY



भारत सरकार
राज्य परिवहन विभाग
(रेलवे विभाग)
GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
(COMMISSION OF RAILWAY SAFETY)

आखेट मंडल, लखनऊ-226 001.
Akh. Mand. Lucknow-226 001.

दिनांक/Date 24.01.2000

आ. सं. 11022/1/94-RS.

EDTK(MC)

DD/11/11
on file
1/21

Dear Shri Agnihotri,

Subject:- Track Tolerances for High Speed Routes as per CAM-1 Report Draft Correction Slip to Para 607 of IRPWU.

Ref.: (i) My earlier DO No. K.11022/1/94-RS Dated 10.10.1999.
(ii) Your DO No. 94/Track-III/TK/23 Vol.II Dated 16.11.1999.

The points raised in your DO letter mentioned above have been considered and the following points are submitted for your consideration :-

- (i) No further Comments are given on the proposed unevenness tolerances. It is however stressed that maintenance practices need to be streamlined.
- (ii) As regards alignment parameter, the matter has been examined in depth with reference to RDSO's Report TH-17 (Oct. '99). The correlation between "Floating" and "Loaded" measurements as arrived by RDSO appears to be valid only in lower ranges viz. upto 5mm. Beyond 5mm, it is seen that there are several locations where "loaded" values are less than "floating" measurements. For example out of 32 cases of "5mm" misalignment in floating conditions, there were less than 5mm in 26 instances in loaded condition.
- (iii) The study covers misalignments mostly upto 5mm (The maximum value being 7.5mm). Hence the conclusion of 10mm misalignment in floating condition becoming "14mm" under loaded condition is not based on actual measurement, but by extrapolation.
- (iv) You would appreciate permitting 14mm misalignments on IRPW/CRR track for higher speeds would only lead to obviously unsafe conditions. Such misalignments on 90 UPR track will definitely lead to premature rail failures.

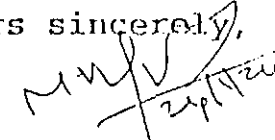
1009/130000/1994 Vol II

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- (v) Tolerances for alignment on curves should have certain correlation with the criteria adopted for realignment of curves "viz. the tolerance should not lead to stretches involving large scale realignment of curves." (Vide Para 421 of IRPMM, 1986).

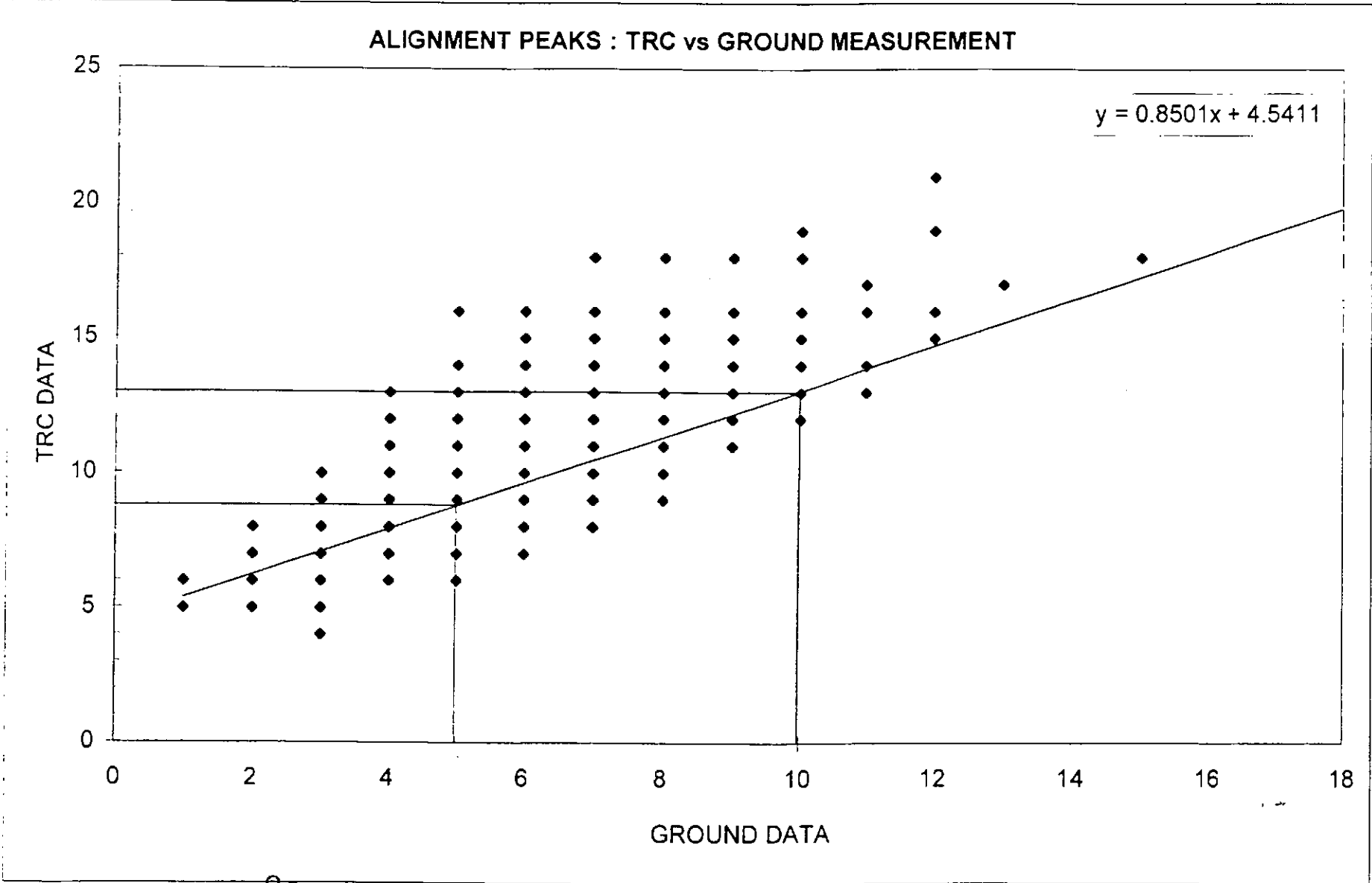
With best wishes,

Yours sincerely,


(Dr. M. Mani)

Shri V.K. Agnihotri,
Member (Engineering),
Railway Board,
Rail Bhawan,
NEW DELHI-110011.

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ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (UP LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
1	677-678	4	7	51		6	8
2		7	12	52		6	8
3		3	7	53		5	7
4		4	7	54		4	7
5	679-680	6	12	55		4	7
6		6	11	56	694-695	4	8
7		5	8	57		5	7
8		4	8	58		5	9
9		4	7	59		5	9
10		5	7	60		5	7
11		5	7	61	695-696	10	15
12	680-681	7	14	62		7	15
13		7	14	63		8	10
14		7	13	64		8	10
15		8	12	65		7	10
16		7	10	66		6	8
17		4	8	67		6	8
18		4	8	68		5	7
19		7	10	69		5	7
20		5	8	70	701-702	4	8
21		4	7	71	702-703	6	10
22		5	7	72	703-704	5	14
23		4	7	73		7	8
24		4	7	74		5	7
25	681-682	4	7	75		4	7
26		3	5	76		4	7
27		4	9	77		6	10
28		4	9	78		8	10
29		4	8	79		6	9
30		3	6	80		6	9
31		3	6	81		5	8
32		3	7	82		6	8
33		3	5	83		4	7
34	682-683	5	13	84	704-705	12	15
35		3	7	85		7	11
36		3	7	86		6	11
37	685-686	10	12	87		5	8
38		6	12	88		4	7
39		7	12	89		5	7
40		6	11	90	705-706	10	19
41		5	7	91		6	14
42	686-687	15	18	92		6	13
43		13	17	93		6	13
44		7	9	94		7	10
45		4	9	95		4	8
46		3	8	96		4	7
47		4	8	97		4	7
48		4	7	98		9	13
49		4	7	99		6	12
50		4	12	100		4	8

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ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (UP LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
101		4	8	151		3	8
102		4	8	152		3	8
103		4	8	153		2	7
104		3	7	154		3	7
105	706-707	8	12	155	726-727	5	10
106		6	7	156		3	9
107		9	12	157	727-728	2	8
108		5	9	158		4	10
109		4	8	159		3	8
110		4	8	160		2	7
111	707-708	6	15	161		2	7
112		5	10	162	734-735	9	16
113	709-710	5	7	163	735-736	11	16
114		5	7	164		6	14
115		4	8	165		6	13
116		5	7	166		3	7
117		5	7	167		6	12
118		5	7	168		4	11
119		4	7	169		5	11
120	711-712	8	10	170	736-737	7	16
121		6	8	171		7	14
122		6	8	172		4	9
123		8	11	173		3	8
124		6	7	174		2	7
125		6	7	175	742-743	3	7
126	712-713	7	15	176		4	9
127		6	7	177		4	9
128		9	12	178		4	8
129		7	9	179		3	7
130		7	9	180	743-744	4	12
131		6	9	181		4	9
132		5	7	182		4	9
133		5	7	183		3	7
134	715-716	5	7	184		6	9
135	719-720	5	11	185		3	7
136		8	12	186	744-745	3	7
137		6	9	187	746-747	3	7
138		4	8	188	747-748	4	13
139		4	8	189		8	10
140	720-721	5	10	190		7	10
141		6	9	191		4	9
142		4	8	192		3	9
143		5	7	193		3	9
144		5	7	194		3	8
145		6	11	195		3	7
146		4	9	196	748-749	6	15
147		4	9	197		6	8
148		5	8	198		3	7
149	721-722	5	7	199		2	7
150	725-726	4	9	200		4	8

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ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (UP LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
201		2	7	251		3	6
202		2	7	252		4	9
203		3	7	253		3	8
204	750-751	2	7	254	779-780	4	11
205	751-752	3	8	255		3	5
206		3	8	256		4	7
207	753-754	4	7	257		2	7
208	754-755	6	12	258	786-787	3	7
209		8	10	259		3	7
210		3	4	260		4	7
211		4	8	261		2	7
212		2	7	262		3	7
213		2	7	263		4	7
214		4	7	264	787-788	4	10
215	755-756	7	10	265		3	8
216		2	7	266		4	7
217		3	7	267	792-793	3	6
218		3	7	268		4	10
219		2	7	269		4	8
220	756-757	6	13	270	798-799	5	7
221		6	13	271		7	14
222		4	8	272		4	11
223		2	7	273		4	10
224		3	8	274		6	10
225		3	7	275		7	9
226	761-762	3	8	276		5	7
227		3	7	277	799-800	3	7
228	762-763	4	13	278		4	10
229		4	9	279		4	8
230		4	9	280	800-801	4	12
231		4	8	281		3	8
232		2	7	282	806-807	11	17
233		3	7	283		11	17
234	769-770	6	13	284		3	6
235		7	13	285	807-808	9	12
236		4	12	286		7	8
237		6	11	287		5	8
238		5	8	288		5	14
239		5	8	289		5	12
240	770-771	4	10	290	808-809	5	9
241		3	7	291		4	7
242		5	10	292		3	8
243		4	8	293	815-816	3	9
244		5	7	294		4	9
245	771-772	4	10	295		4	8
246	777-778	4	9	296		4	7
247		3	9	297		2	7
248	778-779	5	9	298		3	7
249		5	16	299		3	9
250		4	11	300		3	9

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ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (UP LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC, DATA
301		3	9	351		5	8
302		4	9	352		4	6
303	816-817	7	16	353		10	14
304		6	10	354		5	7
305		3	7	355		4	6
306		3	8	356	862-863	8	10
307		3	8	357		4	9
308		5	13	358		3	7
309		4	10	359		6	9
310		5	9	360		3	8
311		5	8	361		5	7
312		5	7	362		8	11
313	817-818	6	13	363		7	10
314		4	11	364		6	9
315		3	10	365		6	10
316		3	8	366		6	9
317		2	7	367	861-862	5	6
318		2	7	368		6	8
319		3	7	369		5	8
320		3	8	370		5	8
321		5	7	371	854-855	6	13
322	818-819	7	11	372		6	11
323		3	5	373		5	8
324		6	9	374		4	6
325		4	9	375		5	7
326		3	8	376		4	6
327		3	8	377		6	8
328		5	12	378	853-854	6	8
329		6	9	379		5	7
330		5	8	380		4	6
331		3	7	381		5	7
332		5	7	382		4	6
333		5	7	383		5	6
334	819-820	2	5	384	846-847	8	18
335		8	14	385		10	18
336		9	15	386		7	13
337		9	14	387		10	12
338	872-873	6	16	388		6	10
339		6	9	389		7	9
340		8	10	390		7	9
341		5	6	391		5	7
342		3	6	392		10	12
343		3	6	393		7	10
344		7	9	394		6	9
345		4	6	395		5	8
346		4	7	396		5	9
347		4	6	397		5	9
348		4	6	398		4	6
349	871-872	5	13	399		4	6
350		5	8	400	918-919	6	12

08094

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY NR
TRC NO : 2500SECTION : Allahabad Division (UP LINE)
MONTH : FEB - 2000

S No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
401		4	10	425		7	8
402	914-915	12	21	426		7	11
403		4	11	427		6	9
404		3	7	428		4	6
405		4	10	429		5	6
406		3	9	430	900-901	4	12
407		3	8	431		4	12
408		2	5	432		2	6
409		4	8	433		4	8
410		2	5	434		6	9
411		3	7	435		5	6
412	909-910	5	10	436		6	10
413		3	6	437		3	7
414	907-908	8	12	438		4	7
415		5	7	439		3	7
416		4	6	440		2	6
417		3	6	441		4	6
418	906-907	4	12	442	899-900	6	14
419		3	8	443		6	9
420		7	8	444		6	7
421		5	7	445		5	6
422		5	6	446		6	11
423		3	6	447		6	8
424		4	8	448		6	8

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ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENTRAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (DN LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
1	721-720	6	12	51		6	9
2		6	11	52		8	12
3		9	12	53		4	8
4		6	8	54		4	8
5		5	9	55		7	8
6		5	8	56		8	12
7		8	11	57		9	12
8		7	9	58		7	12
9		4	7	59		5	6
10		5	7	60		8	10
11	720-719	6	11	61		5	7
12		5	9	62		6	7
13		5	9	63		6	7
14		4	7	64		7	10
15		5	7	65	705-704	11	14
16		5	11	66		7	13
17		4	10	67	704-703	5	8
18		6	8	68		5	7
19		4	7	69	703-702	5	7
20		4	7	70	696-695	5	7
21		6	7	71	695-694	8	10
22	716-715	6	9	72	693-692	6	7
23		5	7	73	820-819	2	7
24		4	7	74	817-816	3	6
25	715-714	5	7	75		4	8
26	713-712	10	14	76		7	16
27		5	9	77		7	15
28		5	8	78		3	8
29		5	7	79		3	7
30		4	7	80		2	7
31		8	12	81	816-815	3	8
32		10	12	82		2	7
33		8	9	83		2	7
34		6	8	84		3	7
35		6	8	85		3	8
36		5	8	86		4	7
37		8	12	87		3	7
38		5	7	88		8	13
39	712-711	10	16	89		4	10
40		6	9	90		6	9
41		5	8	91		3	8
42		9	12	92		4	8
43		6	8	93		4	7
44		5	7	94		3	7
45		4	7	95	813-812	3	7
46	708-707	5	7	96	810-809	7	18
47	707-706	4	8	97		4	10
48		4	7	98		3	7
49	706-705	10	13	99		2	7
50		7	12	100		3	8

08096

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (DN LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S No	KM	GROUND DATA	TRC _i DATA
101	808-807	2	5	151		5	13
102		2	7	152		3	6
103		4	7	153		4	9
104		4	9	154		4	8
105		3	8	155		3	7
106		3	8	156		4	7
107		4	8	157	780-779	5	12
108		2	7	158		6	11
109	807-806	3	9	159	779-778	5	10
110		3	8	160		4	7
111		2	5	161		4	7
112		3	8	162		3	7
113		3	7	163		2	7
114		2	7	164		4	9
115		2	7	165	772-771	5	10
116		5	7	166		4	8
117	799-798	5	14	167		4	9
118		4	10	168		3	8
119		6	10	169		5	8
120		8	11	170		6	7
121		5	8	171		4	13
122		3	7	172		4	12
123		3	7	173	771-770	5	12
124	798-797	12	19	174		3	6
125		8	15	175		4	7
126		4	8	176		4	10
127		4	8	177		3	6
128		5	7	178		4	7
129		3	9	179	770-769	3	7
130	793-792	8	11	180		4	8
131		9	13	181		4	10
132		5	8	182		3	9
133		6	7	183		4	8
134		4	7	184		3	7
135		7	9	185		2	7
136	788-787	4	10	186		2	7
137		4	9	187	766-765	3	7
138		4	7	188	764-763	4	7
139		3	9	189	763-762	3	8
140		5	9	190		3	8
141		3	7	191	762-761	2	7
142		4	8	192		3	7
143		4	7	193		3	9
144		3	7	194	759-758	4	7
145		4	7	195	757-756	6	11
146	787-786	4	9	196		3	9
147		4	7	197	756-755	4	10
148		3	8	198		4	9
149		3	7	199		3	9
150		4	7	200		2	7

16080

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500SECTION : Allahabad Division (DN LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S No	KM	GROUND DATA	TRC DATA
201		8	16	251		3	8
202		4	13	252		4	7
203		3	7	253		4	7
204		2	7	254	743-742	5	8
205	755-754	7	12	255		3	7
206		5	10	256		2	7
207		4	9	257		3	9
208		3	8	258		3	8
209		4	8	259		3	7
210		2	7	260		3	7
211		4	7	261		3	7
212		4	10	262	742-741	2	7
213		3	9	263		2	7
214		5	8	264	741-740	5	7
215		4	8	265	740-739	3	5
216		3	7	266		6	9
217	754-753	3	5	267		2	7
218	751-750	2	5	268		3	7
219	749-748	5	14	269		2	7
220		5	10	270	739-738	3	9
221		4	10	271		3	8
222		5	10	272		4	8
223		6	9	273	737-736	6	13
224		5	9	274		5	13
225		4	8	275		5	13
226		4	11	276		5	12
227		4	9	277		4	11
228		3	8	278		6	10
229		4	8	279		5	10
230		4	8	280		3	9
231		3	8	281		7	15
232		3	7	282		5	12
233		2	7	283		6	12
234	748-747	5	11	284		5	12
235		7	11	285		5	12
236		3	8	286		4	11
237		4	8	287		3	9
238		5	7	288		4	9
239		3	7	289	736-735	9	18
240		5	11	290		4	12
241		5	9	291		5	10
242		4	9	292		3	9
243		3	9	293		4	11
244		3	8	294		4	10
245		4	8	295	734-733	2	7
246	747-746	4	7	296		2	7
247	745-744	2	7	297		3	7
248	744-743	3	9	298		8	12
249		6	10	299		2	7
250		4	8	300		3	7

08098

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC NO : 2500

SECTION : Allahabad Division (DN LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
301	731-730	2	7	310		2	7
302	729-728	3	8	311		6	13
303		3	7	312		4	9
304		3	7	313		3	7
305		7	15	314	727-726	5	7
306		4	10	315		3	9
307		3	7	316		3	8
308		2	7	317	726-725	3	8
309	728-727	6	11	318		2	7

08099

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC : 7973SECTION : Lucknow - Kanpur (UP LINE)
MONTH : FEB - 2000

S No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
1	6-7	5	7	51		4	6
2		4	7	52	15-16	3	6
3		4	8	53		4	10
4		4	7	54		5	7
5		5	6	55		7	8
6		4	7	56		5	8
7		6	7	57		9	11
8		5	6	58		6	10
9		5	8	59		6	7
10		5	6	60		5	9
11		4	6	61		5	6
12		4	6	62		4	6
13		6	9	63		9	11
14	7-8	5	6	64		4	6
15		5	7	65		5	6
16		5	6	66		6	8
17		6	9	67		6	9
18		5	6	68	16-17	7	11
19		5	7	69		5	11
20		5	7	70		6	9
21		4	7	71		8	11
22		5	6	72		6	15
23		5	7	73		8	11
24		4	7	74		7	11
25		6	9	75		6	7
26	12-13	4	6	76		6	10
27		5	7	77		5	7
28		5	6	78		7	9
29		4	6	79		6	8
30		4	8	80		8	11
31		5	7	81		6	8
32		5	6	82		5	10
33		3	6	83	17-18	7	9
34		5	6	84		7	9
35		4	6	85		7	10
36		5	7	86		6	8
37		4	6	87		5	9
38		6	8	88		4	8
39		4	6	89		5	8
40	13-14	4	6	90		7	8
41		4	6	91		4	6
42		3	6	92		7	10
43		5	7	93		5	7
44		4	6	94		4	6
45		5	6	95		5	7
46		5	7	96		5	6
47		4	6	97		6	8
48		4	6	98	19-20	6	8
49	14-15	4	6	99		6	9
50		4	6	100		7	10

08100

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : NR
TRC : 7973SECTION : Lucknow - Kanpur (UP LINE)
MONTH : FEB - 2000

S.No	KM	GROUND DATA	TRC DATA	S.No	KM	GROUND DATA	TRC DATA
101		5	10	151		6	8
102		4	8	152		6	8
103		6	9	153		5	8
104		5	9	154		6	8
105		5	8	155		5	7
106		5	11	156		5	7
107		5	8	157	24-25	7	10
108		6	8	158		6	8
109		8	10	159		6	8
110		5	9	160		5	8
111		3	8	161		6	7
112		4	8	162		5	7
113	21-22	10	13	163		6	7
114		9	11	164		7	9
115		8	10	165		6	8
116		6	8	166		6	8
117		6	8	167		5	7
118		5	7	168		5	7
119		5	7	169		5	7
120		6	7	170		5	7
121		10	12	171		6	7
122		7	10	172	25-26	12	16
123		7	10	173		12	16
124		7	9	174		10	13
125		6	8	175		9	12
126		6	7	176		9	11
127		5	7	177		7	10
128		5	7	178		8	10
129	22-23	11	13	179		9	12
130		7	9	180		9	12
131		6	8	181		8	11
132		6	8	182		7	10
133		5	7	183		7	10
134		4	6	184		8	10
135		6	8	185		7	9
136		5	7	186	26-27	8	11
137		6	7	187		7	10
138		6	7	188		7	9
139		6	7	189		5	8
140		4	6	190		6	8
141	23-24	7	10	191		6	8
142		7	10	192		6	8
143		7	9	193		5	8
144		7	9	194		9	12
145		7	9	195		8	11
146		5	8	196		5	8
147		6	8	197		5	7
148		5	7	198		5	7
149		8	10	199		5	6
150		6	8	200		6	8

08101

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY - NR
TRC : 7973SECTION : Lucknow - Kanpur (UP LINE)
MONTH : FEB - 2000

S No	KM	GROUND DATA	TRC DATA	S No	KM	GROUND DATA	TRC DATA
201	27-28	10	12	222		8	11
202		8	12	223		6	8
203		5	8	224		5	7
204		5	7	225		5	7
205		6	7	226		5	7
206		5	7	227		5	7
207		5	7	228	31-32	7	10
208		7	10	229		5	7
209		6	9	230		3	6
210		6	8	231		3	6
211		5	7	232		3	6
212		5	7	233		3	6
213		5	7	234	32-33	8	11
214	28-29	7	10	235		3	7
215		7	9	236		3	6
216		6	8	237	34-35	6	8
217		5	8	238		4	7
218		5	7	239		2	6
219		5	7	240		3	7
220		5	7	241		3	7
221		6	7				

08102

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENTRAILWAY : CR
TRC NO : 225SECTION : JHANSI (UP LINE)
MONTH : JAN - 2000

S No	KM	GROUND DATA	TRC DATA	S No	KM	GROUND DATA	TRC DATA
1	1386-1385	2	6	51		9	11
2	1386-1386	2	6	52		6	10
3	1384-1383	3	8	53	1377-1376	1	6
4	1384-1383	3	7	54	1376-1375	3	7
5		2	6	55		2	6
6		2	6	56		2	6
7		3	6	57		3	6
8		2	6	58		2	5
9		2	6	59		2	6
10		3	7	60		2	6
11		3	7	61		3	6
12		2	6	62		2	6
13		2	6	63	1375-1374	1	6
14		3	6	64		2	6
15	1383-1382	3	6	65		2	6
16		3	7	66	1374-1373	1	5
17		2	6	67		2	6
18		3	6	68	1373-1372	4	11
19	1382-1381	3	7	69		3	8
20		3	6	70		4	8
21		2	6	71		2	5
22		2	6	72		4	9
23		2	6	73		4	9
24		2	6	74	1372-1371	3	8
25		4	8	75		2	6
26		3	6	76		4	9
27		3	6	77		2	6
28		2	6	78	1371-1370	2	7
29		2	6	79		2	6
30		2	6	80		2	6
31	1381-1380	2	6	81	1370-1369	1	6
32		3	6	82		2	6
33	1380-1379	2	7	83	1369-1368	1	6
34		2	6	84		4	7
35		2	6	85		4	6
36	1379-1378	3	8	86		4	6
37		2	6	87		4	6
38		3	8	88	1368-1367	3	8
39		2	8	89		3	7
40		2	7	90		2	7
41		2	6	91		3	9
42		2	5	92		3	8
43		3	9	93		3	8
44		2	5	94		3	7
45		2	6	95		4	7
46		3	8	96	1367-1366	6	14
47		2	6	97		4	10
48	1378-1377	3	8	98		3	9
49		6	10	99		2	5
50		6	8	100		3	7

08103

ALIGNMENT PEAK VALUES AS PER TRC AND GROUND MEASUREMENT

RAILWAY : CR
TRC NO : 225SECTION : JHANSI (UP LINE)
MONTH : JAN - 2000

101		4	6	147		2	5
102		3	8	148		2	6
103		2	7	149		5	6
104		2	5	150	1358-1357	4	12
105		3	7	151		7	10
106	1366-1365	6	14	152		4	7
107		4	12	153		4	7
108		3	9	154		4	8
109		4	9	155		3	8
110		2	7	156	1357-1356	3	6
111		2	6	157		4	7
112		5	12	158		2	7
113		3	8	159	1356-1355	2	6
114		2	5	160		2	6
115		2	7	161		2	6
116		3	7	162	1355-1354	1	6
117		2	6	163		2	6
118	1364-1363	2	7	164		3	6
119		2	6	165		3	6
120		3	8	166	1354-1353	3	7
121		3	7	167	1353-1352	1	5
122		2	7	168		2	6
123		2	6	169		2	6
124	1363-1362	2	6	170		2	6
125		2	6	171		2	6
126		3	6	172	1352-1351	1	6
127	1362-1361	1	5	173		3	6
128		4	10	174		3	7
129		2	6	175		3	7
130		8	12	176	1350-1349	2	7
131		2	6	177		2	6
132		2	6	178		2	6
133	1361-1360	1	5	179		2	6
134		3	7	180	1349-1348	3	9
135		6	7	181		4	8
136		2	7	182		3	7
137		2	6	183		2	7
138		3	7	184		3	7
139		4	6	185		4	8
140	1359-1358	4	12	186		4	8
141		5	11	187		2	7
142		7	10	188	1346-1345	3	8
143		3	9	189		4	11
144		5	14	190		3	5
145		5	10	191		4	8
146		3	9				

08104

INDIAN RAILWAYS TRACK STANDARDS:
REVISED TRACK GEOMETRY STANDARDS

SECOND REPORT

submitted to

MINISTRY OF RAILWAYS, RAILWAY BOARD

by

TRANSPORTATION SYSTEMS AND MARKET RESEARCH

(TRANSMARK)

in association with

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AS072901.DOC

July 1997

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TRANSMARK

8.5 Peak Exceedences

The peak exceedences for both the TRC 42m measurements, AVP42 and ALP42, were examined in detail and given in Figs, 5.28 and 5.34. As peak values are more an immediate attention or safety problem, standards are only given for the "Urgent" and "Maximum" levels.

Speed kph	Vertical Exceedence AVP42mm		Alignment exceedence ALP42 mm	
	Urgent	Maximum	Urgent	Maximum
<100	20	25	17	22
110 - 120	20	25	17	22
130 - 140	18	25	15	20
150 - 160	15	20	12	16

The peaks values corresponding to the 98% probability of having an acceleration over the limits laid down of 0.30 and 0.35 g were derived from and checked against the data in Figs. 5.38 to 5.40 and Figs 6.29 to 6.33. The limiting peak values derived are given in the following tables:

VERTICAL (Max versine mm)				
Speed	UN3.6	UN3.6	UN9.6	UN9.6
kph	Urgent	Maximum	Urgent	Maximum
0 - 100	12	15	22	25
100 - 120	12	15	22	25
120 - 140	--	--	20	23
140 - 160	--	--	16	20

ALIGNMENT (Max versine value mm)				
Speed	AL7.2	AL7.2	AL9.6	AL9.6
kph	Urgent	Maximum	Urgent	Maximum
0 - 100	16	20	18	22
100 - 120	16	20	18	22
120 - 140	13	17	16	20
140 - 160	10	15	12	17

TWIST (Max twist mm)				
Speed	TW3.6	TW3.6	TW4.8	TW4.8
kph	Urgent	Maximum	Urgent	Maximum
0 - 100	12	15	14	17
100 - 120	11	14	13	16
120 - 140	10	13	12	14
140 - 160	9	11	10	12

There is some question of the twist base length used by Indian Railways, traditionally the twist has been calculated on bases of 3.6m and 4.8m and these have been used in the standards to maintain continuity and to enable trends from historic data to be evaluated. The base of the ICF bogie at 2.9m is quite a bit shorter than these but twist is not usually critical on coaches with

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