Institution of
Permanent Way Engineers (India)

TECHNICAL DIARY
2008

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Permanent Way Engineers (India)

TECHNICAL DIARY
2008

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PREFACE

The Technical Diary of IPWE (India) was brought out for the first time in 1992, the silver jubilee year of the Institution of Permanent Way Engineers (India). Efforts of Shri R.S. Varshney, the then President of IPWE (I), RDSO Center and Shri A.P. Mishra, the then Executive Secretary, IPWE (I), RDSO Center, in bringing out the diary deserve special mention. The diary has since been updated in 1993, 1996, 1998, 1999, 2001-02, 2004, 2005 and 2007. The present edition has been updated to cover the latest information on Track, Track Machines, Bridges & Structures, Geotechnical Engineering and general items. I hope that this diary will prove useful to Civil Engineering officers and staff.

Effort has been made to give only that information in the diary which is most relevant to the men in the field. A few blank pages have also been kept for the field staff to write down notes/information frequently needed by them.

Suggestions for further improvements in the diary are most welcome. Thanks are due to ***Shri A.K. Manuwal****, Director (Track) and Hony. Secretary, IPWE (I) RDSO and to all those who have put in earnest efforts to update this diary.*

Madan Sen
President, IPWE RDSO Centre &
Executive Director Standards (Track)
RDSO Lucknow

Lucknow
Dt : 25-09-2008

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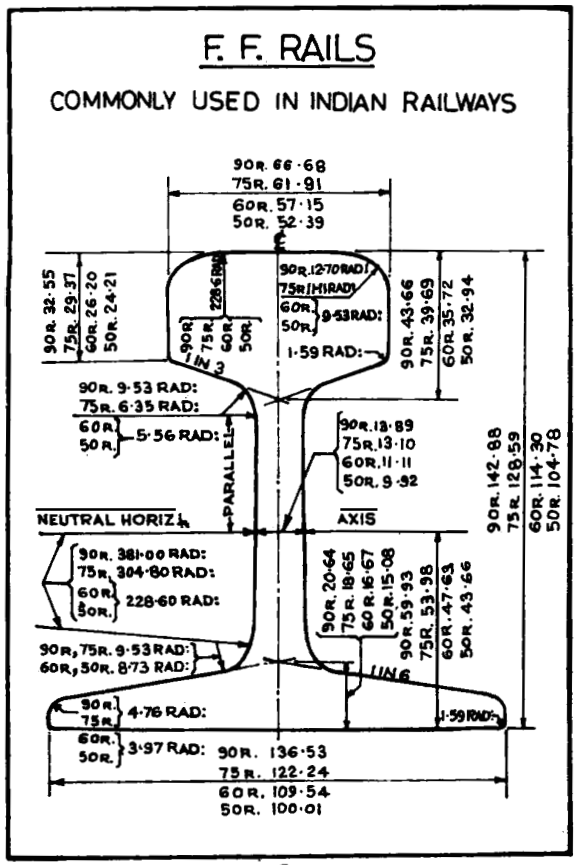
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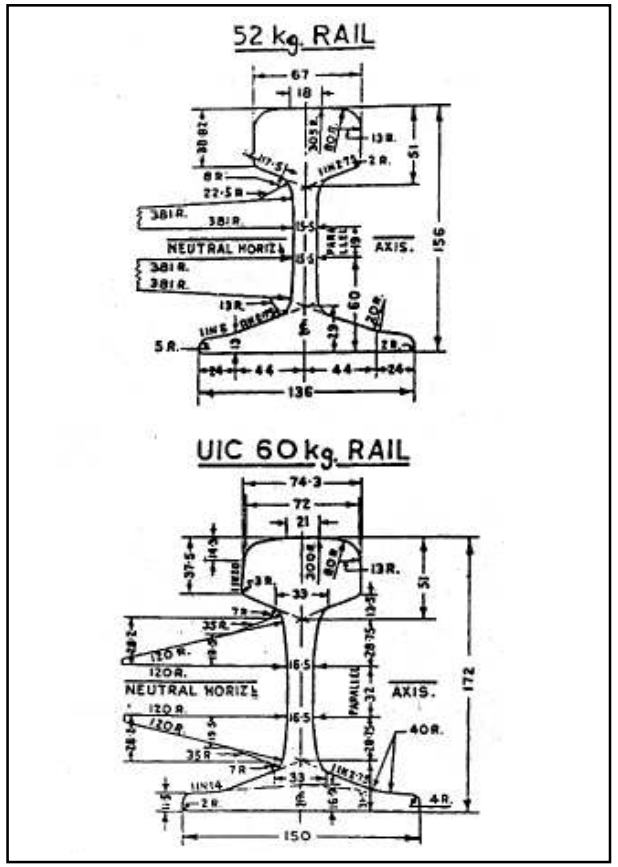
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PROPERTIES OF RAIL SECTIONS

Rail Section	Weight per metre	Area of section	Moment of inertia		Section modulus about horizontal neutral axis		Maximum distance from horizontal neutral axis	
			Horizontal axis	Vertical axis	Top	Bottom	Top	Bottom
	(kg)	(cm^2)	(cm^4)	(cm^4)	(cm^3)	(cm^3)	(mm)	(mm)
50 R	24.80	31.68	476.17	106.97	88.98	93.08	53.59	51.18
60 R	29.76	38.00	676.79	145.68	115.36	121.92	58.67	55.83
75 R	37.13	47.37	1055.56	230.18	159.28	169.44	66.29	62.30
90 R	44.61	56.95	1600.00	320.91	213.85	235.65	74.93	67.95
52 kg	51.89	66.15	2158.00	363.00	268.40	285.50	80.41	75.59
UIC 60 kg	60.34	76.86	3055.00	512.90	335.50	377.40	91.05	80.95

TRACK STANDARDS FOR BROAD GAUGE & METRE GAUGE

INDIAN RAILWAYS PERMANENT WAY MANUAL-1986

Advance correction Slip No. 77 dated 12-8-2002.

1. The para 248(2)(a) be replaced with the following :

(a) **Broad Gauge** : The following minimum rail sections are recommended based on the speeds obtainable and the traffic condition :

	Routes						
Traffic density in GMT	A	B	C	D. Spl.	D	E. Spl.	E
More than 20	60 Kg	60 Kg	60 Kg	60 Kg	60 Kg	60 Kg	60 Kg
10-20	60 Kg	60 Kg	60 Kg	60 Kg	52/90	60 Kg	52 / 90
5-10	60 Kg	52/90	52/90	52/90	52/90	52/90	52/90
Under 5	52/90	52/90	52/90	52/90 or 60 Kg (SH)	52/90 or 60 Kg (SH)	52/90 or 60 Kg (SH)	52/90* (S/H) or 60 Kg (SH)
Loop line	52Kg IRS-T-12 second quality rails or 52 Kg (SH)						
Pvt. Siding	For sidings with operating speed more than 80 kmph and up to 100 kmph.			Track structure specified for D route.			
	For sidings with operating speed more than 50 kmph and up to 80 kmph.			Track structure specified for E route.			
	Where BOX'N' or 22.1 Tonne axle wagon ply or operating speeds exceed 30 kmph and are going up to 50 kmph.			52 Kg IRS –T-12 second quality rails or 52 Kg (SH)			
	For other sidings with operating speed up to 30 kmph.			52 Kg IRS-T-12 third quality rails also called 'Industrial use rails' or 52 Kg (SH)			

Note : 52/90 represents 52 Kg/90 UTS rail section.

(i) Existing 90 R rails may be allowed to remain for speed not exceeding 110 kmph.

(ii) On routes identified for running of 22.1Tonne axle load wagons, 60-kg rails shall be used on all routes.

(iii) Head hardened rails should be used on (a) Local lines where dedicated EMU stock is running (b) Ghat section with gradients steeper than 1 in

150 and/or curves sharper than 2 degree, (c) Locations where due to grades, curves, traffic denisty and type of stock, the rate of wear of rails is such as to necessitate rail renewal, on wear considerations, at a frequency of 10 years or so. (d) Routes where predominantly captive rolling stock is moving in close circuit movement, particularly with heavy mineral traffic (e) The HH rails should be laid on continuous and long stretches.

(iv) * Second hand 52 Kg rails may be used on case-to-case basis, with the prior approval of Railway Board, depending upon quality of released rails available.

(b) **Metre Gauge**: The following rail sections are recommended on MG routes.

Routes	Rail section recommended
'Q' and 'R1'	52 Kg (SH)/90 R (New)**
'R2' and 'R3'	52 Kg (SH)/90 R (SH)
'S'	52 Kg (SH)/90 R (SH) 75 R (SH)

** 90 R (new) to be used only with specific approval of Railway Board in case no suitable 52 Kg (SH) rails are available for use on MG during renewal.

SLEEPER DENSITY (NUMBER/Km)
Indian Railways Permanent Way Manual-1986
Advance correction slip no. 39

The table at para 244 (4) (a) be substituted with the following :

Traffic density in GMT	A	B	C	D Spl.	D	E Spl.	E
	Number of sleepers per km.						
More than 20	1660	1660	1660	1660	1660	1660	1660
10-20	1660	1660	1660	1660	1540	1660	1540
Under 10	1660	1540	1540	1540	1540	1540	1540
Loop line	1340	1340	1340	1340	1340	1340	1340
Pvt. Siding	1340	1340	1340	1340	1340	1340	1340

(i) For routes identified for running 22.1 t axle load wagons, sleeper density of 1660 nos./Km. should be maintained.

TRACK STANDARDS FOR METRE GAUGE

	Items	Q routes speed >75 km/h GMT>2.5	R_1 routes Speed upto 75 km/h GMT>5	R_2 routes Speed upto 75 km/h GMT 2.5 to 5	R_3 routes Speed upto 75 km/h GMT 1.5 to 2.5	S routes Speed < 75 km/h GMT<1.5	Remarks
1.	Rails	90 R new	90 R new	90 R (SS) or 75 R new	90 R (SS) or 75 R new	R (SS)	* With elastic fastening
2.	Sleepers	Concrete Steel* CST-9+	Concrete Steel* CST-9+	Concrete CST-9+	Concrete CST-9	Concrete CST-9	+ As an interim measure upto 110 kmph
3.	Sleeper density	M+7 or 1540/km	M+7 or 1540/km	M+7 or 1540/km	M+4 or 1308/km and M+7** or 1540/km	M+3 or 1250/km and M+7** or 1540/km	**Where LWR is contemplated
4.	Ballast cushion	300 mm++ or 250 mm	300 mm++ or 250 mm	250 mm++ or 200 mm	250 mm** or 200 mm	150 mm or 200 mm with SWR or 250 mm**	++ For 100 kmph speed or above

Note : 1. Heavy haul routes identified for movement of 14t axle load wagons should be laid to a minimum standard prescribed for R_1 routes even if these routes are classified in lower categories.

2. Concrete sleepers should have a minimum ballast cushion of 250 mm.

3. New rails should be laid as LWR and concrete sleepers should be used for LWR as far as possible.

4. Released rails of higher section up to 90 lb may be used if prescribed sections of rails are not available

GUIDELINE FOR HANDLING OF RAILS

Item	Avoid/ Ensure	Guidelines
1 Protection of Straightness	**Avoid**	1. Heavy static loading and sudden impact. 2. Single point slinging. 3. End drop and flange overlap or crossing of rails. 4. Localised point or line contact when stacking.
	Ensure	1. Two point slinging for rails up to 13m length. Increase slinging point at the rate of 1 per 6.5m. 2. Rails are kept horizontal and straight as far as possible while lifting, carrying or stacking. 3. Provide suitable dunnage/spacer to protect rail against point contact. 4. Rails of same length are stacked on a firm level base providing uniform support. Successive layers may be of the same or decreasing width for stacking of unequal length of rails. 5. Subsequent layers should be separated with uniformly placed suitable spacers or dunnage in vertical alignment with the base supports. 7. Rail ends are protected.
2 Protection of Rail Surface	**Avoid**	1. Impact or abrasion of rails and rail bundles against structures, buildings, ships, hatches, wagons, vehicles, etc. 2. Crossing or flange overlap while stacking or making rail bundles. Suitable spacers to be used while making rail bundles.

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		3. Any rail support, handling or clamping device and rail pinch rollers which apply localized or point contact to the rail.
	Ensure	1. Where conventional slings are employed, use of fabric, e.g. polypropylene slings/sleeves is recommended. As an alternative, if flat link chains are used, these should be fitted with fabric sleeves. 2. Rails should be protected against bruising, notching or scoring of surface. 3. Wherever possible, the profile of rail support, handling or clamping device and rail pinch rollers should be contoured to match the rail profile. 4. Use of round-link chain sling. Ideally, lift the rails by using electro-magnetic lifting devices.
3 Prevention of Metallurgical Damage	**Avoid**	All heating, flame cutting, welding and spot welding during rail handling or transit.
	Ensure	Protection of rail from electric arc from adjacent cables or molten metal splashes from nearby welding operations.
4 Protection from contact with injurious substances	**Avoid**	Contact with injurious substances such as acids, alkalis, salts, fertilizers, sulphates, chlorides and nitrates.
	Ensure	Rail stockpiles should be built on a well drained base as per as per drawing no. RDSO/T-6219.
5 Minimising Danger to Personnel	**Avoid**	1. Standing under suspended rails. 2. 1.Sudden dropping or impact of rails. 3. Bundle strapping for lifting, slinging or handling of rails. 4. Contact with rails.

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	Ensure	1. Steel toe-capped protective footwear are used. 2. Distinct coloured helmets and clothings are used for ease of identification and location of personnel while working with machine or crane. 3. Effective protective gloves and clothings to reduce risk of skin abrasions and lacerations and extremes of temperature. 4. Safe working, in the vicinity of electrical conductors and wiring.
6 Stacking	**Avoid**	1. Overlapping of rail flanges. 2. Crossing of layers when dunnage is used. 3. Leaning stack by placing rail ends (rails of the same length) in vertical alignment.
	Ensure	1. Stacking of rail on proper concrete base and supports as per RDSO/T-6219. 2. Stacking of rails of same length. 3. Shorter rail should be placed in upper layers so that each successive layer is of same or decreasing width. 4. Good vertical alignment of dunnage or spacers in the completed stack should be done by placing them in identical positions along the rail length. 5. Use of suitable rail handling equipment, such as electro-magnetic lifting devices, rail grips etc.

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7 Handling of Rails in Flash Butt Welding Plants & Production Units	**Avoid**	Lifting rails which do not have proper lifting points and cause overhang more than 3.25 m
	Ensure	Rails are handled by magnetic lifting devices. The magnets should be suspended from a lifting spreader beam ensuring lifting point at every 6.5 meter and overhang less than 3.25 meter. In case, magnetic lifting devices for rails cannot be provided in Flash Butt Welding Plants, all handling of rails should be done with synchronized electric hoists and spreader beams.
8 Handling of rails at track renewal sites in open line & Construction site (Single Rails)	**Ensure**	1. While unloading single rails from BFRs/BRHs provide a ramp of two unserviceable hardwood crossing sleepers or suitable timber piece kept at 6.5m apart, one end resting on the BFR/BRH and the other end held firmly on the ground. 2. Fasten rails by 'J' type hooks at two places 6.5m apart, held properly with hardwood packing to avoid bruising of rails. 3. The hooks should be held with nylon ropes. 4. Rails are made to slide over the sleeper one by one 5. Overhang does not increase beyond 3.25m each side. 6. On reaching ground, rail is to be lifted by rail-dolly or tongs to clear the end of ramp. Rails can later be carried with the help of rail dollies to sites, wherever required, without causing any damage to them. 7. Single rails can be unloaded at site by road crane also provided provisions of lifting points at every 6.5 meter and restriction on overhang not to increase beyond 3.25 m are met and no infringement endangering safety of moving train on adjacent track is caused.

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		8. For transporting rails by road vehicles to the work sites, Road cranes with a special spreader beam should be used for loading/unloading of rails.
(Three Rail Panel) **(Long Rail Panel)**	**Ensure**	1. Unloading of rail panels in running lines, by providing a ramp of adequate number of unserviceable hardwood crossing sleepers or timber piece, kept 6.5m apart. 2. Unloading these panels preferable on the nearest railway station in loop line following the procedure mentioned above and later on carried out with the help of rail dollies to the site wherever required, without causing any damage to them.
	Ensure	1. Panels unloaded should be kept in upright (head up) in straight alignment. 2. On long bridges, panels are to be supported on bridge timbers and not allowed to sag over the opening.
9 Precautions for Handling of Rails in Electrified areas	**Avoid**	1. Work above or within a distance of 2m from the live OHE without "permit – to work." 2. Touching fallen wires unless power is switched-off and the wire or wires suitably earthed
	Ensure	1. As far as possible closed wagons shall be used for material trains. In case open or hopper wagons are used, loading and unloading of such wagons in electrified tracks shall be done under the supervision of an Engineering Official not below the rank of a Permanent Way Mistry who shall personally ensure that no tool or any part of body of worker comes within the "danger zone " i.e. within 2m of the OHE.

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		2. Rails do not touch each other to form a continuous metallic mast of length greater than 300m.
10 Handling of rails at Ports	**Ensure**	1. Availability of proper facilities for handling of Rails at port as required by these guidelines. 2. Magnetic lifting devices with suitable spreader beams should preferably be used. 3. In case, it is difficult to provide magnetic lifting device for lifting of rails, electric hoists or cranes with suitable spreader beams may be used so as to lift the rails in accordance with the basic principles. 4. Provisions in the contract document procuring for rails to provide for carrying out modifications in the existing facilities available at ports or to develop suitable method for unloading and handling of rails so as to avoid any damage.

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Recommended locations of lifting points for various rail lengths are as under :

Rail length (m)	No. of lifting points	Distance between lifting points (m)	Max. rail end overhang (m)
12-13	2	6.0-6.5	3.00-3.25
26	4	6.5	3.25
39	6	6.5	3.25
130	20	6.5	3.25
260	40	6.5	3.25

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II

WELDING OF RAILS

1. **Tolerances on finished welded joints**

1.1 ***Flash butt joints***

Welds with new rails

i)	Vertical misalignment	+ 0.3 mm - 0 mm	at the centre of a 1m straight edge
ii)	Lateral misalignment	± 0.3 mm	at the centre of a 1 m straight edge
iii)	Head finishing (in width)	Side of rail head should be finished to : ± 0.25 mm on gauge side at the centre of 10 cm straight edge	
iv)	Finishing of top table surface	+ 0.2 mm - 0 mm	at the centre of 10 cm straight edge
v)	Web zone (under side of head, web, top of base, both fillet each side)	+ 3.0 mm - 0 mm	of the parent contour

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vi) Underside of rail foot shall be suitably finished without any minus tolerance to ensure proper seating on sleepers and unhindered movement of welded panels on end unloading rakes.

Welds with old rails

i)	Vertical misalignment	± 0.5 mm	at the centre of a 1 m straight edge
ii)	Lateral misalignment	± 0.5 mm	at the centre of a 1 m straight edge
iii)	Head finishing (on sides)	± 0.3 mm	on the gauge side at the centre of a 10 cm straight edge
iv)	Head finishing (on top of table surface)	± 0.2 mm	at the centre of a 10 cm straight edge
v)	Web zone (under side of head, web, top of base and both fillets on each side)	+ 3.0 mm - 0.0 mm	of parent contour

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1.2 ***A.T. welded joints***

i)	Vertical misalignment	+ 1.0 mm - 0.0 mm	Measured at the end of 1 m straight edge
ii)	Lateral misalignment	± 0.5 mm	Measured at the centre of 1 m straight edge
iii)	Head finishing on sides	± 0.3 mm	On gauge side (measured at the centre of 10 cm straight edge)
iv)	Finishing top table surface	+ 0.4 mm - 0.0 mm	Measured at the end of 10 cm straight edge

Note : Dispensation for joint geometry in case of old rails may be permitted by Chief Engineer.

2. Alumino thermic welding by SKV process— Some salient details

Rail type	Gap between rail ends (mm)	Preheating time (minutes)	Reaction time (sec)	Heating technique
75R(72UTS)	24-26	6-8	20±3	Top heating with air & petrol
75R(90UTS)	24-26	6-8	20±3	do
90R(72UTS)	24-26	8-10	20±3	do
90R(90UTS)	24-26	8-10	20±3	do
52 kg(72UTS)	24-26	11	20±3	do
52kg(90UTS)	24-26	10-12	20±3	do
60kg(72UTS)	24-26	10-12	20±3	do
60kg(90UTS)	24-26	10	20±3	do
60kg(110UTS)	24-26	15	20±3	do
52 kg (90UTS)	24-26	4.0	20±3	Top heating with compressed air petrol.
60 kg (90UTS)	24-26	4.5	20±3	do
Chrome Manganese Alloy Steel Rail				
60 kg (UIC) Head Hardened Rail	24-26	4.5	20±3	Top heating with compressed air petrol and post weld treatment
Wide Gap				
52kg (90UTS)	74-76	10	25±5	Top heating with air petrol.
60kg (90UTS)	74-76	12	25±5	do
52 kg (90 UTS)	74-76	3.0	25±5	Top heating with Oxy-LPG
Combination Joint				
60kg (90UTS) / 52kg(90UTS)	48-50	12	25±5	do

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3. Important parameters of flash butt welding of rails

Rail section	Type of welding plant	Butting load capacity (tons)	Flashing stroke (mm)	Butting stroke (mm)	No. of preheats	Burn off time (sec)	Final flashing time (sec)
90 R (72 UTS)	AI-APHF-30	37	12	8	8	20	25–30
52 kg (72 UTS)	AI-APHF-30	37	12	10	10	10	35
52 kg (90 UTS)	ESAB	79	14	10	10	30–40	20–25
60 kg (72 UTS)	AI-APHF-30	37	12	10	12	10	40
60 kg (90 UTS)	ESAB	79	14	10	12	30–40	20–25
60 kg(110 UTS)	AI-APHF-60	60	5	5	8	5	19–24

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4. **Transverse test on welded test sample :**

The existing para 10.2.2.1 of manual for flash butt welding of rails may be replaced as under.

"10.2.2.1 The test weld sample not less than 1.5 m long with the weld in middle shall be supported on cylindrical or semi-cylindrical supports having a diameter of 30 to 50mm and distance of one metre between them. In case of 60kg 110 UTS/head hardened rail joints the test span shall be 1.25 metre. The mandrel diameter shall be between 30 to 50 mm. The mandrel axis should be perpendicular to the horizontal axis of the rail section and it should be positioned at the centre of the weld. The weld shall be in the centre of the span and loaded in such a manner that the foot of the rail is in tension. The load shall be uniformly and gradually increased. The rate of application of the load should not exceed 2.5 tons/sec. The test joints shall withstand the minimum load and shall show minimum deflection as given in Table 1 without showing any signs of cracking or failure. The minimum deflection values are corresponding to stipulated minimum breaking loads.

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TABLE -1
VALUES OF MINIMUM BREAKING LOAD AND DEFLECTION IN TRANSVERSE LOAD TEST

S. No.	Rail Section	Span	Min. breaking load (tonnes)	Min. deflection at centre (mm)	Frequency of testing	
					Stationary FBW Plant	Mobile FBW Plant
1	60 kg (UIC) NHH	1.25 m	115	30	1in500	1in 100*
2	60 kg (UIC) Cr. Mn. alloy steel	1.25 m	110	12	1in500	1in 100*

3	60 kg (UIC) 90 UTS	1m	150	20	1in1000	1in 100*
4	52 kg 90 UTS	1m	100	15	1in1000	1in 100*
5	60 kg UIC MM (72 UTS)	1m	135	30	1in1000	1in 100*
6	52 kg MM(72 UTS)	1m	100	30	1in1000	1in 100*
7	90R MM(72 UTS)	1m	80	30	1in1000	1in 100*
8	75R MM(72 UTS)	1m	70	30	1in1000	1in 100*
9	60 R MM (72UTS)	1m	60	25	1in1000	1in 100*

27 *Sample joints for first 1000 joints welded by a Mobile Flash Butt Welding Plant will be tested at a frequency of 1 in 100 joints and subsequently at a frequency of 1 in 500 joints. ”

4.1 ***Thermit welded joints***

Rail type	Rail section	Min. transverse breaking load in tonnes	Min. deflection in mm at the centre at the load in col. 3
72 UTS to IRS-T-12	60 R	50	15
-do-	75 R	55	15
-do-	90 R	65	15
-do-	52 kg	85	18
-do-	60 kg	95	18
90 UTS to IRS T-12/UIC 860-0 or equivalent	75 R	60	15
	90 R	80	15
28	52 kg	90	15
	60 kg	115	15
Alloy Steel (Cr-Mn or Cr-V type 110 UTS)	52 kg	95	10
	60 kg	115	10
Head Hardened rails	60 kg	115	12
Combination joint (50 mm gap)	*52 kg (90UTS)/ 90R (72UTS)	70	15
-do-	60 kg (90UTS)/ 52 kg (90UTS)	90	15

*90UTS portion should be used in 52 kg/90 R combination joints.

USFD TESTING OF RAILS AND WELDS

GENERAL

(i) Need based concept of testing of rails has been implemented on all BG routes. However, for other sections Chief Engineer of the railway may adopt suitable frequency on his discretion.

(ii) After the initial testing of rails in rail manufacturing plant, the first retesting need not normally be done untill the rails have undergone 15% of the service life in GMT as given below (para 302(i) (d) of IRPWM).

For rails rolled in April 1999 and later, the test free period shall be 25% instead of 15%. Whenever rails are not tested in rail manufacturing plant, the test free period shall not be applicable and the rail testing shall be done at the periodicity of NBC testing as the case may be right from the day of its laying in field.

1. FREQUENCY OF TESTING OF RAILS AND WELDS IN NEED BASED CONCEPT.

In view of the revised criteria of defect, the testing frequency of 8 GMT has been prescribed.

1.1 After the initial testing of rails in rail manufacturing plant, the first retesting need not normally be done until the rails have undergone 15% of the service life in GMT as given below (para 302(i) (d) of IRPWM).

For rails rolled in April 1999 and later, the test free period shall be 25% instead of 15%.

Gauge	Rail Section	Assessed GMT service life for T- 12/72 UTS rails	Assessed GMT service life for T-12/90 UTS rails
B.G.	60Kg	550	800
	52Kg	350	525
	90 R	250	375
M.G.	75 R	150	225
	60 R	125	-

Whenever rails are not tested in rail manufacturing plant, the test free period shall not be applicable and the rail testing shall be done at the periodicity

given below right from the day of its laying in field. However, the rails having sectional weight and grade equal to or higher than 52Kg/90UTS shall be ultrasonically tested covering gauge face corner of rail head on passage of every 40GMT traffic during test free period.

1.2 Frequency of testing for all BG (rail head center and gauge face corner) and MG routes is given as under: For other sections Chief Engineer of the Railway may adopt a frequency at his discretion.

Route	Routes having GMT	Testing Frequency Once in
All MG routes	< 2.5	5 Years
	2.5 – 5.0	3 Years
	> 5	2 Years
All BG routes (rail head center and gauge face corner testing)	≤ 5	2 Years
	> 5 ≤ 8	12 Months
	> 8 ≤ 12	9 months
	> 12 ≤ 16	6 months
	> 16 ≤ 24	4 months
	> 24 ≤ 40	3 months
	> 40 ≤ 60	2 months
	> 60	1½ months

Frequency of testing of welded joints by 0^o & 70^o probes shall be as per para 1.2 given above.

1.3 Testing of AT welded joints shall comprise of testing by probes as per table below :

S.No.	Probes	Scanned area	Remarks
1.	0^o 2 MHz	Head, web	–
2.	70^o 2 MHz	Head, weld foot	–
3.	70^o 2 MHz (8 mm x 8 mm)	Weld foot (Half Moon Defect)	–
4.	45^o 2 MHz	Weld foot (Half Moon Defect)	To be done as an alternative to S. No. 3 wherever feasible.

(Testing mentioned in item 3 and 4 above are not required to be conducted in case of initial acceptance test of welds)

The frequencey of testing AT welds with above listed probes shall be as under

S.No.	Types of Welds	Type of Testing	Testing Schedule	
1.	Conventional AT	Initial Acceptance Test	Just after execution of weld as per AT Welding Manual	
2.		First Periodic Test	On completion of one year service life by weld	
3.		Subsequent Periodic Tests	Every 40 GMT after First Periodic Test	
4.	SKV	Acceptance Test	Immediately after welding	
5.		First Periodic Test	1 Year	
			Routes having GMT	**Frequency**
6.		Further tests based on route GMT	> 45	2 Years
7.			> 30 ≤ 45	3 Years
8.			> 15 ≤ 30	4 Years
9.			0-15	5 Years

Due to unusually high weld failure or other abnormal development in some sections, Chief Engineer may order testing of welds early, as per need.

The USFD testing can be dispensed with in case of those welds which are more than 15 years old and protected by joggled fish plates with two far end tight bolts.

1.4 Through Weld Renewal should be planned after the welds have carried 50% of the stipulated GMT of rails. Among the various sections, due for Through Weld Renewal (TWR) as per this criteria, Chief Track Engineer will decide inter se priority based on incidences of defects detection and weld failures.

1.5 For Flash Butt Welds

45° and 70°, 2MHz hand probing for web and flange : In case of flash butt welds normally there is no need for hand testing (with 45° and 70° probes), however, Chief Engineer may order hand probing with these probes in case failure rates are high in his opinion.

2. ACTION TO BE TAKEN AFTER DETECTION OF DEFECTS IN NEED BASED CONCEPT

2.1 Following action shall be taken in respect of defective rails & welds (Through rail testing) :

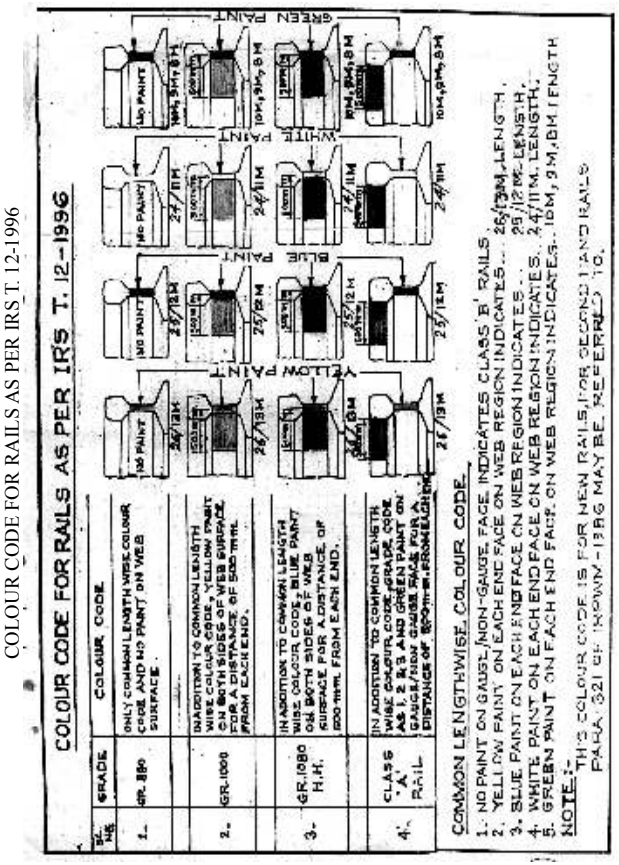
S. No.	Classifi-cation	Painting on both faces of web	Action to be taken	Interim Action
1.	IMR IMRW	Three cross with red paint	The flawed portion should be replaced by a sound tested rail piece of not less than 6m length within 3 days of detection.	SE / JE(P-Way) / USFD shall impose speed restriction of 30 Kmph or stricter immediately and to be continued till flawed rail/weld is replaced.
				He should communicate to sectional SE/JE(P-Way) about the flaw location who shall ensure that clamped joggled fish plate is provided within 24 hrs.
2.	OBS OBSW	One cross with red paint	Rail/weld to be provided with clamped joggled fish plate within 3 days.	SE/JE(P-Way) / USFD to advise sectional SE/JE(P-Way) within 24 hrs about the flaw location.
			SE/JE(P-Way)/ USFD to specifically record the observations of the location in his register in subsequent rounds of testing.	Keyman to watch during daily patrolling till it is joggled fish plated.

2.2 Action to be taken for defects in AT welds shall be same as at Para 2.1 above and in addition to the following shall also be applicable for welds classified as defective (DFW) in periodic testing of AT welds with 0^{o} 2MHz, 70^{o} 2 MHz, 45^{o} 2 MHz, 70^{o} 2 MHZ (8 mm x 8 mm) probes:

Classification	Painting on both faces of weld	Action to be taken
Defective weld 'DFW' with 0^{o} 2MHz, 70^{o} 2MHz, 45^{o} 2 MHz or 70^{o} 2MHz (8 mm X 8 mm) probe	Two cross with red paint	SE/JE(P.Way)/USFD shall impose speed restriction of 30 Kmph or stricter immediately. He should communicate to sectional PWI about the flaw location who shall ensure following : (i) Protection of defective weld by joggled fishplates using minimum two tight clamps/2 far end tight bolts one on each side after which speed restriction can be relaxed up to 75 Kmph for goods train & 100 Kmph for passenger trains on BG and 30 Kmph for goods train & 60 Kmph for passenger trains on MG. (ii) In case the protection of weld has been done using joggled fishplates with clamps, the defective weld shall be replaced within 15 days. However, in case the protection has been done using joggled fish plates with 2 far end tight bolts, the speed restriction imposed in (i) above shall continue till the defective weld is replaced which should not be later than 3 months. The defective weld with speed restriction as (i) above may be continued in track if the track is to be renewed within 12 months.

Action to be taken for flash butt and gas pressure weld defect shall be same as given in Para 2.1 above.

COLOUR CODE FOR RAILS AS PER IRS T. 12-1996



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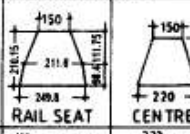
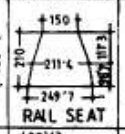
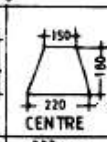
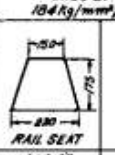
CONCRETE SLEEPERS – IMPORTANT DETAILS

DRAWING NO.		RDSO/T 2496 (60 Kg) UIC				RDSO/T-3178 (52 Kg). RDSO/T 4013 (60 Kg) UIC				RDSO/T-3504 MG.-90R.			
LENGTH	mm	2750				2750				2000			
TOTAL BEARING AREA	Cm^2	6662				6662				4374			
TOTAL WEIGHT	kg	286'5				285'4				156·5			
H.T.S.; DIA.; TYPE; B.L. UTS; WEIGHT; NOS.	mm / kg	3×3 STRAND; 184 kg/mm²; 8'22; 18				9'5, 7 PLY, STRAND; 10433; 7'128; 6				3x3; STRAND; 184 Kg/mm²; 3·99; 12			
SECTIONAL DIMENSIONS	mm	 RAIL SEAT		CENTRE		 RAIL SEAT		 CENTRE		 RAIL SEAT		 CENTRE	
AREA OF SECTION	Cm^2	429		339		428'63		333		323·75		280·6	
MOMENT OF INERTIA	Cm^4	15317		8884		15290		8884		8164		5562	
		TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM
SECTION MODULUS	Cm^3	1347	1529	929	1054	1346	1586	929	1054	878	996	879	761
BENDING MOMENT IMPOSED	tm		1.15	-1.25			1'24	1'2			1·05		0·70
CRACKING MOMENT	tm	1.51	2.41	1.38	1.52	1'48	2'26	1'56	1'42	0·71	1·58	0·75	1·17
FAILURE MOMENT	tm		4.64				4'6				3·29		
FACTOR OF SAFETY	—		2.02	1.27			1'83	1'30			1·51		1·67
LOAD FACTOR	—		3.00				3'7				3·13		

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DESIGN DETAILS OF TURNOUT CONCRETE SLEEPERS

Gauge (mm)	Turn out type	Rail section	LH/RH fan shaped (FS)	Brief description	No. of sleepers excluding approach sleepers	Drawing No. of Layout	Drawing No. of Sleeper	Remarks
Broad Gauge								
1673	1:12	60 kg	FS	Switch : 10125 mm Xing : CMS	83	RT-4218	RT-4512 to RT-4594	Current
1673	1:12	52 kg	FS	Switch : 10125 mm Xing : CMS	83	RT-4732	do RT-4512	Current
1673	1:8.5	60 kg	FS	Switch : 6400 mm Xing : CMS	54	RT-4865	RT 4793 to 4844 & RT-4512	Current
1673	1:8.5	52kg	FS	Switch : 6400 mm Xing : CMS	54	RT-4865	do	Current
1673	1:8.5	90 R	FS	Switch : 6400 mm	54	RT-4865	do	Current
1673	1:16	60 kg	FS	Switch : 11200 mm Xing : CMS	101	RT-5691	RT-4513 to 4517, RT-5595 to 5690	Current
1673	1:20	60 kg	FS	Switch 12460 mm Xing : CMS	120	RT-5858	RT-4513 to 4517 RT-4921 to 6035	Current
1673	1:8.5	52 kg 60 kg	RH/LH	Derailing switch	22	RT-5836 RT-6068	RT-4512 RT-4793 to 4806 RT-6770 to 6775 RT-6776 to 6781	Current For RH For LH
Metre Gauge								
1000	1:12	90R 52kg		Switch : 7130 mm Xing : CMS	53	RT-4623 RT-6450 RT-6327	RT-4631 to 4683	Current
1000	1:8.5	52kg		Switch : 5500 mm Xing : CMS	44	-	RT-4631 to 4634 & RT-4918 to 4928 RT-6383 to 6411	Current

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DESIGN DETAILS OF CONCRETE SLEEPERS FOR 1: 8.5 DIAMOND X-ING

Gauge (mm)	Turnout Type	Rail Section	Brief Description	No. of Sleepers	Drawing No. of Layout	Drawing No. of Sleeper
1673	1:8.5	52 Kg	Without slip	a) Diamond 41 b) 1:8.5 14 x2 c) Exit 4x 4	RT-5362	RT-5331 to 5351 RT-4831 to 4844 RT-5471 to 5474
1673	1:8.5	52 Kg	Single slip	a) Diamond 43 b) 1:8.5 13x2 c) Exit 5x4	RT-5363	RT-5309 to 5330 RT-4832 to 4844 RT-5471 to 5474 & RT-4786
1673	1:8.5	52 Kg	Double slip	a) Diamond 43 b) 1:8.5 13x 2 c) Exit 5x4	RT-5364	RT-5309 to 5330 RT -4832 to 4844 RT-5471 to 5474 & RT-4786

DESIGN DETAILS OF CONCRETE SLEEPERS FOR 1: 8.5 SCISSORS CROSSOVER
(Track centres 4725 mm)

Gauge (mm)	Turnout Type	Rail Section	Brief Description	No. of Sleepers	Drawing No. of Layout	Drawing No. of Sleeper
1673	1:8.5	60 Kg	X-ing : 1:8.5 LH & RH Acute CMS, 1:4.25 Acute & Obtuse CMS Switch : - 6400 mm	a) S.X-Over 39 b) 1:8.5 34x4 c) Approach 5x4	RT-6092	RT-6126 to 6145 RT-4512 & RT-4793 to 4824 RT-4786 to 4790

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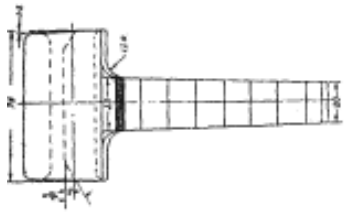
QUANTITY OF MATERIALS PER SET OF PSC SLEEPERS FOR TURNOUTS

S. No.	ITEM	1:20	1:16	1:12	1:8.5	1:8.5 Derailing Switch	1:8.5 Scissors X-Over	1:85 Diamond Crossing	
								W/O Slip	With Slip
1.	No. of sleepers In a set	133	114	96	67	31	195	85	89
	(a) Diamond or Scissors	-	-	-	-	-	39	41	43
	b) Turnout	120	101	83	54	22	34x4	14x2	13x2
	c) Approach	5	5	5	5	5	5x4	-	-
	d) Exit	4x2	4x2	4x2	4x2	4	-	4x4	5x4
2.	Total length of sleepers (m)	459.39	396.88	326.29	225.84	88.50	762.564	304.45	335.49
3.	Cement (Kg)	12739	11006	9048	6264	2454	21146	8443	9303
4.	HTS (Kg)								
	3-ply 3 mm	2280	1970	1620	1121	440	3786	1512	1666
	9.5 mm 7-ply	2198	1899	1562	1081	424	3648	1457	1605
5.	M.S. stirrups in (Kg)								
	3-ply 3mm	353	304	250	164	69	592	230	254
	9.5 mm 7-ply	347	299	246	162	68	581	226	250
6.	Inserts (nos)	709	638	533	350	86	1188	551	384
7.	Dowels (nos)	282	222	233	145	149	804	-	539

CONCRETE SLEEPERS FOR SPECIAL LOCATIONS

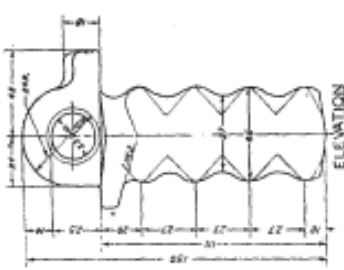
Location	Rail Section	Drawing No.	Remarks
Level crossing	60kg/52kg	RDSO/T-4148-4148-A	-
Switch expansion joint	(i) -do- (ii) 60 kg	RDSO/T-4149 RDSO/T-6253	with 120 mm gap with 300 mm gap
Curves	60 kg	RDSO/T-3670	Slack gauge up to 1681 mm obtained by using liners of different thickness.
Curves	60 kg	RDSO/T-4170-4173	4 different sleepers for gauge 1675, 1677, 1679 & 1681 mm with the use of normal liners.
Curves (MG)	90R	RDSO/T-4909-4913	4 different sleepers with gauge 1002, 1004, 1006 & 1008 mm
Curves with check rails	60kg with 52 kg check rail	RDSO/T-4183-4186	Specially designed for KK line with 75 mm clearance
Curve with check rails	60 kg with 52 kg check rail	RDSO/T-6896-6899	With check rail clearance of 65 mm
Curves with check rails	52 kg with 52 kg/90R check rail	RDSO/T-5738 to 5740	Gauge widening up to 1679 mm
For ballasted deck bridges	(a) 60 kg (b) 52 kg	RDSO/T-4088-4097 -do-	With 52 kg guard rail. With 52 kg/90R guard rail
For rail joints (MG)	90 R	RDSO/T-4779	On mainline sleeper, ERC Mk. II clip to be used in reverse position.
Shallow sleeper	60 kg	RDSO/T-4852	For location with restricted headway.
Wider sleeper	60 kg	RDSO/T-3735	For trial on heavy haul routes
Mixed gauge (4 rail seat)	60kg/ 52kg	RDSO/T-3527	Specially developed for gauge conversion
Mixed gauge (3- rail seat)	52 kg/ 90 R	RDSO/T-4857	Specially developed for Southern Railway
Mixed gauge (3 rail seat)	60 kg	RDSO/T-6256	Specially developed for gauge conversion
For use without liners	60kg/52 kg	RDSO/T-4306-4307	For economy and better maintainability

SGCI Inserts



SIDE ELEVATION

SGCI INSERT
RDSO/T-381 Alt : 8
SPECIFICATION :- IRS/T-46



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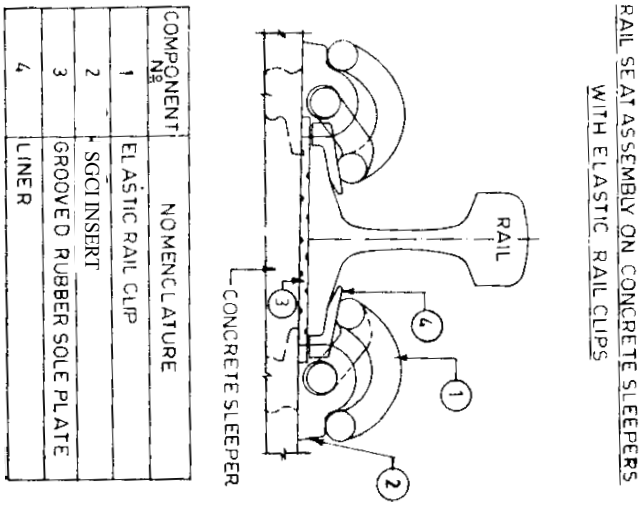

COMPONENT No	NOMENCLATURE
1	ELASTIC RAIL CLIP
2	SGCI INSERT
3	GROOVED RUBBER SOLE PLATE
4	LINER

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Assembly with type of clip	Name of component and relevant RDSO drawing number				
	Elastic Rail Clip	SGCI Insert	GR soleplate	Liner	
				GFN-66	Metal
(A) 52 kg rail on 52 kg concrete sleeper (BG)					
1. ERC ROUND TOE	RDSO/T-1892	RDSO/T-381	RDSO/T-3703	RDSO/T-2505	RDSO/T-645
2. ERC FLAT TOE	RDSO/T-3700	RDSO/T-381	RDSO/T-3703	RDSO/T-3702	RDSO/T-3738
3. ERC Mk-III	RDSO/T-3701	RDSO/T-381	RDSO/T-3703	RDSO/T-3702	RDSO/T-3738
(B) 52 kg rail on 60 kg concrete sleepers (BG)					
ERC Mk-III	RDSO/T-3701	RDSO/T-381	RDSO/T-3711	RDSO/T-3707 (GS) & RDSO/T-3708 (NGS)	RDSO/T-3741 (GS)& RDSO/T-3742 (NGS)
(C) 60 kg rail on 60 kg concrete sleeper (BG)					
1. ERC-Mk-III	RDSO/T-3701	RDSO/T-381	RDSO/T-3711	RDSO/T-3706	RDSO/T-3740
(D) 90R rail on concrete sleeper (MG)					
1. ERC Mk-II	RDSO/T-3722	RDSO/T-3087	RDSO/T-3724	RDSO/T-3723	RDSO/T-3739

GS-Gauge side

NGS-Non gauge side

PROPERTIES OF ELASTIC RAIL CLIPS

Drawing No. of clip	Type of clip	Dia (mm)	Approx-imate weight of clip (kg)	Toe deflect-ion (mm)	Toe load range (kg)	Contact of surface for flat toe clips	
						Major axis (mm) minimum	Minor axis (mm) minimum
RDSO/T-1892	ERC round toe	20.64	1.000	11.4	645-800	-	-
RDSO/T-3700	ERC flat toe	20.64	1.000	11.4	645-800	28	9.5
RDSO/T-3701	ERC Mk-III Flat toe	20.64	0.910	13.5	850-1100	28	9.5
RDSO/T-3722	ERC Mk-II Flat toe	18.00	0.600	11.2	700-900	20	8
RDSO/T-4158	ERC-J	20.64	1.000	3.5	300	-	-
RDSO/T-6254 & RDSO/T-6255	Anti-theft Elastic Rail Clip & Circlip	20.64 -	0.937 0.022	13.5 -	850-1100 -	28 -	9.5 -

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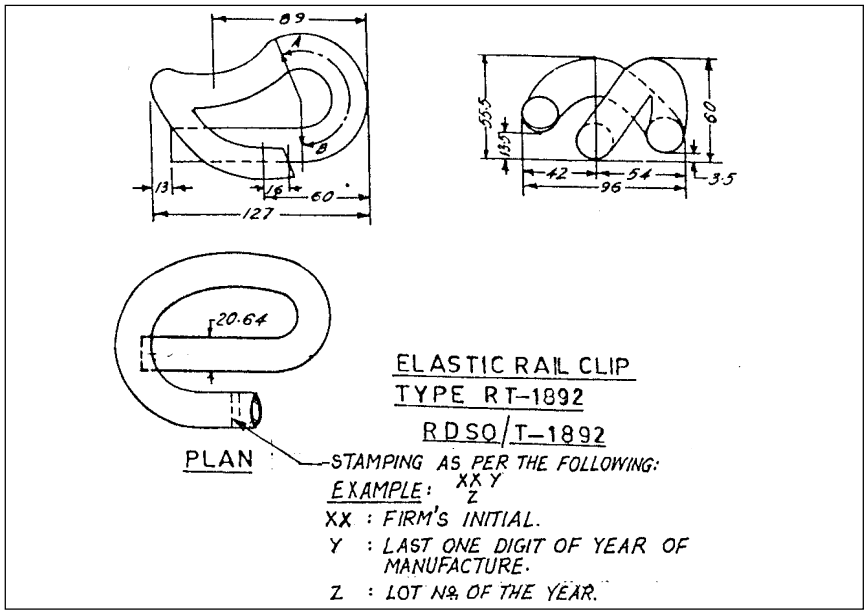

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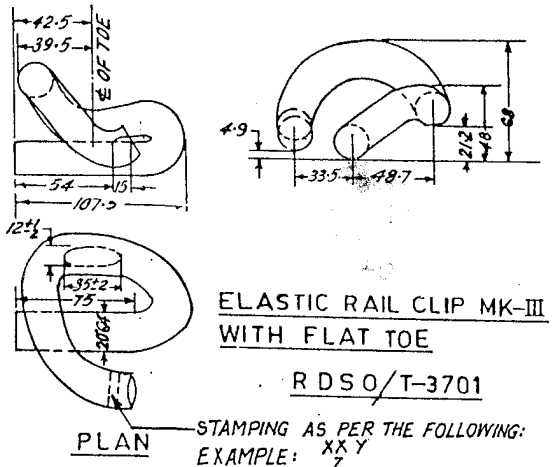

ELASTIC RAIL CLIP MK-III
WITH FLAT TOE

RDSO/T-3701

STAMPING AS PER THE FOLLOWING:

EXAMPLE: $\frac{XX\,Y}{Z}$

XX : FIRM'S INITIAL.

Y : LAST ONE DIGIT OF YEAR OF MANUFACTURE.

Z : LOT NO. OF THE YEAR.

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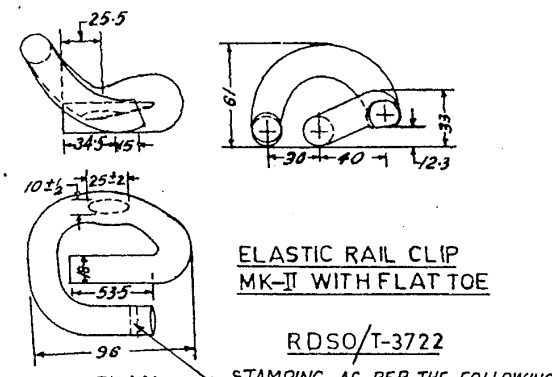


ELASTIC RAIL CLIP
MK-II WITH FLAT TOE

RDSO/T-3722

STAMPING AS PER THE FOLLOWING:

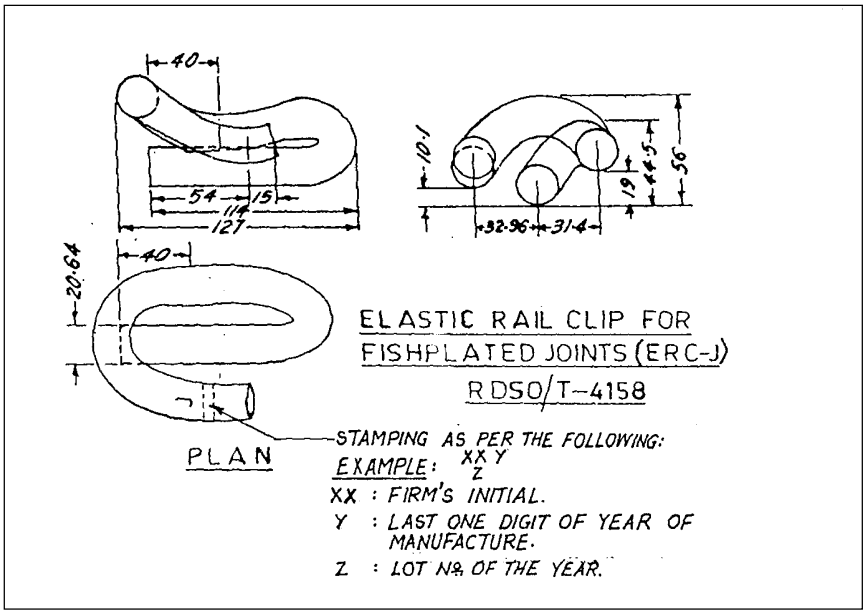
EXAMPLE: $\frac{XX\,Y}{Z}$

XX : FIRM'S INITIAL.

Y : LAST ONE DIGIT OF YEAR OF MANUFACTURE.

Z : LOT NO. OF THE YEAR.

47


40
54
15
114
127
40
20.64
PLAN
10.1
19
44.5
56
32.96
31.4
ELASTIC RAIL CLIP FOR
FISHPLATED JOINTS (ERC-J)
RDSO/T-4158
STAMPING AS PER THE FOLLOWING:
EXAMPLE: XX Y Z
XX : FIRM'S INITIAL.
Y : LAST ONE DIGIT OF YEAR OF MANUFACTURE.
Z : LOT NO. OF THE YEAR.

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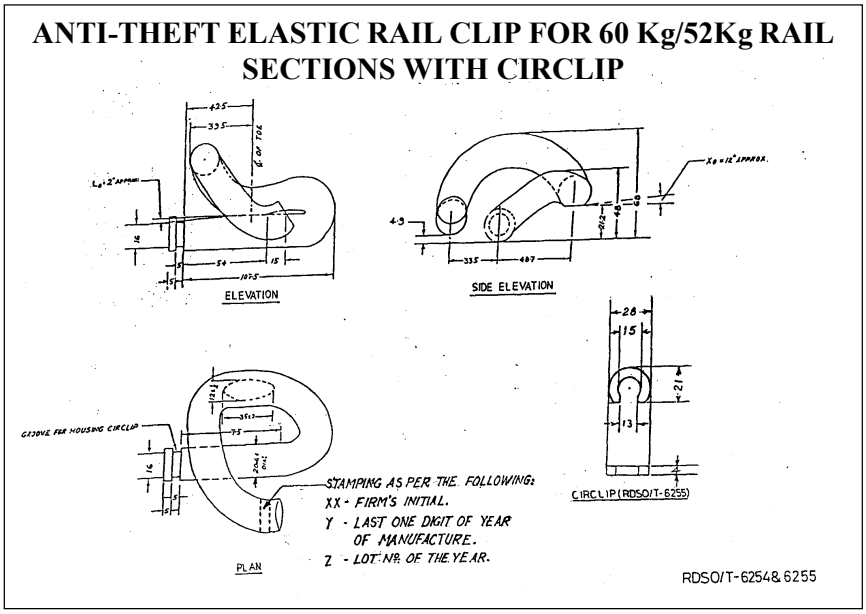
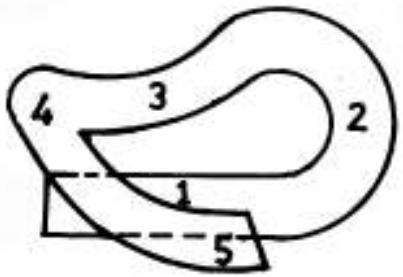

ANTI-THEFT ELASTIC RAIL CLIP FOR 60 Kg/52Kg RAIL SECTIONS WITH CIRCLIP
ELEVATION
SIDE ELEVATION
PLAN
CIRCLIP (RDSO/T-6255)
STAMPING AS PER THE FOLLOWING:
XX - FIRM'S INITIAL.
Y - LAST ONE DIGIT OF YEAR OF MANUFACTURE.
Z - LOT NO. OF THE YEAR.
RDSO/T-6254 & 6255

HOW TO VISUALLY DISTINGUISH BETWEEN DIFFERENT TYPES OF ELASTIC RAIL CLIPS

For the purpose of visually distinguishing between different Elastic Rail Clips, the clip can be divided into five parts as shown in the figure and further described below:



Part No.	*Description*
1.	Central leg (which goes into the hole of MCI/SGCI insert)
2.	Front arch (where the clip is pushed during insertion)
3.	Toe (round or flat, which rests on rail flange)
4.	Rear arch (which is pushed for removal of clip)
5.	Heel (which rests on the insert shoulder)

Visual distinction of different types of clips using the above part numbers can be done as per Table 1.

Table 1

Items	ERC-ROUND	ERC-FLAT	ERC MK II-FLAT	ERC Mk III
	ERC round	*ERC flat*	*ERC Mk II*	*ERC Mk III*
(i) Dia of rod (part1) (mm)	20.64	20.64	18.0	20.64
(ii) Toe (Part3)	Round	Flat	Flat Therefore/(a)	Flat Mk. II clips distinguished as the dia of clip rod is lesser than dia of any other clip
(iii) Arches (Part 2&4)	Part1 is higher than 4	Part 2 is higher than 4	Part 2 is lower than 4 Therefore/(a)	Part 2 is lower than 4 ERC/ERC Flat are distinguished w.r.t. Mk. III clips for part 2 being higher than part 4. With in ERC round /flat,(b) difference is self explanatory.
(iv) Dimension X(mm)	43.68	43.68	40	48.7
(v) DimensionY (mm)	31.68	31.68	30	33.5

DO's AND DON'Ts FOR RAIL SEAT ASSEMBLY ON CONCRETE SLEEPERS WITH ELASTIC RAIL CLIPS

1. DO's

   1.1. Ensure that all components of the assembly are available. Check drawing number of components as stamped on them (except on clip).

   1.2. Ensure that sleepers are laid centrally and square to the centre line of the track.

   1.3. Ensure that there is equal gap between rail foot and insert on both sides. Slew the sleeper laterally to achieve this.

   1.4. Ensure that rail flange top is clean.

   1.5. Ensure that liners are seated evenly on the rail.

   1.6 Keep "toe" of elastic rail clip on the liner and fix it by using driving tool of approved design.

   1.7. Ensure that the end face of central leg of driven clips is flush with the face of the insert.

2. DON'Ts

   2.1 Do not assemble fittings unless complete set of fittings of correct/ matching drawing are available.

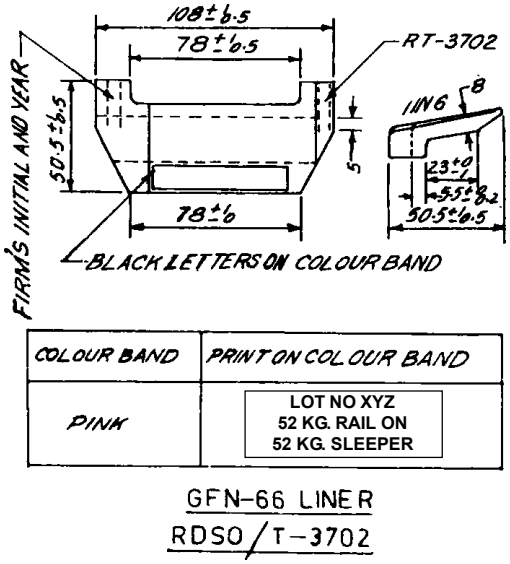
   2.2 Do not fit liner upside down.

   2.3 Do not fit liner till equal gap is available on either side of rail foot.

   2.4 Do not hit liner at top for seating evenly on rail.

   2.5 Do not hammer the clip for fixing.

   2.6 Do not allow the central leg of driven clip to either remain inside or project out of the eye of the insert.



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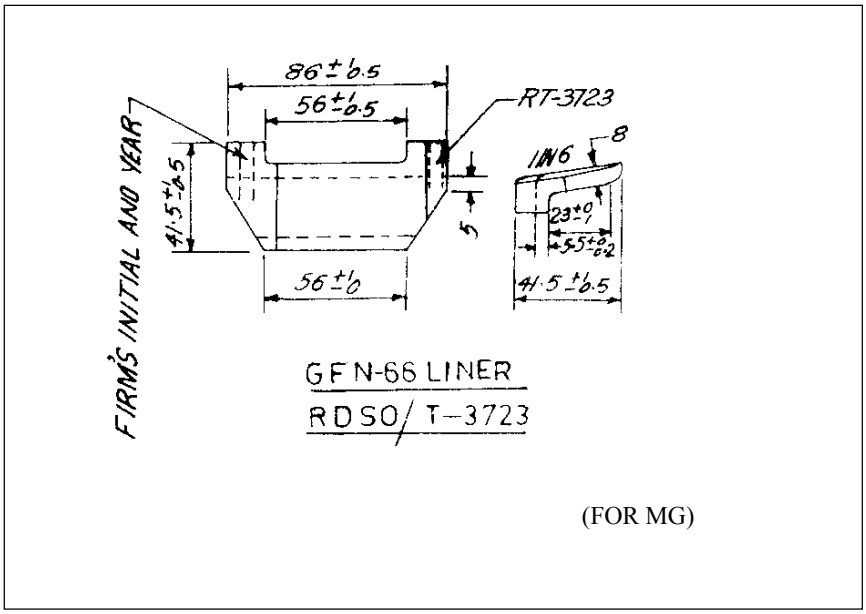

(FOR MG)

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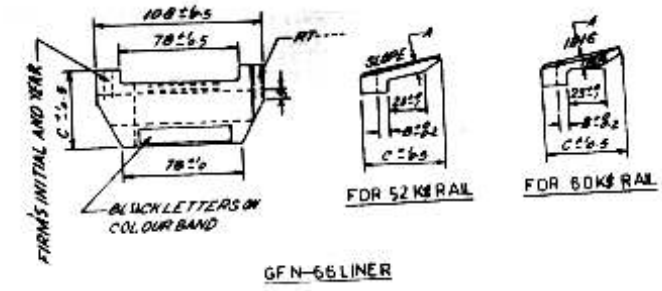

Sl. No.	Rail Section	Drawing No.	Identification Mark		A	B	C	SLOPE
			COLOUR BAND	PRINT ON COLOUR BAND				
1.	60 Kg UIC	RDSO/T-3706	WHITE	LOT NO XYZ 60 KG RAIL ON 60 KG SLEEPER	8.0	5.5	50.5	AS SHOWN
2.	52 Kg	RDSO/T-3707	YELLOW	LOT NO XYZ 52 KG RAIL ON 60 KG SLEEPER (GS)	9.5	9.0	54.0	1 IN 6
3.	52 Kg	RDSO/T-3708	LIGHT GREEN	LOT NO XYZ 52 KG RAIL ON 60 KG SLEEPER (NGS)	10.5	15.0	60.0	1 IN 6

G.S. - Gauge side
NGS – Non Gauge side

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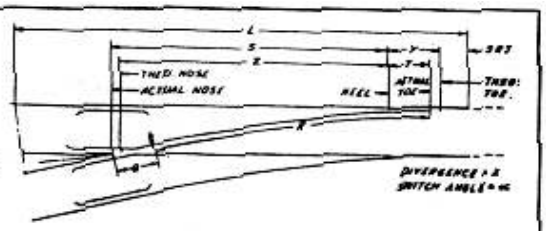
DRAWING Nos & IMPORTANT DIMENSIONS OF B.G. TURNOUTS WITH CURVED SWITCHES ON DIFFERENT TYPES OF SLEEPERS.



NOTATIONS	1 in 8.5						1 in 12					
	90 R		52 kg		60 kg		52 kg			60 kg		
	On wooden/ steel sleepers	On PSC sleepers (fan shaped) spacing	On wooden/ steel sleepers	On PSC sleepers (fan shaped) spacing	On wooden sleepers	On PSC sleepers (fan shaped) spacing	On wooden/ steel sleepers	On PSC sleepers (Conc. mono block) spacing	On PSC sleepers (fan shaped) spacing	On wooden/ steel sleepers	On PSC sleepers (Pre-stressed mono block) spacing	On PSC sleepers (fan shaped) spacing
DRG. NO	TA-20940, TA-20933	RDSO/T-4865	TA-20935, TA-20935	RDSO/T-4865	RDSO/T-3003	RDSO/T-4865	TA-20931, TA-20931	RDSO/T-1312	RDSO/T-4732	RDSO/T-2578	RDSO/T-5776	RDSO/T-5216
Z	18833	18393	18335	18335	18424	18335	27870	27870	25831	25831	25831	25831
Y	6835	6838	6835	6835	7135	6838	8478	7730	10125	10125	10125	10125
∝	0°-27'-33"	0°-28'-59"	0°-27'-33"	0°-28'-59"	0°-25'-08"	0°-26'-59"	0°-27'-33"	0°-27'-33"	0°-20'-09"	0°-20'-09"	0°-20'-08"	0°-20'-08"
θ	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	4°-45'-49"	4°-45'-49"	4°-45'-49"	4°-45'-49"	4°-45'-49"	4°-45'-49"
S	18513	18514	18327	18327	18361	18536	22056	20036	20017	20033	20025	20025
T	6400	6400	6400	6400	7125	6400	7730	7730	10125	10125	10125	10125
R	232220	232260	232220	232260	231440	232260	458120	458120	441360	441360	441360	441360
X	182-8	182	182-5	182	182-5	182	133	133	175	175	175	175
Q	1052	1078	936	1102	1021	1120	1418	1418	2083	2073	2073	2073
L	29302	28613	29316	28613	29316	28613	41004	41004	33993	41004	41004	38978
XING. TYPE & LENGTH	BUILT-UP 5370	CMS 3300	BUILT-UP 4800	CMS 3300	BUILT-UP 4810	CMS 3300	BUILT-UP 5370	BUILT-UP 5370	CMS 4330	BUILT-UP 5370	BUILT-UP 5370	CMS 4338

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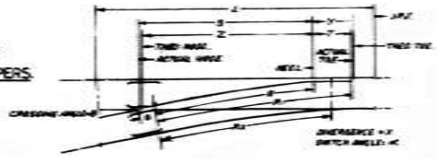
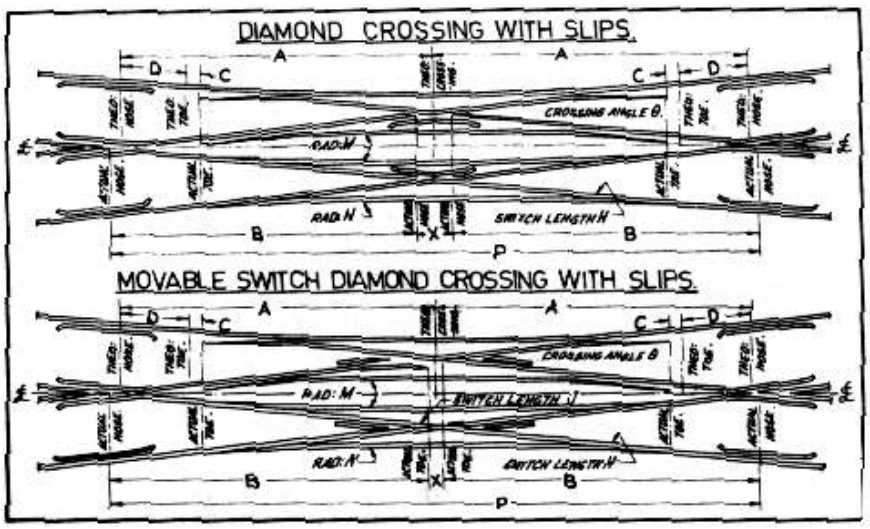
DRG. NO & IMPORTANT DIMENSIONS OF M.G. TURNOUTS ON DIFFERENT TYPES OF SLEEPERS.



Notation	1:8.5					1:12					1:12
	MG				NG	MG				NG	MG
	75R		90R	52KG	60R	75R		90R		60R	52Kg
	Straight on wooden/ Steel sleepers	Curved on wooden/ Steel sleepers	Curved on wooden/ Steel sleepers	Curved on wooden/ Steel sleepers	Straight loose heel	Straight fixed heel	Partly curved fixed heel	Partly curved on wooden/ steel sleepers	Partly curved on fan shaped PSC sleepers	Straight fixed heel	Curved PSC Sleeper
DRG No.	TA-20404 TA-21004	TA-20451 TA-21019	TA-20497 TA-21025	RDSO/T-6327	TA-20604	TA-20401 TA-21001	TA-20464 TA-21016	TA-20494 TA-21022	RDSO/T-4623	TA-20601	RDSO/T-6450
Z	11560	9515	9515	9515	8280	16323	15108	14678	14678	11723	14678
Y	4320	6206	6206	6206	4320	5777	7544	7974	7974	5777	7974
∝	1°-35'-30"	0°-29'-14"	0°-29'-14"	0°-29'-14"	1°-35'-30"	1°-9'-38"	0°-24'-27"	0°-24'-27"	0°-24'-27"	1°-9'-38"	0°-24'-27"
θ	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	4°-45'-49"	4°-45'-49"	4°-45'-49"	4°-45'-49"	4°-45'-49"	4°-45'-49"
S	11672	9627	9633	9647	8375	16480	15265	14845	14846	11857	14864
T	4115	5500	5500	5500	4115	5485	6700	7130	7130	5485	7130
R	119610	-	-	-	82600	240604	-	-	-	167340	-
R1	-	130210	130210	130205	-	-	-	-	-	-	-
R2	-	-	-	-	-	-	258300	258300	258300	-	258310
X	120	169	169	169	120	117	117	130	130	117	130
Q	1027	1027	1033	1047	1010	1377	1377	1387	1387	1394	1405
L	19676	19676	19676	19918	16365	26495	26494	26502	25711	21861	25776
Xing type & length	Built-up 4800	Built-up 4800	Built-up 4800	HTWXing 4550	Built-up 4800	Built-up 4800	Built-up 4800	Built-up 4800	CMS 3550	Built-up 4800	CMS 3550



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BG DIAMONDS WITH SLIPS

SN	Description	Notation	Diamonds with slips			Movable switch diamond crossing with slips					Diamond with slip on PSC	
			1in 8.5			1in 8.5		1in 10		1in 12	1in 8.5	1in 8.5
			90R with straight switches	52Kg with straight switches	52Kg with curved switches	90R	52Kg	90R	52Kg	52Kg	52Kg curved switches	60Kg curved switches
	Drawing no.		TA-20146	TA-20247	TA-20247 (modified)	TA-20136	TA-20220	TA-20131	RDSO/T-6889	TA-20216	RDSO/T-5364	RDSO/T-6494
1	Gauge	G	1676	1676	1676	1676	1676	1676	1673	1676	1673	1673
2	Crossing angle	Q	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	6°-42'-35"	5°-42'-38"	5°42'-38"	4°-45'-49"	6°-42'-35"	6°-42'-35"
3	Distance between actual noses of point rails of an obtuse crossing	X	494	508	508	118	132	140	155	186	938	940
4	Distance between theoretical nose of the acute and obtuse crossings	A	14320	14320	14320	14320	14320	16825	16792.5	20165	14294	14294
5	Distance between actual noses of the acute and obtuse crossings	B	13944	13944	13944	14379	14386	16895	16870	20258	13957	13965
6	Distance between actual and theoretical toe of switch in slips	C	225	225	435	225	225	225	435	324	435	435
7	Distance between theoretical nose of acute Xing and theoretical toe of the nearest switch in slips	D	2360	2360	2150	2360	2360	2820	2648.5	3323	2150	2150
8	Angle of switch in slips	∝	1°-34'-27"	1°-34'-27"	0°-47'-27"	1°-34'-27"	1°-34'-27"	1°-34'-27"	0°-47'-27"	1°-8'-0"	0°-47'-27"	0°-47'-27"
9	Length of switch in slips	H	4725	4725	6660	4725	4725	4725	6800	6400	7000	7000
10	Radius of slips (Outer rail)	M	225800	225800	262420	225800	225800	405230	374772	464590	261840	261840
11	Radius of slips (Inner rail)	N	224124	224124	260744	224124	224124	403554	373099	462914	260176	260176
12	Distance between actual noses of the acute crossings	P	28876	28904	28904	28876	28904	33930	33895	40702	28852	28852
13	Length of switch in movable diamond crossing	J	-	-	-	4738	4733	4733	4409	4738	-	-

DRAWING NOS OF TURNOUT ON PSC SLEEPERS

Gauge	BG							MG		
Angle	1 in 8.5			1 in 12				1:12		1:8.5
Rail Section	90R	52Kg	60Kg	52Kg		60Kg		90R	52Kg	52Kg
Type of layout	Fan shaped	Fan shaped	Fan shaped	Conventional	Fan shaped	Perpendicular	Fan shaped	Fan shaped	Fan shaped	Fan shaped
Turnout	RDSO/T-4865	RDSO/T-4865	RDSO/T-4865	*EDO/T-1912	RDSO/T-4732	* RDSO/ T-3776 RDSO/ T-4074	RDSO/T-4218	RDSO/T-4623	RDSO/T-6450	RDSO/ T-6327
Switch Sub-assembly	4866	4866	4966	2045	4733	RDSO/ T-3777	4219	4624	RDSO/T-6451	RDSO/ T-6328
Crossing Sub-assembly	4867	4867	4967	1914	4734	RDSO/ T-3779 RDSO/ T-3940	4220	4625	RDSO/T-6452	RDSO/ T-6329 (Heat treated welded)
Details of CMS crossing	4867/1	4867/2	4967/1	-	4734/1	3940/1	3940/1	4625/1	RDSO/T-6452/1	-
Details of CMS crossing	-	RT-6784 (Heat treated welded)	RT-6813 (Heat treated welded)	-	RT-6698 (Heat treated welded)	-	RT-6619 (Heat treated welded)	-	-	-
	* with built-up crossing									

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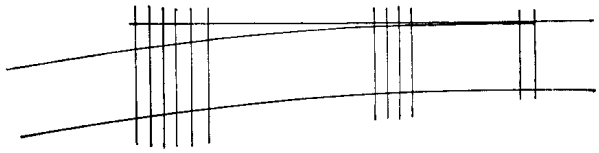
DRAWING NOS OF DERAILING SWITCH ON PSC SLEEPERS



GAUGE	B.G. (1673mm)	
ANGLE	1 IN 8.5	
RAIL SECTION	52 Kg.	60 Kg. (UIC)
TYPE OF LAYING	PERPENDICULAR	PERPENDICULAR
SWITCH SUB-ASSEMBLY	RDSO/T-5836	RDSO/T-6068

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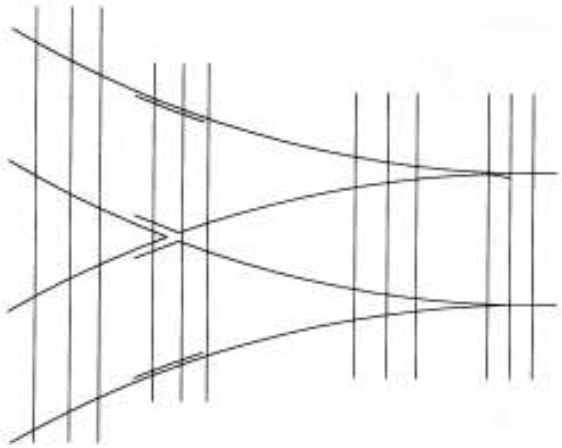
SYMMETRICAL SPLIT LAYOUT



Drawing Nos. of symmetrical splits on PSC sleepers (BG 1673mm)

Angle	1:12	1:8.5
Rail	52 & 60kg	52 & 60 kg
Turnout assembly	RDSO/T-5553	RDSO/T-5353
Switch assembly	RDSO/T-5554	RDSO/T-5354
Radius	882290mm	464070mm
Switch length	10125mm	6400mm
CMS crossing	RDSO/T-4734/4220	RDSO/T-4867/4967
Speed potential	70Kmph	40Kmph

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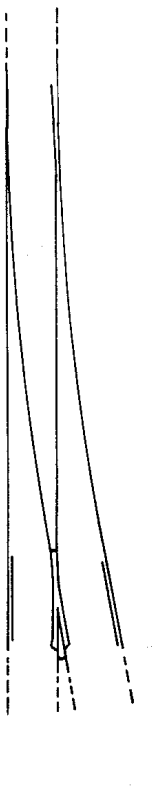
DRAWING NOS. OF THICK WEB CURVED SWITCHES ON PSC SLEEPERS



Type of TWS	CR-100	ZU-2-49	ZU-1-60	ZU-1-60
Rail section	52 Kg	52 Kg	60 Kg	60 Kg
Type of laying	Fan-shaped	Fan-shaped	Fan-shaped	Fan-shaped
Gauge	BG (1673 mm)	BG (1673 mm)	BG (1673 mm)	BG (1673 mm)
Angle	1 In 12	1 In 12	1 In 12	1 In $8^{1}/_{2}$
Turnout	RDSO/T-5168	RDSO/T-5268	RDSO/T-6154	RDSO/T-6279
Switch sub assembly	RDSO/T-5169	RDSO/T-5269	RDSO/T-6155	RDSO/T-6280
Crossing sub assembly	RDSO/T-4734	RDSO/T-4734	RDSO/T-4220	RDSO/T-4967
Details of CMS crossing	RDSO/T-4734/1	RDSO/T-4734/1	RDSO/T-3940/1	RDSO/T-4967/1

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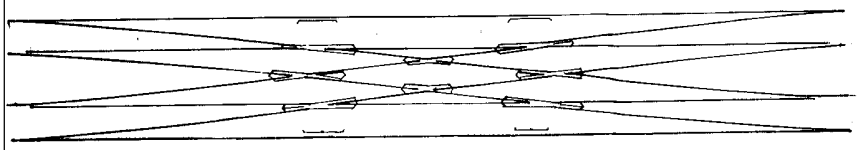
SCISSORS CROSS-OVER ON PSC SLEEPERS



GAUGE	(BG –1673 mm)
Angle	1 IN 8.5
Rail section	60 Kg (UIC)
Types of laying	Perpendicular
Crossing assembly	RDSO/T-6092
Crossing sub assembly Acute LH 1 in 8.5	RDSO/T-6093
Detail of acute crossing LH 1 in 8.5	RDSO/T-6093/1
Crossing sub assembly Acute RH 1 in 8.5	RDSO/T-6096
Detail of acute crossing RH 1 in 8.5	RDSO/T-6096/1
Crossing sub assembly Acute 1 in 4.25	RDSO/T-6099
Detail of acute crossing 1 in 4.25	RDSO/T-6099/1
Crossing sub assembly obtuse 1 in 4.25	RDSO/T-6102
Detail of obtuse crossing 1 in 4.25	RDSO/T-6102/1

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SEJs ON PSC SLEEPERS

S.N.	Rail	Drawing No.	Remarks
1	52 kg	RDSO/T-4160	80 mm gap
2	60 kg (UIC)	RDSO/T-4165	80 mm gap
3	60 kg (UIC)	RDSO/T-5478	80 mm gap for 1° curve
4	60 kg (UIC)	RDSO/T-5586	80 mm gap for theft prone area
5	60 kg (UIC)	RDSO/T-5748	80 mm gap for 1/2° to $1^1/_2$° curve
6	60 kg (UIC)	RDSO/T-6227	300 mm gap for bridge approach
7	60 kg (UIC)	RDSO/T-6263	190 mm gap for bridge approach
8	CR-120 Crane Rail	RDSO/T-6257	80 mm gap
9	52 kg	RDSO/T-6039	190 mm gap for bridge approach
10	60/52Kg	RDSO/T-6782	80mm gap combination SEJ with stock rail 52Kg and tongue rails 60 Kg

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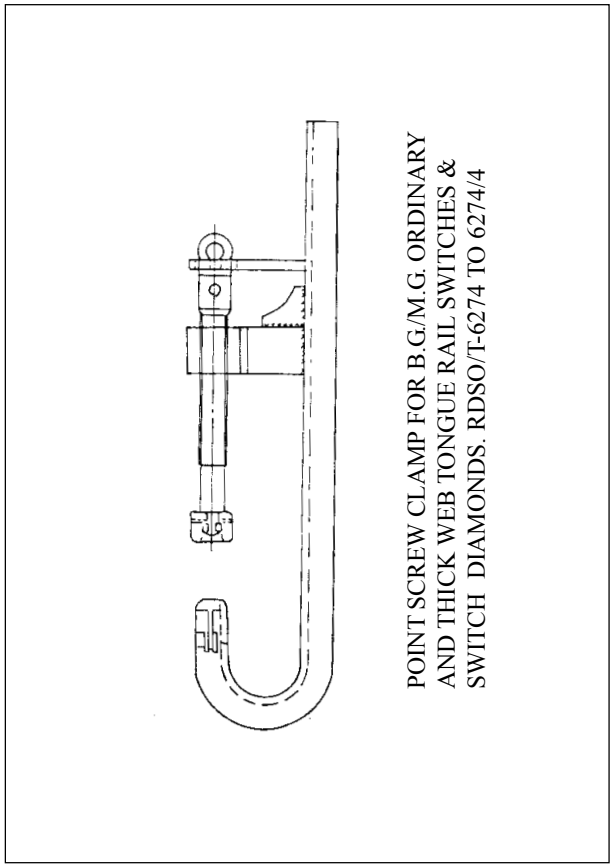
Improved SEJs ON PSC SLEEPERS

S.N.	Rail	Drawing No.	Remarks
1	60 kg	RDSO/T-6902	80 mm (max gap)
2	52 kg	RDSO/T-6914	80 mm (max gap)
3	60 kg	RDSO/T-6922	65 mm (max gap)
4	52 kg	RDSO/T-6930	65 mm (max gap)



POINT SCREW CLAMP FOR B.G./M.G. ORDINARY
AND THICK WEB TONGUE RAIL SWITCHES &
SWITCH DIAMONDS. RDSO/T-6274 TO 6274/4

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CHECK–LIST FOR RESURFACING OF WORNOUT MEDIUM MANGANESE/90 UTS SWITCHES, CROSSINGS, SEJs AND CMS CROSSINGS

The following checks should be carried out during resurfacing :

1. **Crossing condition :** The crossing shall be inspected and it shall be ensured that it is reparable. In case, crack extends across the complete section either through nose or through wing rails, it should not be taken up for repairs. Bolt holes, if elongated, shall be re-deposited by welding followed by drilling.
2. **Grinding :** In case of single electrode system, it shall be ensured that after grinding, the depth of wornout area is not less than 3 mm at any location.
3. Only those electrodes which are approved by RDSO, shall be used (see list at Annexure-I showing various brands of electrodes approved by RDSO).
4. Electrodes should be connected to correct polarity using recommended current. Tong testers will have to be used to determine actual current flow.
5. During welding, straight-edge should be employed continuously for correct build-up. After completion of welding, built-up area should be carefully examined and any underwelded spot shall be deposited again while the crossing still remains hot.
6. Pre-heating of MM/90 UTS switches, crossings and SEJS before welding to a temperature of about 250 degree centigrade to 300 degree centigrade shall be done by to and fro movement of the oxyacetylene torch. The blow pipe shall not be held at one spot. No preheating is required for CMS crossings.
7. Welding shall be commenced immediately after pre-heating is discontinued.
8. Preheating of electrodes shall be done at 130 to 170 degree centigrade for at least one hour immediately before use. In case, the packing of electrodes is absolutely intact and all the electrodes are consumed within six hours after opening of the packing, preheating of electrodes may be dispensed with.

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9. Complete removal of slag shall be ensured during welding with the help of hardened chipping hammer having flat and pointed ends and hardened wire brush having three rows of bristles on a width of 25 mm.
10. Electrodes with damaged and cracked coating shall not be used.
11. In case the crack in switch, crossing or SEJ is deep, instead of grinding, suitable cutting of gouging electrodes shall be utilised to remove such cracks easily.
12. Temperature of the switches, crossings and SEJs shall be checked during welding. It shall not exceed 300 degree centigrade for MMS/90 UTS switches, crossings & SEJs and 150 degree centigrade for CMS crossings.
13. In case of CMS crossings, it shall be ensured that the crossing is submerged in a water tank with only the head portion projecting out of water by 1 cm. Lower current of the recommended range shall be employed with stringer bead of shorter length, say 7 cm, deposited at a time. In case of CMS crossings, electrodes should be connected to positive polarity to reduce heat input.
14. It shall be ensured that all records regarding history of the switches, crossings and SEJs like number of times reconditioned, wornout area reclaimed, electrode used, laying particulars, service life in terms of GMT etc. are recorded in a card or register. Preferably, card shall be maintained separately for each switch, crossing and SEJ (see proforma at Annexure-II for recording performance of reconditioned crossing).
15. For further details, the Manual for reconditioning of wornout points and crossings, SEJs and CMS crossing shall be referred to. This Manual is presently under consideration of the Railway Board for approval and the same is expected to be issued shortly for implementation.

Annexure-I

List of various brands of electrodes approved by RDSO against IRS class H3, H3A & H3B of IRS M-28 specification.

A. Brands approved under single electrode system :

S. No.	*Brand Name*	*Manufacturer's Name*	*Class of electrode*
1.	VALDUR-45	M/s Valency Compounds, Ahmednagar	H_3
2.	TUFALOY-600 X	M/s Diffusion Engineers Ltd., Nagpur	H_3
3.	E.7191	M/s ADOR welding Ltd., Mumbai	H_3A
4.	TUFALOY-1200 X	M/s Diffusion Engineers Ltd., Nagpur	H_3A
5.	CPRS-060	M/s EWAC ALLOYS, Mumbai	H_3A
6.	DELTA THERM HF 2RA	M/s SUNULTRA Technologies, (P) Ltd. Gwalior	H_3A
7.	CPRS 050	M/s EWAC Alloys Ltd, Mumbai	H_3B
8.	E714 MC	M/s ADOR Welding Ltd, Mumbai	H_3B

H3 series of electrodes are to be used for reconditioning of CMS crossings also.

The above list is subject to change from time to time. List of approved brands is circulated by RDSO once in six months.

Annexure-II

Proforma for Recording Details Regarding Reconditioning of Built-up/CMS Crossings

Railway_____Division_____PWI Section_____

1. Station :
2. S. No. of crossing :
3. Make :
4. Angle/Gauge/Section/Sleeper type :
5. Laying and traffic carried particulars (GMT)

	New Crossing	After I recond.	After II recond.	After III recond.	After IV recond.
a) Point No. :					
b) Line (up/down) :					
c) Direction of traffic : (Facing/Trailing)					
d) Location (Curve/Straight) :					
*e) Date of laying :					
*f) Date of removal :					
g) Reasons for removal :					
h) Traffic density of section (GMT) :					
i) Traffic carried since last reconditioned (GMT) :					
j) Cumulative traffic carried (GMT) :					

6. Wear and welding particulars :

	For I recond.	For II recond.	For III recond.	For IV recond.
a) Wear on nose when released from track (100 mm away from ANC).				
b) Wear on nose after surface preparation (100 mm away from ANC). :				
c) Date of reconditioning :				
d) Technique of welding :				
i) Whether depot or in-situ :				
ii) Whether single electrode, or continuous wire process :				
e) Brands of electrodes used :				
f) Qty. of electrodes consumed : (Nos/Kg)				

7. Remarks

Signature of PWI concerned.

* Note : - In case of reconditioning being done in-situ, col. 5(e) and 5(f) will be replaced by date of reconditioning.

Permissible speeds on turnouts and special layouts

Description of turnouts	Permissible speed (kmph)			
	With straight switches		With curved switches	
	BG	MG	BG	MG
1:8.5	10	10	25	15
1:8.5 (symmetrical split)	15	15	40	25
1:12 (with ordinary OR tongue rails)	15	15	40	25
1:12 (with thick web tongue rails)	-	-	50	-
1:12 (with improved design on PSC sleepers)	-	-	50	-
1:12 (symmetrical split with improved design on PSC sleepers)	-	-	70	-

Conditions to be fulfilled before permitting 30kmph speed on BG loops vide Railway Board's letter No. 91/ CE-II/TS/1 dated 28.5.92 and 27/30.7.93.

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1. All turnouts shall be 1:12 or flatter with curved switches.
2. Such turnouts shall be provided in a continuous stretch on a reasonably long section on all running lines.
3. All the turnout joints shall be welded except two joints at ends of tongue rails and four joints at ends of crossing (No panel should exceed 3-rail length). The stock joints shall invariably be welded.
4. Track structure in loops shall be minimum 90R, 3 rail panel M+4 sleeper density with 150 mm ballast cushion, out of which at least 75 mm should be clean.
5. Turn-in curves shall not be sharper than turnout curves.
6. Turn-in curves shall be of same rail section as turnout curves with PRC or ST sleepers at 60 cm (Maximum) spacing with extra ballast shoulder of 15 cm on outside of curve. Wooden and CST-9 sleepers may also be used in turn-in curves subject to provisions of Rly. Board's letter dated 30.7.93 being fulfilled.

A certificate of compliance with above conditions shall be furnished to CRS when approaching him for raising speeds through loops to 30 kmph.

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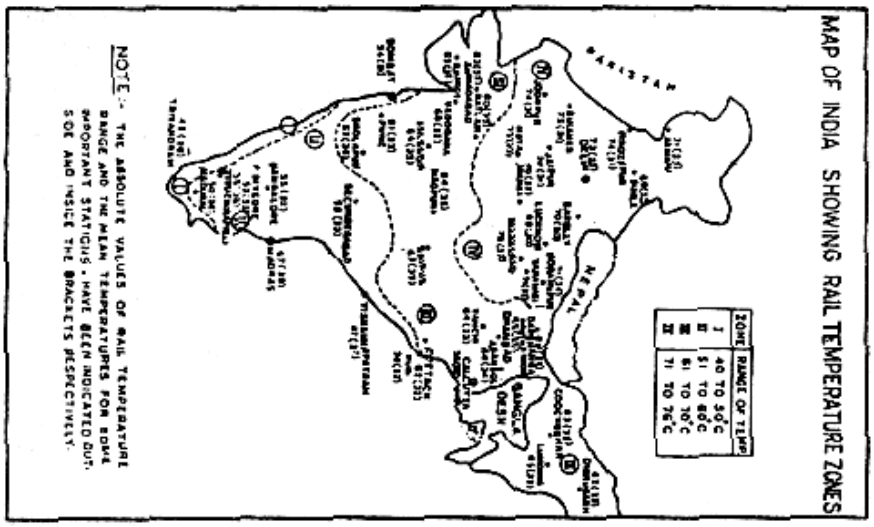
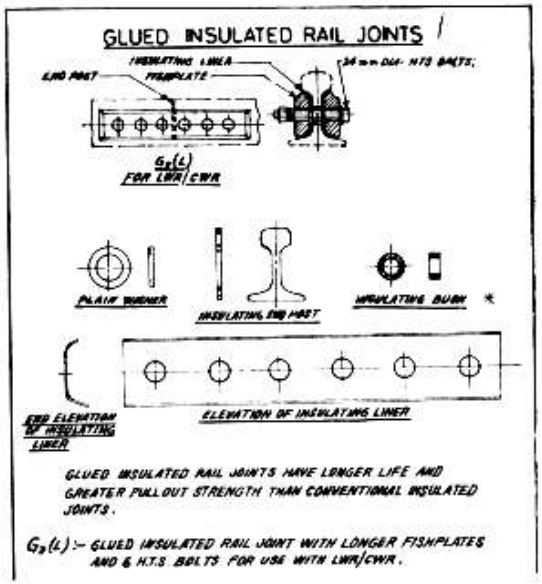




* INSULATING BUSH SHALL BE USED WITH 6 mm THICK END POST DESIGN WHILE INSULATING SLEEVE AROUND BOLT SHALL BE USED WITH 10mm THICK END POST DESIGN.

TABLE OF DIMENSIONS

S.No	GAUGE	RAIL SECTION	TYPE	LENGTH OF FISHPLATE	WIDTH OF FISHPLATE	PULL-OUT STRENGTH	REMARKS
1.	B.G.	60kg 52kg 90R.	$G_3(L)$ " "	950 950 950	40 40 40	170 t 150 t 125 t	FOR USE WITH LWR
2	M.G.	90R. 75R.	$G_3(L)$ "	950 630	40 40	125 t	FOR USE WITH LWR

LIST OF INDIAN RAILWAY STANDARDS SPECIFICATIONS FOR TRACK COMPONENTS

S. No.	Specification No.	Description	Corrigendum No.
1.	IRS. T-1-1966	Fish Plates	8 of July, 2008
2.	IRS.T-2-1966	IRS Dog Spikes	3 of May, 1973
3.	IRS. T-4-1966	IRS Round spikes	3 of May, 1973
4.	IRS. T-5-1965	Rectangular M.S. Bearing plates	2 of Sep, 1986
5.	IRS. T-6-1965	Fish plates combination	3 of Feb, 2008
6.	IRS. T-7-1983	C.I. Sleeper plates, bearing plates and chair	Nil
7.	IRS. T-8-1966	Tie bars, gibs, cotters and Keys	8 of Sep, 1991
8.	IRS. T-9-1970	Transverse track and turnout steel sleepers	3 of Sep, 1983
9.	IRS. T-10-2000	Fabricated switches and crossings, welded/heat treated crossings and switch expansion joints (SEJ)	Nil
10.	IRS.T-12-1996	Flat bottom railway rails	5 of Feb. 2007
11.	IRS.T-13-1966	IRS Fangs, Bolts & nuts	1 of Sep. 1967
12.	IRS.T-15-1967	Inspection Trolleys, Material trolleys or lorries and duplicated lorries	Nil
13.	IRS.T-16-1981	Rail/plate screws	2 of June, 1997
14.	IRS.T-17-1968	Loose jaws for steel trough sleepers	1 of April, 1976
15.	IRS.T-19-1994	Fusion welding of rails by Alumino-thermic process	6 of Aug. 2003
16.	IRS.T-21-1972	Steel clamps for wooden sleepers	Nil
17.	IRS.T-23-1967	IRS Fishbolts and nuts	5 of Oct. 1987
18.	IRS.T-24-1965	Rail anchors	4 of Sep, 1991

S. No.	Specification No.	Description	Corrigendum No.
19.	IRS.T-26-1967	B.G. second quality transverse track steel sleepers	Nil
20.	IRS.T-28-1973	High tensile fish bolts and nuts	Nil
21.	IRS.T-29-2000	Cast Manganese Steel Crossings	5 of Nov, 2004
22.	IRS.T-30-1975	Transverse track steel sleepers for use with welded M.S. plates and pandrol clips	Nil
23.	IRS.T-31-1992	Elastic Rail Clips	2 of April, 1999
24.	IRS.T-36-1981	Modified Loose Jaw for use on ST sleepers with Elastic Rail Clips	1 of Aug., 1985
25.	IRS.T-37-1982	Grooved rubber sole plates for placing beneath rails	Nil
26.	IRS.T-38-1982	Steel rail pads and their electric welding on to steel sleepers	Nil
27.	IRS.T-39-1993	Pre-tensioned Pre-stressed Concrete Sleeper for Broad Gauge and Meter Gauge	4 of Oct 2003
28.	IRS.T-40-1985	Special grade cement for use in concrete sleepers	Nil
29.	IRS.T-42-1988	Single coil spring washers for track	1 of April, 2000
30.	IRS.T-43-1992	Flat Bottom Railway rails for use on industrial sidings	Nil
31.	IRS.T-44-1995	Glass filled Nylon-66 insulating liner	1 of April 2007
32.	IRS.T-45-1996	Pre-tensioned Pre-stressed Concrete Sleeper for turnout for Broad Gauge and Meter Gauge	5 of Dec. 2002
33.	IRS.T-46-1996	Spheroidal Graphite Cast Iron inserts	Nil

S. No.	Specification No.	Description	Corrigendum No.
34.	Provisional-1997	Polyethylene dowels for concrete sleepers	Nil
35.	IRST-47-2006	Grooved rubber sole plates 6.0 mm thick for placing beneath rails	1 of June, 2007
36.	Provisional-1989	Grooved rubber sole plates 10 mm thick	2 of Dec. 1993
37.	Provisional-1995 Amended - 2001	Metal liner	Nil
38.	Provisional –1995	Rail joints welded with mobile gas pressure welding equipments	Nil
39.	Provisional – 2001	Retro-Reflective Engineering Indicators using high intensity grade sheeting (encapsulated lens type)	Nil
40.	Provisional – 2003	Track Based Lubricators (Electronic & Hydraulic type)	Nil
41.	Provisional – 2003	Spring Steel Circlip for use with antitheft elastic rail clip	Nil
42.	Provisional – 2006	Ultrasonic Testing of rails	Nil

Essential Information of Rubber Pad

S. No.	Description/Track item	Specification No.	Drawing No.	Remarks
1.	Grooved Rubber Sole Plates 6mm thick	IRS-T-47-2006	Various drawings	Third revision in Feb. 06
2.	Grooved Rubber Sole Plates 10mm thick	IRS (Prov.) 1989)	T-3709, T-5159 to 5164 and T-5199	Used over bridge steel channel sleepers
3.	Elastomeric Pad 25mm thck	M&C/RP/179/ 03 (Prov.)	B-1636/IR	Used over bridge steel channel sleepers
4.	Elastomeric Pad 5mm thick	M&C/RP/174/ 92 (Prov.)	B-1636/I	

TRACK MACHINES AND MONITORING DIRECTORATE

CONTENT

B L A N K

Position of Large Track Machines on Indian Railways

Type of machines	CR	ER	ECR	ECOR	NR	NCR	NER	NFR	NWR	SR	SCR	SER	SECR	SWR	WR	WCR	Total
Unomatic					1	2	1								1		
Duomatic	5	4	5	2	7	5	1	1	3	6	6	4	4	2	4	5	64
Continuous action Tamping machines	4	3	3	2	5	3	1	2	3	4	5	3	2	3	4	3	50
Tamping Express	1	1	1		1	1		1		1	1	1	1		1	1	12
Multipurpose Tamping machines		1	1	1	1	1		1		1		1				1	9
Point Crossing Tampers (Unimat)	6	3	3	3	7	4	1	3	3	3	6	5	3	2	7	4	63
Ballast Cleaning machines	5	4	4	4	6	5	1	1	3	5	7	4	3	2	4	4	62
Point & Crossing Ballast Cleaning machines	1					1											2
Shoulder Ballast Cleaning machines	2	2	2	2	3	2		1	1	2	3	2	1	1	4	1	29
Dynamic Track Stabilizer	4	4	5	3	7	5	2	2	2	5	5	6	3	1	4	4	62
Rail Grinding machines					1												1
Track Relaying Train					2	1			1	1		1				1	7
Turn out Changing machines (Set)	1	1	2	1	1	1	1	1	1	1	3	2	1		2	2	21
Track laying Portals	9	2	6		6	6		6	1	4	6	4	1		2	6	59
Sleeper Exchanger	1									1							2
Rail Vac	1																1
Utility Track Vehicle	4	2	3	1	5	2			2	2	4		2	1		2	31

1. Track Machine Organization

The organisation work under the overall charge of Chief Track Engineer (Machines) of the Railway who shall be reporting to the Chief Engineer through Chief Track Engineer. The organisation shall be responsible for the following functions: -

(i) Field operation of track machines,

(ii) Repair and maintenance of machines,

(iii) Supervision and technical services including training, and

(iv) Planning and deployment of machines.

Strength of staff shall be as per para 8.2 of chapter 8 of Indian Railway Track Machine Manual-2000

2. Types of Machines

Following major on-track machines are working on Indian Railways at present.

Tamping Machines

(*i*) Plain Track Tamping Machines

- a) 08-16 Unomatic
- b) 08-32 Duomatic
- c) 09-32 Continuous Action Tamping Machine (CSM)
- d) 09-3x Tamping Express

(ii) Points and Crossing Tamping Machines

- a) 08-275 Unimat
- b) 08-275-3S Unimat

(iii) Multi-purpose Tamper (MPT)

Dynamic Track Stabilizer (DTS)

Ballast Handling Machines

(i) Ballast Cleaning Machines

- a) RM-80 92U (Plasser make)
- b) RM-80 92I (Plasser make)

c) RM-76 (Plasser make) Only for Turnout cleaning

d) KBC-600 (Kershaw make)

(ii) Shoulder Ballast Cleaning Machines

a) FRM-80 Plasser Make

b) KSC-600 Kershaw Make

(iii) Ballast Regulating machines

Track Laying Machines

(i) Track laying Equipment (PQRS) By Plasser for sleeper renewal

(ii) Track laying Equipment By Simplex for sleeper renewal

(iii) Track Relaying Train (TRT) for complete track renewal

(iv) Points and Crossing changing Machine T-28 (AMECA-Make)

Special Purpose Machines

(i) Mobile Flash Butt Welding Plant K-355 APT (Plasser & Theurer make)

(ii) Rail Grinding Machine (Loram)

(iii) Utility Track Vehicle

(iv) Rail Cum Road Vehicle

3. The main functions of tamping machines are:

(i) Correction of alignment,

(ii) Correction of longitudinal and cross levels, and

(iii) Packing under the sleepers.

4. Packing/Tamping System

Vibratory pressure tamping works according to non-synchronous even pressure principle. All tamping tools exert the same pressure on ballast, independent of their movement. The movement of the tool pairs is completely independent, according to the resistance encountered from the ballast.

5. Tamping Units

Two independent tamping units are provided, one for each rail. These are attached to the machine frame by means of vertical guiding columns. The tamping units may be for tamping one sleeper or two sleepers or three sleepers at a time depending upon type and model of the tamping machine. 16 tamping tools are provided for tamping each sleeper.

The tools are vibrated by piston rods pivoted on eccentric shaft driven by hydraulic motors with following parameters:

a)	Number of revolutions of vibratory shaft	-	2100 rpm (approx.)
b)	Vibration frequency of tamping tools	-	35 Hz. (approx.)
c)	Amplitude of oscillation of tamping tools	-	10 mm

6. Pre-tamping Operations

The following preparatory works shall be completed before undertaking tamping of track:-

i) Hogged, battered and low joints shall be attended.

ii) Low cess should be made-up.

iii) All fittings and fastenings should be properly tightened, replaced/ recouped.

iv) Broken and damaged sleepers shall be replaced.

v) Sleepers should be correctly spaced and squared.

vi) Guard rails at the approach of bridges and check rails shall be removed temporarily.

vii) Wooden blocks and joggled fishplates shall be removed temporarily.

viii) In electrified sections, the earthing bond should either be removed or properly adjusted for tamping.

7. Operations during Tamping

The following points should be observed by the Machine Operator and the Section Engineer (P.Way):-

i) The gap between top edge of the tamping tool blade and the bottom edge of the sleeper in closed position of the tamping tool will be as under:

a)	Metal sleeper	:	22-25mm
b)	Flat bottom sleeper	:	10-12mm

ii) The tamping (squeezing) pressure for plain track should be as under:

a)	CST-9 sleeper	:	90 -100 kg/sq.cm.
b)	ST or wooden sleeper	:	100-110 kg/sq.cm.
c)	PSC sleeper	:	110-120 kg/sq.cm.

iii) The tamping (squeezing) pressure for turnout track is as follows:

a)	ST/Wooden sleepers	:	110-115 kg/sq.cm
b)	PSC sleepers	:	135-140 kg/sq.cm

iv) CST-9 sleepers and steel trough sleepers may require double insertion before passing on to the next sleeper.

v) Wooden sleepers require one insertion up to 20 mm lift and two insertions for lifts above 20 mm.

vi) Concrete sleepers require one insertion up to 30 mm lift and two insertions for lifts above 30mm.

vii) For maintenance packing, squeezing time of 0.4 to 0.6 second should normally be adequate.

viii) The tamping tools should not be loose or worn out. The wear on the tool blade should not be more than 20% of its sectional area.

ix) A ramp of 1in 1000 shall be given before closing the work. The next day's work shall begin from the point of commencement of previous day's ramp.

x) If work is to be done during night, sufficient lighting at work site should be ensured.

xi) Heavy slewing or lifting should normally be done in steps of not more than 50 mm.

xii) During and before tamping of turnout, S&T and Electrical staff should also be associated to complete their portion of work.

8. Tamping Cycle

The tamping cycle currently in existence is as follows which may have to be reviewed from time to time:

a) On PSC sleepers, the frequency of tamping will be once in two years or passage of 100 GMT of traffic whichever is earlier.

b) On other than PSC sleepers, frequency of tamping will be once in a year.

9. Dynamic Track Stabilizer (DTS)

After maintenance operations consolidation of track can be achieved faster and more effectively by causing "controlled settlements" of track by means of a Dynamic Track Stabilizer. The controlled settlement produced by the DTS has the following major advantages:-

(i) Elimination of initial differential settlements which can be caused by the impact of passing trains.

(ii) The track geometry achieved by tamping machines is retained for a longer duration.

(iii) Homogenous structure of ballast bed is built up.

(iv) Lateral track resistance increases resulting in enhanced safety against track buckling.

(v) Speed restrictions are relaxed faster.

10. Ballast Cleaning Machines

The function of the Ballast Cleaning Machine is to carry out cleaning of ballast by removing muck, thereby improving drainage of track and elasticity of the ballast bed. It consists of the following main units:

(i) Excavating unit

(ii) Screening unit

(iii) Conveyer system for distribution of ballast and disposal of muck

(iv) Track lifting and slewing unit

(v) Recording unit

11. Pre-requisites for Working of BCM

i) Since the cutter bar moves continuously below the track, the machine can not work if there is any lateral or vertical infringement. For such locations, either some special preparations are required or work has to be done manually.

ii) Since the setting and closing time of the machine is longer, a block of at least four hours is necessary to effectively utilize the machine.

iii) Adequate arrangements for supply and training out of ballast shall be ensured.

iv) Gas cutting equipment should be available at site to cut any obstruction like rail pieces, pipes etc which might get entangled with cutting chain.

v) Spoil disposal units should be attached with the machine while working in station yards, cuttings or multiple lines section where dumping of the spoil along the cess is not feasible. If waste is to be disposed off across any adjacent track, the adjacent track shall also be blocked for traffic.

vi) A trench of 30 cm depth and one metre width should be made for lowering cutter-bar by removing one sleeper or re-spacing of sleepers.

12. Ballast Regulating Machines

These machines have their main application in ballast transfer, spreading and profiling operations. For this purpose, a front mounted one pass transfer plow, left and right ballast wings and a rear mounted track broom are provided as standard equipments. The machine can move ballast towards centre of track or away from centre of track, transfer ballast across the track and transfer ballast from a surplus zone to deficient zone.

13. Track Relaying Train (TRT)

TRT is a system for complete mechanization of track renewal process. It

does the following jobs:

(i) Removes old rails from track.

(ii) Removes old sleepers.

(iii) Levels and compacts ballast bed.

(iv) Places new sleepers.

(v) Puts new rails into track.

TRT consists of the following main units:-

(i) Beam Car

(ii) Handling Car

(iii) Power Car

Salient Features

(i) There is no need to prefabricate panels.

(ii) No auxiliary track is to be laid.

(iii) Concrete sleepers loaded on modified BRHs are directly taken to site and relayed one by one.

(iv) New rails unloaded at site on shoulders and duly paired or fishplated are exchanged with old rails along with sleeper renewals.

14. Points and Crossing Changing Machine

It is used for relaying of turnouts on PRC sleepers. It consists of the following:-

(i) Self propelled portal crane

(ii) Motorized rail trolley

(iii) Non-motorized rail trolley

(iv) Jib crane

15. MECHANICAL TRACK RELAYING BY PORTAL CRANES

Mechanical track relaying involves the use of BFR mounted portal cranes followed by tamping machines for lifting and tamping of relayed track. Two portal cranes are deployed at site and one portal crane is used at depot both for prefabrication of new track panels as well as standby in case of

break-downs.

i) GENERAL

a) Para 1406 of IRPWM specifies procedures for mechanical relaying of track using portal cranes.

b) A minimum regular block of 2,1/2 hours is usually arranged in coordination with Sr.DEN,Sr. DOM and got approved from DRM,CTE/CE and COM. Similarly requirement of engine for regular working of relaying train should be got included in the Divisional power plan.

c) Depending upon the progress of work, a work site tamper (UNO or DUO) should be deployed in the rear for lifting and tamping of relayed track. The relaying work should be carried out in 'pulling' direction of relaying traion barring exceptional circumstances.

ii) BASE DEPOT

a) Base depot should be accessible by road and the distance of remotest site of work should not exceed 30 to 40 kms on either side.

b) Ideal base depot should have three sidings of 500 metre length each with a shunting neck. Each of these sidings should have an auxiliary track with a turning square arrangement at the dead end to facilitate transfer of portal cranes from one siding to other. If only two sidings are available a progress of about 3 km per month is achievable. Such an alternative should be resorted to at place where extent of work is small and lead time to and from site of work is short.

c) Illumination of the base depot and provision of an electrical plug point is considered necessary to facilitate activities like welding and other repairs to the relaying equipment at night.

iii) PRECAUTIONS TO BE TAKEN AT SITE OF WORK

a) Auxiliary track should be laid at a dynamic gauge of 3400 mm. Special care should be exercised at curves to avoid major realignment and adjustment of super elevation of curves.

b) Auxiliary rails should be well supported and well stabilized at every two metres such that support shall not extend beyond 250 mm from the gauge on the inside.

c) Rail level of auxiliary track should be 40mm above rail level of running track. In no case should it be lower than the existing rail level.

d) Full fastening in the old sleepers need to be ensured at the time of dismantling.

e) All cables, signaling rods and bond wires etc. should be temporarily disconnected during block period. Assistance of S&T and TI departments should be sought and such fixtures should be restored after completion of work.

f) A set of gas cutting equipment, two set each of rail closures in various lengths from 0.5 meter to 3.0 and 4 sets of junction Fish plates with bolts should be ensured at site of work to take care of unforeseen situation.

iv) REMEDIAL MEASURES TO TAKE CARE OF BREAKDOWNS

a) Emergency back up system should always be in working order

b) Testing of duplex and simplex chains as per Rly.Board's letter No.90/ Track-III/TK/46 dated 19-01-03 should be ensured (Copy at next page)

A. NEW CHAINS – To be tested at the time of procurement

B. Chain already in service-To be tested ones a year

16. Alignment of Track

The machine can be worked in smoothening mode or design mode. Currently single chord lining system for alignment of Track is in use on all tamping machines.

Single Chord Lining System

This system is controlled electronically. The system has arrangement for both 4- point and 3-point lining.

Type of chain	Size	Tensile load which the chain should be able to withstand without showing any sign of plastic deformation or any other damage (Tonnes)
Duplex	1-1/4''	19
Simplex	1-1/2''	17
Simplex	1-1/4''	9.5
Simplex	1''	6.5

4-Point Lining Method

Type of chain	Size	Tensile load which the chain should be able to withstand without showing any sign of plastic deformation or any other damage (Tonnes)
Duplex	1-1/2''	15
Simplex	1-1/2''	12.5
Simplex	1-1/4''	8.5
Simplex	1''	6

Trolleys at A, B, C and D are pneumatically pressed against the rail selected for line measurement, usually the high rail of a curve. The wire chord stretched between A and D represents the 'Reference Line' and the transmitting potentiometers (transducers) which are fixed to the measuring trolley B and lining trolley C are connected to this wire by means of forks and the wire drives.

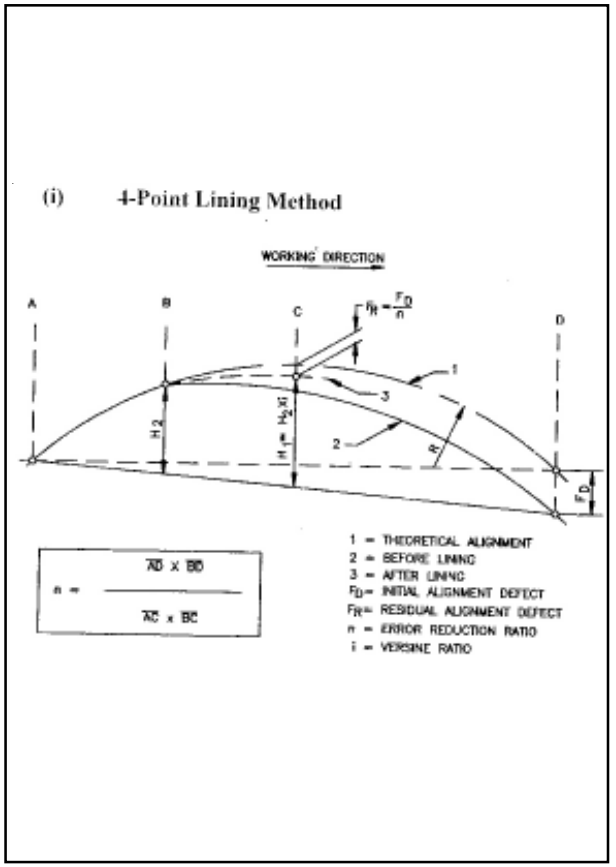
The measured ordinate at B is multiplied through the electronic circuit by the specified ratio and compared with ordinate at C. Then electronic signal is emitted which activates the hydraulic control of the lining mechanism to effect necessary correction.

When working on transition portion of curve, necessary adjustments can be applied by digital control on the front trolley. The method of applying adjustments is explained in the Annexure 2.1 of IRTMM.

3-Point Lining Method

The track is measured at three points B, C and D and lined according to specified theoretical versines. The chord at measuring position B, is fixed by the fork and the potentiometer is switched off. The ordinate at C only is measured on chord BD and compared with preset ordinate value. Any difference detected will activate the lining control to effect the necessary correction.

The 3-point method is mainly used if :



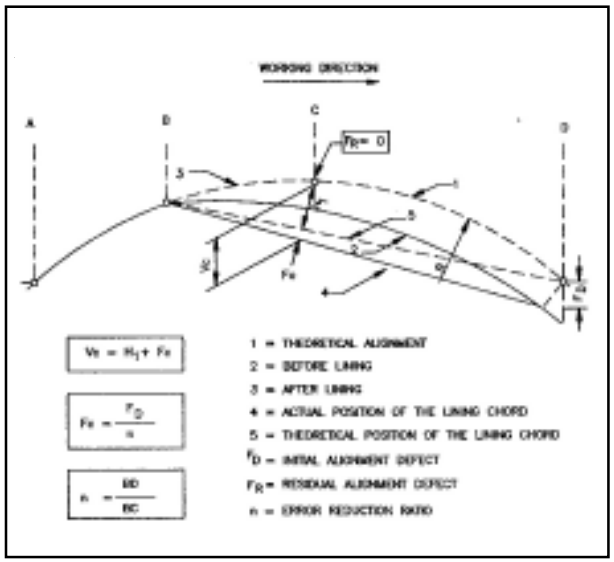
- The track is to be lined according to specified radii or versines.
- The lining system is used in conjunction with a sighting device and remote control or a Laser.

17. Levelling of Track

Longitudinal level of track is corrected by principle of proportional levelling as shown in Fig.

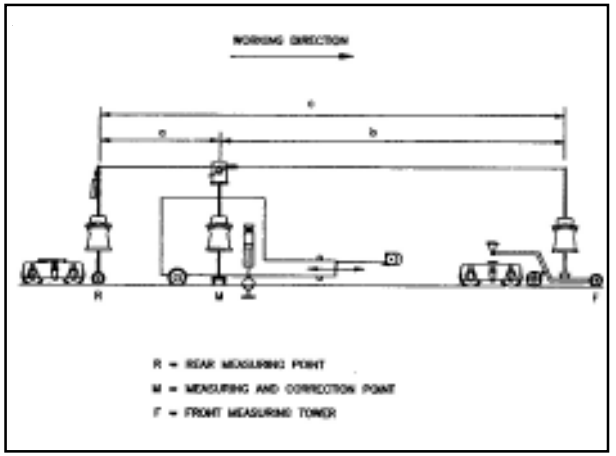
Different machines have different ratio (c/a) for lifting as under:-

Ratio (c/a)	Machine Type
4.3	UT
3.0	UNO, DUO, CSM, MPT



18. Leveling in Automatic Mode (Smoothening Mode)

The amount of lift, which is given to track while tamping to cover all



undulations, is called **general lift**. It is decided on the magnitude of dips generally available in track.

The general lift should always be more than the largest of dips, which shall be ascertained by Section Engineer (P.way) in advance. In the beginning, run-in ramp of 1 in 1000 and while closing the work, run-out ramp of 1 in 1000 is given for smooth transition. Leveling system consists of two chord wires, one for each rail which are stretched tightly from front tower to measuring bogie.

In all tamping machines height transducers have been provided on feeler

rollers which cut-off lifting process as soon as required level of lifting is achieved.

On front tower, a pendulum is incorporated between the two chord wires through a PCB. If a general lift is given to datum rail chord wire, the other chord wire will automatically get lifted or lowered via the pendulum and PCB as to maintain correct cross-level.

19. Leveling and Lining correction in Design Mode

Leveling and lining correction can be done as per guidelines given in annexure 5.3 of IRTMM . By adopting design mode of leveling and lining, desired track geometry can be achieved.

20. Geometry Value Assessment (GVA)

It is a small computer that eliminates the feeding of adjustment values from tables and marking on sleepers. The locations of main points of curve i.e. starting of transition, end of transition, transition length, radius, super elevation and vertical curve data etc are fed into the computer. The attention of the operator is not distracted by adjustment operation, mistake in calculation is avoided and therefore, the higher progress is achieved with improved quality.

21. Competency of Operator

Medical category of the operator is A-3. If wearing spectacles, he shall carry one extra pair while on duty and that of Technicians and helpers is B-1.The operator shall undergo training in train working rules at the Zonal Training Centre/I RTMTC, Allahabad and after every 3 years he is required to go for refresher course at IRTMM/ALD.

22. Failure of Track Machines in Mid-section

In the event of breakdown, the track machines have to be protected as per GR 6.03 and SR thereto by the machine staff, as directed by machine in charge. Failures in block sections of the track machines will be treated as accident under class 'H'. Accidents involving track machines shall be treated as train accidents under the appropriate class and action shall be taken as per the rules in force.

23. Line Blocks, Stipulated Corridors and Monitoring

Following options depending upon the track requirement and traffic patterns have to be followed for block working.

On single line section

Either one block of at least 4 hours or 2 blocks of 2-1/2 hours or in exceptional cases minimum two hours wherever 2-1/2 hours are not possible.

On double line section

a) One spell of 4 hours on "Up" or "Dn" line daily.

b) Two 2-1/2 hours split blocks on "Up" or "Dn" line on alternate days.

c) One 2-1/2 hours block on each line daily or in exceptional cases minimum 2 hours wherever 2-1/2 hours are not possible. On Construction Projects and multiple lines, additional working hours/ blocks are planned.

24. Inspection by Higher Officers

The Assistant Engineer shall accompany during inspections by the higher officers. Following records shall be made available during inspection: -

(i) History register of the engine and the machine.

(ii) Failure analysis register.

(iii) Progress bar charts and analysis.

(iv) Unit cost statement.

(v) Maintenance schedule register.

(vi) Inspection notes of higher officers and compliance report duly updated.

(vii) Operation and maintenance manuals of the machines.

(viii) Programme of deployment of machines.

25. Inspection Schedules for Track Machine Officers

** SEN/MC should carry out these inspections if no AEN/MC is posted under him.*

26. Cost of Machine Working and Financial Control

To keep the track laying/track maintenance cost is kept as low as possible, the expenditure on machine working has to be monitored. The total unit cost of working shall be worked out,

a) Including the Capital Recovery Factor value

b) Excluding the Capital Recovery Factor value

S. No.	Type of Machine	Inspection Schedule	
		AEN/MC*	SSE/MC
1.	CSM	Monthly	Fortnightly
2.	UNIMAT	Monthly	Fortnightly
3.	BCM	Fortnightly	Weekly
4.	BRM	Once in two months	Monthly
5.	SBCM	Monthly	Fortnightly
6.	DTS	Once in two months	Monthly
7.	UNO	Monthly	Fortnightly
8.	DUO	Monthly	Fortnightly
9.	T-28	Monthly	Fortnightly
10.	PQRS	Monthly	Fortnightly
11.	TRT	Weekly	Daily

Railway shall maintain a register for showing the actual expenditure incurred under various heads so that the cost of working could be computed once in three months for review at zonal railway level and once in a year at all railways level.

Procedure for Calculation of Unit Cost of Working of Different Track

1. The unit cost of working shall be calculated taking capital recovery factor with interest rate of 12% from the tables in Annexure-C of Indian Railways Finance Code (1982 edition).

2. Life of the machine in terms of gross units of work done, unit cost of the machine, weightage for different types of machines for proportionate distribution of overheads on technical and general supervision and works units between IOHs are as follows:

3. The life of machines has been given in terms of kilometres. This divided by annual output will be the life of machine in years. The maximum life should be limited to 15 years.

4. The proportionate expenditure on IOH/POH should be as follows:

$$\frac{4 \times \text{cost of IOH} + \text{Cost of POH}}{15}$$

5. Unit cost of working for different machines shall be worked out for every financial year.

S. No.	Type of machine	Life of machines (Gross units of work done) (km)	Work Units between POH (km)	Work units between *IOH (2 IOHs* between. POH) (km)	Weig-htage
1.	UNO	4500	2250	750	1
2.	DUO	6000	3000	1000	1
3.	CSM	7500	3750	1250	1
4.	UNIMAT	10000 T/Outs	5000 T/Outs	1650 T/Outs	1
5.	Portal craneOf 3 sets	500	-	250	0.5
6.	TRT	1500	750	250	3
7.	BCM	1000	500	175	1.5
8.	DTS	10000	5000	1700	1
9.	BRM	10000	5000	1700	0.8
10.	RGM	17500	8750	2925	1
11.	SBCM	3000	1500	500	1.5
12.	Multipurpose tamping machines	7500	3750	1250	1
13.	Tamping Express 09-3X	11000	5500	1850	1
14.	Points and crossing changing machine T-28	1000	500	175	1

27. Weightage Factors (Units) for Track Machines

28. Types of Maintenance Schedules

Maintenance and repairs of machines shall be carried as per following Schedules.

Types of Workshops

Workshops to deal above schedules, works at following five levels:-

(i) Central Periodical Overhauling Workshop(CPOH)

S. No.	Type of Machines	Weightage Factor
1.	Tampers, Rail Grinding Machines (each module of 16 stones), Dynamic Track Stabilizer, Mobile Flash Butt Welding Plant, Points & Crossing Laying Machine	1.0
2.	Ballast Regulator, Utility vehicle (self propelled), Track maintenance vehicle	0.8
3.	Ballast Cleaning Machine, Shoulder Ballast Cleaning Machine and rail vacuum excavating machine (VM-170)	1.5
4.	Track Relaying Train	3.0
5.	Portal Cranes, Spoil disposal unit/Tie crane/Tie exchanger/ Rail lifting unit/Rail cum road vehicle	0.5

(ii) Intermediate Overhauling Workshop (IOH)/Zonal Base Depot

(iii) Satellite Depot

Schedule	Periodicity	Duration	Location
Schedule – I	Daily	One hour	in the field (Camp Coach)
Schedule –II	50 Engine hrs.	Two hrs.	-do-
Schedule –III	100 Engine hrs.	One day	-do-
Schedule –IV	200 Engine hrs.	Two days	Mobile Van
Schedule –V	1000 Engine hrs.	7 days	Workshop (IOH/POH)
Schedule –VI	2000 Engine hrs.	45 days	Workshop (IOH)
Schedule-VII	6000 Engine hrs.	90 days	Workshop (POH)

(iv) Mobile Workshop

(v) Camp Coach Workshop

29. PRECAUTION FOR MECHANIZED LAYING OF PSC SLEEPER TURNOUT

Two types of PRC turnout sleepers have been manufactured on Indian Railways–

i) Left hand (L.H.) design

ii) Fan shaped design

PRC turnout sleepers of LH design can be used on existing left hand turnouts. However, PRC sleepers of fan shaped layout are different from all other layouts, keeping distance between stock joints and TNC unaltered.

A. Transportation and unloading :

Each set of PRC turnout sleepers is loaded in one flat-bottom BFR/BRH wagon at the manufacturing depot after inspection. Shorter sleepers for switch portion are loaded transversely while the longer ones longitudinally along the length of BFR/BRH. Marking are engraved on the shoulders of the sleepers to facilitate correct pattern of unloading. Unloading shall be done in such a manner that the "L" marking on the shoulder remain on left hand side and "R" marking on the right hand side while looking from facing direction. This will avoid rotation of sleepers by 180º at the assembly stage.

B. Planning & pre-requisites for laying :

Following should be ensured at site before laying

i) Because of requirement of geometry of the turnout, longer/heavier turnout sleepers and S&T fixtures, meticulous planning must be done in advance clearly laying down step by step activity so that the work can be completed with minimum traffic block.

ii) Clean ballast cushion of 300 mm below the proposed bottom of PRC sleepers is a must (track has to be lifted in most cases, alternatively formation may be lowered if unavoidable). Deep screening may be necessary in most cases.

iii) Effective drainage is a must. The problem of drainage is likely to get

aggravated with lowering of formation to provide 300 mm cushion. This is specially so in large yards where it may not be possible to drain on side slopes. Therefore, drainage should be provided prior to laying of PRC sleepers for turnout.

iv) Too low a cess shall be made up to facilitate maneuverability of cranes and other equipment, men & material at the time of laying.

v) Care shall be taken to prevent damage to fixtures such as:

- Pipes, cables, signaling rods, conductors, etc.
- Structures with tight overload clearances.
- Any other structural/special features.
- If temporary removal of such fixtures is not feasible, adequate protection/prominent markings shall be ensured for clear visibility to machine operators.

vi) Full complement and proper fitment of track fastenings shall be ensured to prevent falling of sleepers while dismantling and lifting he panels.

C. Post laying activities: Ensure

i) Perfect geometry during tamping cycles to raise speed to normal.

ii) Complete and tight fittings

iii) Welding of stock joints and other joints wherever feasible

iv) Continuity of track structure on approaches on PRC sleepers road and up to one rail length on all approaches on non PRC sleepers road

SMALL TRACK MACHINES DETAILS
WELD TRIMMER (POWER PACK)

Purpose : Removal of extra metal from rail head after AT welding

Salient features:

Overall weight	:	175 Kg approx.
Men required for handling & transportation	:	Two (skilled)
Transportation	:	By monorail trolley/Rail dolly/Push Trolley/ Powered Material Trolley
Block requirement	:	Works under traffic block
When to start trimming	:	3-4 minutes after tapping of weld
Trimming time	:	Within one minute for all rail sections
Cutter blades	:	Specific for each rail section
Fast consumable	:	Cutting head, retipping after cutting 200 Nos. weld heads.

PORTABLE RAIL PROFILE GRINDER

Purpose : Grinding of AT weld joints after trimming

Salient features:

Overall weight	:	80 Kg
Men required	:	One (skilled)
Transportation	:	By monorail trolley
Block requirement	:	No traffic block is necessary
When to start grinding	:	Immediately after weld trimming
Grinding time	:	6 to 15 minutes depending upon rail section & UTS
Power source	:	Gen. Set/Electric power supply (230V.A.C)
Finish tolerance on rail top	:	+0.2 mm on top of rail head with 10 cm straight edge

		0.5 mm on top of the rail head, gauge and non-gauge face with 1m straight edge.
		0.3 mm on gauge face, non-gauge face of rail head with 10 cm straight edge.
Fast consumable	:	Grinding stone

HYDRAULIC TRACK LIFTING CUM SLEWING DEVICE (TRALIS) (15t CAPACITY)

Purpose : Simultaneously lifting and slewing of track and T-out.

Salient Features:

Reaction trough size	:	180 ± 5 mm x 720 ± 5 mm
Capacity	:	(a) Vertical jack : 15 tons
		(b) Horizontal jack : 7.5 tons
Hydraulic lift	:	(a) Vertical jack : 120 mm ± 5 mm
		(b) Horizontal jack : 150 mm ± 5.00 mm (left or right)
Overall weight including oil & hoses	:	120 ± 05 kg
Close Height (top of saddle to bottom of plate)	:	230 ± 02 mm
Transportation	:	On mono rail wheel barrow designed for this purpose.

HYDRAULIC TRACK LIFTING CUM SLEWING DEVICE (TRALIS) (10T CAPACITY)

Purpose : Simultaneously lifting and slewing of track and T-out.

Salient Features:

Reaction Support plate size	:	Min. 400 x 200 x 50 mm (Farbicated)
Reaction through size	:	140 x 300 mm

Capacity	:	(a) Vertical jack : 10 tons
		(b) Horizontal jack : 5 tons
Hydraulic lift	:	(a) Vertical jack : 80 mm
		(b) Horizontal jack : 50 mm left + 50 mm right
Overall weight including oil & hoses	:	95 ± 05 kg (individual part shall not weight more than 25 kg)
Close Height (top of saddle to bottom of reaction support plate)	:	230 mm
Transportation	:	On mono rail wheel barrow designed for this purpose.

MECHANICAL TRACK JACK (NON-INFRINGING) (Rack and Pinion & Rack and Pawl Models)

Purpose : Lifting of track

Salient Features :

		Rack & Pinion Model	Rack and Pawl Model
Lift	:	100 mm (Min)	100 mm (Min)
Capacity a) Top	:	8.0 t	8.0 t
b) Toe	:	7.0 t	7.0 t
Height of top of jack in lowest position	:	250 mm	250 mm
Height of toe of jack in lowest position	:	120 mm	120 mm
Base area	:	155 x 300 mm	155 x 300 mm
Weight	:	20kg	20kg
Manpower required for handling & transportation	:	One skilled	two

Lift per stroke of operating lever	:	3 to 6 mm	13 to 15 mm
Time for release	:	Instantaneous	Instantaneous
Length of operating handle	:	800 mm	1250 mm

HYDRAULIC TRACK JACK (NON-INFRINGING)

(10t and 15 t capacity)

Purpose : Lifting of track for rectification of cross levels.

Salient Features :

		10t capacity	15 t capacity
Overall weight	:	10.5 ± 0.5 kg	13.0 ± 0.5 kg
Capacity	:	10 t designed	15 t designed
Lift	:	80 + 3 mm (Max.)	80 + 3 mm
Height of jack in closed position	:	166 mm	166 mm
Manpower required	:	One (semi skilled)	One (semi skilled)
Release	:	Instantaneous	Instantaneous

ABRASIVE RAIL CUTTER

Purpose: cutting of rails at faster speed

Salient features:

Overall weight	:	Upto 30 kg
Men required	:	Two (one skilled, one unskilled)
Cutting time	:	Upto 5 minutes depending upon rail section
Tolerance	:	± 0.5 mm from vertical
No. of cuts per disc	:	Min. 07 nos. of cuts on 52 kg/90UTS rails at discard dia. of 260 mm
Fast consumable	:	Abrasive disc

PORTABLE DC WELDING GENERATOR

Purpose : For reconditioning of worn-out points & crossings in-situ

Salient features:

Engine output	:	Adequate capacity for required electrical outputs
Engine type	:	4 stroke, Air cooled, Petrol/Diesel run
Welding current	:	60-200 amp (at 60% duty cycle)
Open circuit voltage	:	Shall not exceed 100 V
Welding voltage	:	20-30 V
Max. hand welding current	:	Shall not exceed 270 amp.
AC auxiliary output	:	2.5 KVA at 50 Hz, 220-240 V A.C.
Insulation class of wirings	:	"F"
Total weight	:	Within 150 kg
Manpower requirement (for operation & transport)	:	Three

RAIL CUTTING MACHINE (Saw type)

Purpose : For cutting rails in-situ in tracks of low traffic density and on cess.

Salient features:

Engine output	:	2 to 3 HP at 3000 to 4000 r.p.m.
Engine type	:	Air cooled, 4 stroke, Air cooled, Petrol and kerosene run
No. of cuts per liters of fuel	:	4 to 5 (depending upon rail section & its UTS)
Cutting time	:	Upto 30 minutes
Overall weight	:	Upto 70 kg
Manpower required	:	Two

RAIL DRILING MACHINE

Purpose : Drilling holes in web of rail

Salient Features:

Overall weight including prime mover	:	65 kg
Men required for operation & transportation	:	2 nos.
Operating time	:	3 to 4 min.
Tolerance for dia and Positioning	:	$\pm$ 0.7 mm
Block requirement	:	Not necessary
Consumables	:	Drill bit

MECHANICAL TOE LOAD MEASURING DEVICE

Purpose : Measurement of toe load of Elastic Rail clip

Salient Features:

Spring capacity to measure toe load	:	1400 kg
Spring characteristics	:	Axial deflection of 16 to 20 kg/mm
Manpower required for operation	:	Two

ELECTIRONIC TOE LOAD MEASURING DEVICE

Purpose : Measurement of toe load of Elastic Rail clip

Salient Features:

Load cell overall capacity	:	2000 kg
Measuring capacity	:	1400 kg
Manpower required for operation	:	Two

HYDRAULIC ELASTIC RAIL CLIP EXTRACTOR

Purpose : Removal of jammed elastic rail clips

Salient Features:

Overall weight	:	Upto 40 kg
Men required	:	2 nos.
Time for operation including fixing	:	5 to 10 min
Maximum force exerted on clip	:	10t
Block requirement	:	Not necessary

RAIL TENSOR HYDRAULIC (NON-INFRINGING TYPE) 70 t CAPACITY

Purpose: Tensioning of rail during de-stressing of LWR (when rail temperature < t_d)

Salient features :

Pulling force	:	70 t (min.)
Pushing force	:	30 t (min.)
Hydraulic stroke	:	300 mm (Min.)
Total weight	:	375 kg (weight of heaviest part 115 kg)
Man required	:	4 nos. (one skilled + three unskilled)

Components:

- Two hydraulic cylinders (double acting) operated through a hand pump.
- Rail grip and clamp assembly.
- Tie Bar (for pulling operation only).

Features:

- Obstruction less
- Hydraulic operated by hand pump.

Uses:

- De-stressing of LWR/CWR at rail temperature < t_d
- During AT welding
- Installation of insulated joints/glued joints.
- Repair works of rail failures.

OFF-TRACK TAMPERS (POWER-PACK VERSION)

Purpose: For tamping of track for slack packing in concrete sleeper track as a means of intermediate attention between the runs of on-track tampers).

Salient Features:

A. Tamping unit:

Type/model	:	Hand held type
Weight (excluding tools)	:	Within 15 kg
Weight of tamping tool	:	2.5 kg (approx.)
Voltage	:	230 V, A.C.
Current input	:	Upto 8.5 Ampere
Power input	:	Max. up to 1600 Watts.
Power output	:	Not less than 620 Watts.
Impact rate (blows/min.)	:	In the range of 900 to 2200
Dimensions		
(L x B x thickness)	:	Approx 650 x 250 x 120 mm
Performance output	:	At lease 10 to 12 sleepers per tamper per hour of tamping on an average 50 mm lift of the track
Manpower requirement	:	6 (4+2 rest giver) per set

B. Power source:

Power source	:	External Generator
Fuel	:	Diesel/Petrol/Kerosene
Capacity (output)	:	Min. of 3.6 KW(rated) at 230 V, AC at 3000 r.p.m. (should be capable to feed two tampers continuously at full load).
Fuel comsumption	:	2.0 litres/hr in case of diesel/kerosene driven 2.5 litres /hr in case of petrol driven
Fuel tank capacity	:	Around 10.0litres
Starting mechanism	:	Rope start/self starter
Continuous operating time	:	Not less than 4 hrs.
Operating noise level	:	Less than 100 dB

OFF-TRACK TAMPERS (ENGINE MOUNTED VERSION)

Purpose : For tamping of track for slack packing in concrete sleeper track as a means of intermediate attention between the runs of on-track tampers.

Salient features:

Impact Engery	:	40 J
No. of blows per minute	:	700 – 1620
Tamper dimension		
(LxBxH)	:	927 x 611 x 331 mm
Tool dimension		
(tip width x working length)	:	100 x 400 mm
Engine Power	:	1.2 Kw at 6500 rpm (in-built)
Cooling System	:	Fan cooled
Starting system	:	Recoil start
Fuel consumption	:	1.3 liter/hr
Fuel Tank capacity	:	1 liter
Weight		
(excluding tamping tool)	:	25 kg (approx.)
Weight of tamping tool	:	4.8 kg (approx.)
Manpower required	:	6 (4+2 rest giver) for 4 tampers

TRAIN SPEED RECORDER

Purpose: To record speed of train at speed restricted location of track to detect over speeding trains

Salient features:

• Range of Speed	:	01 to 200 Kmph
• Traffic Condition	:	Bi-directional on double lines

- Mode of Speed measurement : Repetitive speed measurement on passage of at least every fourth wheel
- Tolerance of speed measurement : 01% for all speeds
- Calendar and time recorder : High stability crystal based real time calendar clock with an accuracy of 1 microsecond
- Installation Time : Within 15-20 minutes
- Weight : Within 20 Kg
- Manpower required : Two (Semi-Skilled)

GANG/WORKSITE REMOTE CONTROL HOOTER

Purpose: To alert the workmen at worksite against an approaching train.

Salient features:

- The Device consists of : A hooting unit (remains at worksite) and a remote unit (remains at remote end with the look-out man)
- Operating Distance : 1200 m (Between Hooting unit & Remote unit.)
- Sound intensity : 105-110 dB
- Sound frequency : 370±15 Hz (low) and 660±15 Hz (high)
- Power Source : Chargeable Battery
- Manpower Required : Two (semi-skilled)-one at worksite and other as look-out man.

TRACK TOLERANCES

A. BROAD GAUGE

Initially track tolerances were issued vide Railway Boards letter No. 71/W6/HS/1 dt. 21.10.1971 (Popularly called C&M-1 tolerance). Subsequently based on this advance correction slip (CS-45) was issued vide Rly. Bds letter no. 94/Track-III/T.K./23 Vol. II dt. 17.2.2000, which specifies following track tolerances.

The following limits of track tolerances are prescribed for the guidance of the engineering officials on the suitability* of standard of maintenance of track for sanctioned speeds above 100 km/hr and up to 140 km/hr on B.G. track.

(i) Alignment defects (Versine measured on a chord of 7.5 metres under floating conditions).
   (a) On Straight track: 5 mm values up to 10 mm could be tolerated at few isolated locations. **
   (b) On curves : ± 5 mm over the average versine, values up to ± 7 mm could be tolerated at few isolated location.**

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

(ii) Cross level defects : No special tolerance limits. As regard cross levels, the track should be maintained to standards generally superior to that at present available on main line track on which unrestricted speeds up to 100 kmph are permitted.

(iii) Twist (to be measured on a base of 3.5 m)
   (a) On straight and curve track, other than on transitions, 2 mm/metre, except that at isolated locations ** this may go up to 3.5 mm/metre.
   (b) On transition of Curves- Local defects should not exceed 1 mm/metre except that at isolated location ** this may go up to 2.1 mm/metre.

(iv) Unevenness rail joint depressions (versine measured on a chord of 3.5 m) 10 mm in general and 15 mm for isolated locations**.

(v) Gauge Variations: No special specifications. The maximum limits for tight and slack gauge should be as indicated in Para 224(2)(e).

(*) Suitability - Suitability refers to good riding quality for passenger comport and not from stability point of view.

(**) In above "few isolated locations" has been taken as not exceeding 10 per km.

B. METRE GAUGE

As all the M.G. routes are being converted to BG gradually, M.G. Track recording has since been dispensed with vide Rly. Board letter No. 91/Track-III/TM/20 Vol. II dt. 29.6.99 and the left over routes are to be monitored by OMS only till conversion is completed.

C. MONITORING BY TRCS

Frequency of Track Recording : Track geometry monitoring of metro Gauge routes is not to be done by track recording car. The Broad Gauge routes should be monitored by TRC as per the following frequencies (except for the routes where track recording is to be dispensed with) :-

i) Routes with existing speeds above 130 kmph - once in 2 months
ii) Routes with existing speeds above 110 kmph and upto 130 kmph - once in 3 months
iii) Other Group 'A' and 'B' routes - once in 4 months
iv) Group 'C' 'D' and 'D Spl' routes - once in 6 months
v) Group 'E' and 'E Spl' routes - once in 12 months

Ref : As per Correction slip No. 83 to para 606 of IRPWM-1986 vide Rly Bds letter No. 91/Track-III/TM/26- Vol III dt. 25-2-03.

D. CTR value = 100 - (U+G+T+A)

U = Number of peaks per km exceeding 6 mm in unevenness
G = Number of peaks per km exceeding 3 mm in gauge
T = Number of peaks per km exceeding 5 mm in twist
A = Number of peaks per km exceeding 5 mm in alignment

In case alignmentis not recorded then CTR value = 75 - (U+G+T)

E. Monitoring of riding quality by OMS (Ref. : Rly Bds letter No. 91/Track-III/TM/26. Vol. II (Pt) dt.7.7.99).

1. Frequency of recording

1.1 Broad Gauge :

(a) Routes having speed of 100 kmph and above : Once every month
(b) Other routes : Once in 2 months

1.2 Metre Gauge :

(a) Routes having speed of 75 kmph and above : Once every month
(b) Other routes : Once in 2 months

2. Recording of defects :

Peak values exceeding the following present limits for both lateral and vertical modes shall be recorded for various routes

2.1 Broad Gauge :

(a) High speed routes above 110 km/h on A & B routes : Greater than 0.15 g
(b) Other routes up to 110 kmph : Greater than 0.20 g

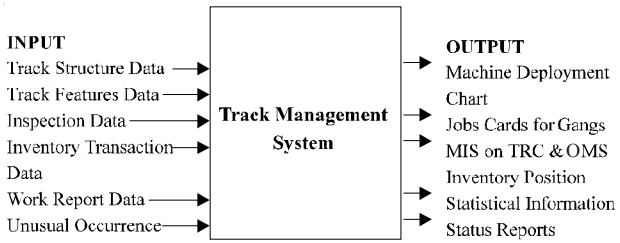
2.2 Metre Gauge : Greater than 0.2 g

3. Classification of track quality

	Very Good	Good	Average
(a) High Speed	Less than 1.0	1-2	Greater than 2
(b) Rest of routes	Less than 1.5	1.5-3	Greater than 3

TRACK MANAGEMENT SYSTEM (TMS)

Track Management System (TMS) is a computer aided system which will integrate various inspection data, track structure data, track features data and gives various decisions support systems and Management Information Systems (MIS).



Minimum hardware configuration for running the TMS is PCAT-386 and run time version of ORACLE RDBMS VER. 5.1 is also required for the same limited module of Track Management System has also been developed which contains almost all the decision support systems and MISs and this can be run even on PC XTs. For running the limited module, no special application software is required and executable files can be directly run on the DOS platform.

TRACK GEOMETRY INDEX (TGI)

1.0 A standard deviation based track recording index, called Track Geometry Index (TGI) has been evolved by RDSO and approved by the Board for phased adoption on the routes where recording is done by micro-processor based TRCs. The formula is as under :

$$TGI = \frac{2UI + TI + GI + 6\,AI}{10}$$

where

UI (Unevenness Index) = $100e^{-(SDUM-SDUR)\,/\,(SDUUR-SDUR)}$

TI (Twist Index) = $100e^{-(SDTM-SDTR)\,/\,(SDTUR-SDTR)}$

GI (Gauge Index) = $100e^{-(SDGM-SDGR)\,/\,(SDGUR-SDGR)}$

AI (Alignment Index) = $100e^{-(SDAM-SDAR)\,/\,(SDAUR-SDAR)}$

TGI will be calculated for a block of 200 m length of track and the measured values of SD of different parameters will be for the block.

$SDU_M = (SDU_{2L}+SDU_{2R})/2$

SDU_{2L} = Measured value of SD of Unevenness of left rail at 9.6 m chord

SDU_{2R} = Measured value of SD of Unevenness of right rail at 9.6 m chord

SDT_M = Measured value of SD of twist at base of 3.6 m

SDG_m = Measured value of SD of gauge

$SDA_M = (SDA_{IL}+SDA_{IR})/2$

SDA_{IL} = Measured value of SD of alignment of left rail at 7.2 m chord

SDA_{IR} = Measured value of SD of alignment of right rail at 7.2 m chord

SDU_{UR} = SD prescribed for maintenance for unevenness at 9.6 m chord = 6.20

SDU_R = SD prescribed for newly laid track for unevenness at 9.6 m chord = 2.50

SDT_{UR} = SD prescribed for maintenance for twist at base of 3.6 m = 3.80

SDT_R = SD prescribed for newly laid track for twist at base of 3.6 m = 1.75

SDG_{UR} = SD prescribed for maintenance for gauge = 3.60

SDG_R = SD prescribed for newly laid track for gauge = 1.0

SDA_{UR} = SD prescribed for maintenance for alignment at 7.2 m chord = 3.0

SDA_R = SD prescribed for newly laid track for alignment at 7.2 m chord = 1.50

SD values for maintenance and planning for maintenance for routes having more than 105 km/h max. speed, and for routes having 105 km/h and less max. speed shall be as under :

Parameter	Routes having more than 105 km/h max. speed		Routes having 105 km/h and less max. speed	
	S.D. values for Maintenance	S.D. values for planning for maintenance	S.D. values for Maintenance	S.D. values for planning for maintenance
Unevenness (on 9.6 m chord)	6.2	5.5	7.2	6.5
Twist (3.6 m Base)	3.8	3.4	4.2	3.8
Gauge	3.6	2.9	3.6	2.9
Alignment (7.2 m chord)	3.0	2.8	3.0	2.8

$$\text{TGI for KM} = \frac{\text{Sum of TGI of all the blocks in the Km}}{\text{No. of blocks in the KM}}$$

1.2 The track recording cars will continue to report 8/10 worst peak locations for each parameter both long and short chords and these isolated locations will have to be attended irrespective of fact that the value of different indices is above 45.

1.3 For those routes on which micro-processor based track recording cars are not running, follow revised CTR formula which was recommended by 66th TSC would be adopted.

$CTR = 100 – (U_B+G_B+T_B+0.5\ AL_B) — 0.25\ (U_A+G_A+T_A)$

where UA, GA and TA are the number of peaks exceeding A category limits but less than B category for unevenness, gauge and twist parameters.

UB, GB, TB and ALB are the number of peaks exceeding B category limits for uneven gauge, twist and alignment parameters.

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BRIDGES AND STRUCTURES
Contents

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Precast RCC slabs

Clear Span (m)	Drawing number	Overall length (mm)	Overall depth at centre (mm)	No. of units	Weight of each unit (t)
0.610	RDSO/B-1598 (M-25)	1210	265	2	2.2
0.915	RDSO/B-1598 (M-25)	1515	285	2	3.0
1.220	RDSO/B-1598 (M-25)	1970	310	2	4.1
1.830	RDSO/B-1598 (M-25)	3290	370	2	8.1
0.610	RDSO/B-1599 (M-30)	1210	245	2	2.1
0.915	RDSO/B-1599 (M-30)	1515	265	2	2.8
1.220	RDSO/B-1599 (M-30)	1970	290	2	3.9
1.830	RDSO/B-1599 (M-30)	2580	320	2	5.6
2.440	RDSO/B-1599 (M-30)	3290	345	2	7.6

Precast RCC MG slabs suitable for BG on gauge conversion with insertion of additional unit 'Y'

Clear Span (m)	Drawing number	Overall length (mm)	Overall depth at centre (mm)	No. of units	Weight of each unit (t)
0.610	RDSO/B-1600,1600/1(M25)	1210	265	2	Slab 'X' = 2.0
				1	Slab 'Y' = 0.6
0.610	RDSO/B-1600, 1600/1 (M30)	1210	245	2	Slab 'X' = 1.8
				1	Slab 'Y' = 0.5
0.915	RDSO/B-1600, 1600/2 (M25)	1515	285	2	Slab 'X' = 2.6
				1	Slab 'Y' = 0.8
0.915	RDSO/B-1600,1600/2 (M30)	1515	265	2	Slab 'X' = 2.5
				1	Slab 'Y' = 0.7
1.220	RDSO/B-1600, 1600/3 (M25)	1970	310	2	Slab 'X' =3.7
				1	Slab 'Y" = 1.1
1.220	RDSO/B-1600, 1600/3(M 30)	1970	290	2	Slab 'X' = 3.5
				1	Slab 'Y' = 1.0
1.830	RDSO/B-1600, 1600/4 (M25)	2580	345	2	Slab 'X' = 5.3
				1	Slab 'Y' = 1.6
1.830	RDSO/B-1600, 1600/4 (M30)	2580	320	2	Slab 'X' = 4.9
				1	Slab 'Y' = 1.4
2.440	RDSO/B-1600, 1600/5 (M 25)	3290	370	2	Slab 'X' = 7.1
				1	Slab 'Y' = 2.1
2.440	RDSO/B-1600, 1600/5 (M 30)	3290	345	2	Slab 'X' = 6.7
				1	Slab 'Y' = 2.0

BG Standard Open Web Girders

Clear Span (m)	Drawing number	Height (m)	Width (m)	Weight (t)	Remarks
30.5	BA-11341-57 (Riveted)	7.315	5.18	61.49	
	BA-11401-13 (Underslung)	4.60	2.30	43.9	
	BA-11461-79 (Welded)	7.315	5.28	55.00	
45.7	BA-11361-77 (Riveted)	7.315	5.18	111.45	
	BA-11481-99 (Welded)	7.315	5.28	99.61	
61.0	BA-11321-38 (Riveted)	9.00	5.50	17.60	
	BA-11581-98 (Welded)	10.50	5.50	290.56	
76.2	BA-11151-68 RDSO/B-1524 (Riveted)	10.50	5.50	290.56	
	BA-11601-19 (Welded)	10.50	5.50	260.56	

Modification to MGML girder for BG loading

Clear span (m)	Drawing number	Height (m)	Width (m)	Weight (t)
30.5	RDSO/B-1651-67	7.315	5.18	60.11
45.7	RDSO/B-1671-87	6.858	5.18	114.26
45.7	RDSO/B-1702-18	6.858	5.18	103.67

MG standard open web girders

Clear span (m)	Drawing number	Height (m)	Width (m)	Weight (t)
30.5	BA-11421-37	6.50	4.68	46.57
305	BA-11251-64 underslung	4.60	2.00	35.16
45.7	BA-11301-17	6.86	4.675	91.12
61.0	BA-11441-58	8.55	5.10	141.17

Height = Distance between CGs of bottom chord and top chord.
Width = Distance centre to centre of bottom chords

BG standard welded plate girders (with riveted stiffeners)

Clear Span (m)	Drawing no.	Area of painting (m^2)	Overall length (mm)	Overall depth at centre (mm)	Weight including bearing (t)
12.2	RDSO/B-1528	142	13300	1284	8.28
18.3	RDSO/B-1529	300	19670	1840	17.16
24.4	RDSO/B-1555	470	26050	2052	35.9

Steel Channel Sleeper

S. No.	Description	Drawing No
1.	Steel channel sleeper for Bridges (BG&MG) (suitable for all standard span of OWG and plate girders)	BA-1636/R2
2.	Steel channel sleeper for Bridges-seating arrangement and arrangement for fixing gangway	BA -1636/1/R2
3.	Steel channel sleeper, 175 mm height to avoid thicker packing plates on Plate Girder Bridges	BA -1636/2
4.	Steel channel sleeper for 30.5 m U/S girder	RDSO/B-1739
5.	Steel channel sleeper suitable for gauge conversion	RDSO/B-1745
6.	Steel channel sleepers for bridges (NG)	RDSO/B-1636/3
7.	Steel H-beam sleepers for bridges (BG)	RDSO/B-1636/4,5

PSC Slab Ballasted Deck

BR = Ballast Retainer S = Slab

Clear span (m)	Drawing number	Overall length (mm)	Overall depth at centre (mm)	No. of units	Weight per unit (t)	Remarks
MBG loading						
3.05	BA-10235	3900	350	BR-2 S-2	3.13 5.66	-
3.66	BA-10236	4550	410	BR-2 S-2	4.045 7.73	-
4.57	BA-10237	5520	490	BR-2 S-2	5.4 11.3	-
6.1	BA-10221/R	7150	560	BR S	6.8 16.8	-
3.66	BA-10228	450	325	2	8.85	For MG loading suitable to to BG conversion
4.57	BA-10228	5520	395	2	12.5	
6.10	BA-10228	7150	495	2	19.68	
6.1	BA-10239	7150	530	BR-2 S-3	5.462 9.760	
9.15	BA-10240	10280	760	BR-2 S-3	9.894 20.802	Pre-tensioned
9.15	BA-10241	10280	780	BR-2 S-2	9.894 31.588	Post Tensioned
12.2	RDSO/B-10248/R	13380	1100	BR-2 S-4	20.510 29.80	-

HM loading

6.1	BA-10238	7150	600	BR-2 S-3	5.462 11.930	Pre-tensioned
3.05	BA-10249	3900	450	BR-2 S-2	3.182 7.198	Pre-tensioned
3.66	BA-10250	4550	500	BR-2 S-2	4.193 9.451	Pre-tensioned
4.57	BA-10251	5520	600	BR-2 S-2	5.086 1.4029	Pre-tensioned
12.2	RDSO/B-10255	13380	1170	BR-2 S-4	20.120 30.982	Post tensioned

BG precast RC ballastless slabs

Clear Span (m)	Drawing number	Overall length (mm)	Overall depth at centre (mm)	No. of units	Weight of each unit (t)
0.61	BA-10053 (M-25)	1220	300	2	2.5
0.915	BA-10054 (M -25)	1525	300	2	3.4
1.220	BA-10055 (M-25)	1830	300	2	4.4
1.830	BA-10056 (M-25)	2440	300	2	6.2
2.44	BA-10057 (M-25)	3300	325	1	10.2
3.05	BA-10058 (M-25)	3950	375	1	14.1

BG PSC Girders

Clear Span (m)	Drawing No.	Overall length (mm)	Overall depth at centre (mm)	No. of units	Weight per unit (t)	Remarks
MBG loading (Post Tensioned)						
12.2	BA-10223	13360	1670	2 I-Girder	24.86	All girders are having ballasted deck
18.3	BA-10227	19400	2440	-do-	56.38	
30.5	BA-10222	31900	2300	1 Box	399.63	
12.2	B-1533	13350	1060	4 Box	21.64	
45.1	BA-10232	48090	3480	1 Box	657.0	
18.3	B-1519	19650	1600	4 Box	35.60	
30.5	B-10242	31976	2500	1 Box	416	
12.2	B-10246	13360	1450	2I-Girder	20.625	
12.2	B-10244R	12200	1150	4I(RH) Girder	20.23	
18.3	B-10245R	18600	1500	4I(RH) Girder	52.62	
18.3	BA-10247	18600	1850	2I Girder	54.528	
12.2	B-10254 (A) C/C 14.11M	12910	1450	2I Girder	19.969	
12.2	B-10254 C/C-13.4 M	12200	1450	2I Girder	20.25	
24.4	BA-10243	25200	2150	1 Box	259.200	
12.2	B-1752	13350	1230	3T Girder	110.992	
29.87	B-1732	31320	2328	1 Box Girder	297.95	Ballast Less
HM Loading (Post Tensioned)						
18.3	BA-10233	19760	2700	2I Girder	67.88	
12.2	BA-10234	13360	2000	2I Girder	30.82	

BG standard welded composite girders

Clear span (m)	Drawing number	Area of painting (m^2)	Overall length (mm)	Overall depth at centres (mm)	Weight including bearing (t)
9.15	RDSO/B-1623	68.0	10200	666	8.54
12.2	RDSO/B-1569/R	136.0	13300	1142	11.37
18.3	RDSO/B-1534/R	237.0	19650	1430	24.05
20.0	RDSO/B-1581/R	286.0	21450	1680	26.90
24.4	RDSO/B-1730	388.0	26050	1902	43.92

Open Web Girders (H.M. Loading)

Clear span (m)	Drawing number	Height (m)	Width (m)	Weight (t)	Remarks
45.7	BA-11501-18 (welded)	7.60	5.40	116.47	
30.5	BA-11521-38 BA-11572	7.315	5.28	63.0	
61.0	BA-11551-68	9.00	5.50	222.93	
76.2	BA-11621-39	10.5	5.50	323.40	

Details of Painting Area for plate Girder of HM Loading

Clear Span (m)	**RDSO's Drawing No.**	**Overall length (mm)**	**Over all depth at centre (mm)**	**Total weight (t) including bearing**	**Area of Painting (sq. m)**
12.2	BA/16007	13300	1456	10.731	162.21
18.3	BA/16008	19670	1880	28.122	314.3
24.4	BA/16006	26050	2276	58.47	502.61

Abutment Profile - Mass Concrete M-20 for MBG loading - 87

S.No.	Span (m)	Type of Superstructure	Drawing No.
1.	6.10	Plate Girder PSC Deck Slab	RDSO/B-1689
2.	9.15	Plate Girder Composite Girder	RDSO/B-1690
3.	12.2	Plate Girder Composite Girder PSC Girder	RDSO/B-1691
4.	18.3	Plate Girder Composite Girder PSC Girder	RDSO/B-1692
5.	24.4	Plate Girder PSC Girder	RDSO/B-1693
6.	30.5	Plate Girder PSC Girder	RDSO//B-1694
7.	30.5	Open Web Girder Underslung Girder	RDSO/B-1736
8.	45.7	Open Web Girder	RDSO/B-1736
9.	61.0	Open Web Girder	RDSO/B-1737
10.	76.2	Open Web Girder	RDSO/B-1737

Pier Profile of Mass Concrete M-20 for MBG loading - 87

S.No.	Span (m)	Type of Superstructure	Drawing No.
1.	6.1	Plate Girder Prcast PSC Slab	RDSO/B-1695
2.	9.15	Plate Girder Composite Girder	RDSO/B-1695
3.	12.2	Plat Girder Composite Girder PSC Girder	RDSO/B-1696
4.	18.3	Plate Girder Composite Girder PSC Girder	RDSO/B-1697
5.	24.4	Plate Girder Composite Girder PSC Girder	RDSO/B-1698
6.	30.5	Plate Girder PSC Girder	RDSO/B-1698
7.	30.5	Open Web Girder Underslung Girder	RDSO/B-1733
8.	45.7	Open Web Girder	RDSO/B-1734
9.	61.0	Open Web Girder	RDSO/B-1734
10.	76.2	Open Web Girder	RDSO/B-1735

Pier Profile of Mass Concrete (M-15)-MGML

S. No.	Span	Type of Superstructure for which Pier Profile has been developed with M-15 Grade of Mass Concrete conforming to MGMOL Loading-1929	Drawing No.
1.	6.10 m	Plate Girder PSC Slab	RDSO/B-1610
2.	9.15 m	Plate Girder	RDSO/B-1611
3.	12.2 m	Plate Girder Composite Girder	RDSO/B-1612
4.	18.3 m	Plate Girder	RDSO/B-1613
5.	24.4 m	Plate Girder	RDSO/B-1614
6.	30.5 m	Plate Girder	RDSO/B-1615

Revised Passenger Platform Shelters (B.G.)

S. N.	Description	Steel Requirement Kg/m^2	Drawing No.	Remarks
1.	Revised Passenger Platform shelters of 10.67 m width as per current I.S. 875 suitable for all location except coastal regions	31.25	RA-10631 to 10638	21% economical over old drawings which required 39.64 kg/m^2 of steel
2.	Low level Passenger platform shelters suitable for wayside station using RHS/SHS.	20.00	RDSO/B-1758 and 1758/1	Width 4 m, span 5.5 m
3.	Low level Passenger platform shelter suitable for wayside station using hollow circular tubes.	18.18	RDSO/B-1760 and 1760/1	Width 4 m, span 5.5 m

DOs AND DON'Ts FOR CONCRETING

1. Handling and storage of cement

DOs	DON'Ts
1. Check weight of cement bags periodically.	1. Do not use more than six months old cement unless retested with successful results.
2. Stack different types and grades of cement separately in water-tight sheds.	2. Do not exceed 7 bags stack height if storage period is likely to exceed two months. However, never exceed 12 bags stack heights.
3. Use placards displaying type, grade, name of manufacturer, date of arrival at different cement stacks.	3. Do not store cement in newly constructed warehouse unless interior is thoroughly dried.
4. Restack cement if stored for more than six months. Use cement on "first in first out" basis.	4. Do not use set cement.
5. Stack cement bags close together to restrict circulation of air.	
6. Keep stack minimum 500 mm clear of wall.	
7. Stack bags on pallets or on dry board platform minimum 150 mm clear of the ground.	
8. Enclose the stack completely in polythene (700 gauge) sheets in monsoon.	
9. For temporary storage at site, keep only one week's consumption with adequate precautions in monsoon.	

2. Aggregates (fine and coarse)

DOs	DON'Ts
1. Stack aggregates in bins with dividers., Use distinct stacks or baffle dividers.	1. Do not mix different types of aggregates.
2. Provide adequate slope in bin bottom to allow effective drainage.	2. Do not make conical heaps.
3. Plan out storage of aggregates, placing of mixer etc. for convenience in mixing and leading of concrete.	3. Do not use bottom 300 mm layer of fine aggregate without ascertaining moisture content.
4. Explain implication of existence of water in aggregates to workers.	4. Do not exceed height of stack more than that resulting from one lorry load.
5. Wash the aggregates before use in case they contain dirt/clay or organic matter.	

3. Reinforcing steel

DOs	DON'Ts
1. Ensure effective drainage of stacking site.	1. Do not stack steel on unlevelled ground.
2. Prevent distortion, deterioration and corrosion.	2. Do not allow water to accumulate near steel.
3. Provide anti-corrosive treatment in conformity with procedure laid down by CECRI, Karaikudi while working in corrosive environment.	3. Do not keep grease, oil, paint near steel to avoid even occasional contact.
4. Stack bars clear of ground, preferably under cover.	4. Do not use bars with mud and dirt sticking to them.
5. Stack prestressing steel in water proof sheds, protect it against ground dampness & preferably keep anti-rust powder in shed.	
6. Test prestressing steel stored for long time before use.	

4. Forms/shuttering

DOs	DON'Ts
1. Form work should be strong enough so as not to deform under weight of concrete or force of vibration.	1. Do not use Black oil as form release agent.
2. Ensure even surface of form work.	2. Do not use polythene sheets to make form work watertight as these sheets cause wrinkles on concrete surface.
3. Wet the form surface immediately before placing concrete so that water from concrete is not absorbed by the form work.	3. Avoid jerks while removing form work.
4. Use form release agents of good quality before placing the reinforcement.	
5. Provide adequate base supports and diagonal/lateral bracing. Use wedges which help in de-shuttering. All wedges to be held in position with nails.	
6. Take hot weather concreting precautions when working above 40°C ambient temperature and high winds. Normally, no placement of concrete be done if ambient temperature is more than 40°C.	
7. Seal joints in forms to prevent leakage of cement slurry.	
8. Design the form work in such a way that these can be reused. This will save time and cost.	
9. Observe stripping time of form work as given in IS : 456. (Clause 10.3)/ relevant specification	

5. Assembly of reinforcement

DOs	DON'Ts
1. Use full scale drawings for difficult locations before cutting bars.	1. Do not store steel in contact with grass/ground leading to corrosion.
2. Use correct placement methods. Use chairs & cement mortar/synthetic cover blocks.	2. Do not use stone chips or similar pieces to maintain cover during concreting.
3. Reduce wastage to minimum by planning cut-lengths	3. Do not use steel after prolonged storage without cleaning and applying anti-corrosive coating.
4. Store all cut-lengths at raised level having proper drainage.	
5. Join bars securely at crossings with soft iron wires of 18/20 SWG or by spot welding.	
6. Do detailing of overlaps and intersections in advance.	

6. Mixing of concrete

DOs	DON'Ts
1. Proportion the aggregates either by weight or in steel boxes if by volume.	1. Do not allow hand mixing even for small jobs.
2. Always use concrete mixers. For very small jobs, manually operated mixers should be used.	2. Do not mix the left out concrete, in which initial set has started, with the fresh concrete.
3. Put cement in between aggregate layers in mixer hopper to avoid flying off of cement.	3. Do not add excess water to make mix workable, as it would result in porous concrete.
4. Ensure correct mixing time depending upon type of mixer (normally 90 to 120 seconds).	
5. Maintain correct gap between drum and blade for efficiency of mixer.	
6. After mixing, concrete should have uniform consistency (By pressing & throwing up in hands it should be possible to roll it in balls).	
7. Use only clean water, free from materials such as silt, clay, organic matters, acids, alkalis and chemical salts etc. Water "good enough for drinking" is generally suitable for concrete.	
8. Use appropriate brand of chloride free plasticisers for proper workability in thin/narrow section.	

7. Placing and compaction

DOs	DON'Ts
1. Place concrete in position before initial set occurs i.e. normally within about 30 minutes of mixing.	1. Do not allow concrete to fall more than 1.5 m in open to avoid segregation.
2. Place concrete in position gently rather than throwing it.	2. Do not allow more than 30 cm thick layer of concrete to avoid formation of cold joint or improper consolidation.
3. In deep falls of 1.5-2.0, ensure that the concrete falls on soft bed of mortar or wet concrete. Use chutes if placed from more than 1.5 m height.	3. Do not distribute heaped concrete with vibrator.
4. Avoid cold joints. If joint is unavoidable, treat it to obtain good adhesion. Place fresh layer before the previous layer has hardened.	4. Do not disturb reinforcement and cover blocks by walking/moving/vibrations.
5. Provide walkway away from reinforcement.	5. Do not leave concrete unvirbrated or under vibrated.
6. Use vibrator for compaction of concrete.	6. Avoid over vibration.
7. Select vibrator needle according to aggregate size, reinforcement spacing, etc.	7. Do not place concrete during rains unless proper cover is provided.

8. Finishing

DOs	DON'Ts
1. Carry out concrete finishing with worked up slurry. Do not use mortar.	1. Do not spray dry mortar or dry cement for finishing.
2. Use back forms, if necessary, or adjust water/cement ratio to get stiffer mix in slope, with repeated working.	

Contd.

3. Use vacuum dewatering techniques for floors in workshops/ platforms, etc, to achieve hard wear resistant surface. Use power trowell for levelling.	
4. Use concrete mix of such consistency which gives float of mix rather than flowing slurry.	

9. Curing

DOs	DON'Ts
1. Explain the importance of curing to workers.	1. Never resort to alternate wetting and drying. It adversely affects concrete strength.
2. Ensure 100% humidity around concrete for at least 7 days to prevent evaporation of water from concrete.	2. Do not use leaky forms which will lead to loss of water from concrete.
3. Keep concrete surface covered by absorbent materials and spray water at regular intervals.	3. Do not wait for 24 hours final set in hot weather. Start spraying water when concrete becomes so hard that thumb impression is not marked.
4. Use potable water for curing.	4. Do not neglect curing. It is better to over-cure than to under-cure. Under-curing results in loss of strength which cannot be improved.
5. Do water flooding on flat surfaces.	
6. At isolated locations or where there is shortage of water, use curing compound of approved quality.	

10. Testing of concrete

DOs	DON'Ts
1. Use cube moulds of correct dimensions and finishing.	1. Do not make concrete specially for cubes. Take samples at random from concreting site.
2. Monitor date of testing religiously.	2. Do not cure cubes more than parent concrete laid at site to get reliable result.
3. Cure test samples along with parent concrete.	
4. Make adequate number of cubes for intermediate result and for stripping of forms etc.	
5. Make at least 3 cubes for testing at each stage and not just one or two.	
6. Make concrete cubes by taking samples from concrete, being used in the work, at random covering entire concreting.	
7. Calibrate testing machines periodically to avoid erroneous results. Rate of loading for cube testing should be 40 ton per minute.	

New building materials

With the technological advancement large number of new building materials are available in the market. Some of these products are technically superior, cost effective and meet functional requirement better. These products must, therefore, replace the conventional materials. Most of these products are covered by Indian Standards. A number of evaluation reports made by RDSO on new materials have been circulated by Railway Board to Zonal Railways, brief details of which are given below :

	New material/ method	Conventional materials/method	IS specification	Main advantages	Economy	Railway Board endorsement number	RDSO report/ Reference
	1	2	3	4	5	6	7
1.	UPVC pipes	GI, CI, AC, pipes	IS: 4985, 7634	Light weight, corrosion free, smooth flow	30 to 40% cheaper	NO. 90/EDCE (G) Misc/11 dated 11.4.91 and 17.6.91	CBS/BMC/1
2.	RMP roofing	GI, AC sheet	–	Light weight, suitable for temporary accommodation	40% costlier than AC sheet	No. 90/EDCE (G) Misc./11 dated 11.4.91	CBS/BMC/2
3.	PVC doors and windows	Wood	–	Suitable for interior location, bathroom kitchen, etc.	Comparable with teak wood	No. 90/EDCE (G) Misc./11 dated 11.4.91	CBS/BMC/3
4.	UPVC pipe fittings	GI, CI, AC fittings	IS : 7834 10124	Light weight, corrosion free	30 to 40% cheaper	No. 90/EDCE (g) Misc/11 dated 17.4.91	CBS/BMC/4
5.	Moulded polyethylene water tanks	Brick, pressed steel, concrete	IS: 12701	Quick installation maintenance free, light weight	Costlier but suitable for small capacity,	No.90/EDCE (G) Misc./11 dated 17.6.91	CBS/BMC/5

	1	2	3	4	5	6	7
6.	FRP water tank	Brick, pressed steel, concrete	—	Slightly better than moulded polyethylene, colour choice available	Costlier but suitable for small capacity	No. 90/EDCE(G) Misc/11 dated 19.12.91	CBS/BMC/7
7.	Hollow block masonry	Brick masonry	IS: 2185, 2572, 6042	Most suitable where good quality brick not available and for hilly regions	12% cheaper	No. 90/EDCE (G) Misc/11 dated 26.12.91	CBS/BMC/8
8.	Hand operated concrete block making machine	Hand moulded	—	Quality control better in small scale production of hollow concrete block	—	No. 90/EDCE (G) Misc/11 dated 19.12.91	CBS/BMC/9
9.	Hand operated concrete mixers	Hand mixing	—	Better quality control in small concreting jobs	Labour saving of 26.5%	No. 90EDCE (G) Misc/11 dated 19.12.91	CBS/BMC/10
10.	Hollow block for roofing, flooring	RCC beam and slab system	IS:6061	Saving in cement and steel, quick construction	Overall 10% with saving in steel 30%	No. 90/EDCE (G) Misc/11 dated 20.12.91	CBS/BMC/11
11.	Vacuum dewatered Industrial flooring	Granolithic cement concrete with hardener bitumenmastic	—	Cheaper than other technique, suitable for workshop, platform and parcel godown	20 to 70% cheapr than conventional	—	CBS/BMC/17
12.	PTMT bathroom fittings	CP, MS, brass	—	Scrap value 'Nil' hence to theft, Suitable for public places and residences	70 to 80%	—	CBS/BMC/18

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	1	2	3	4	5	6	7
13	Economy in water supply network	GI, CI, AC pipes and fittings brick, pressed steel RCC water tanks	IS:4985 7634, 7834, 10124, 12701	Consolidated report on various alternative materials for water supply network	Pipes and fittings of new material are 30 to 40% cheaper	—	RBF/BMC/19
14.	Quality control in concreting	—	—	Quality concrete guidelines	It covers guidelines for quality control of concrete. Guidelines have been framed to suit the requirement of field staff.	—	RBF/BMC/20
15.	Functional aspects of buildings and structures	—	—	Consolidated instructions issued by Railway Board on the subject	Cost effective	—	RBF/BMC/21
16.	Guidelines on use of admixtures in concrete	—	IS:9103	Various admixtures for desired end results have been detailed in the report	—	—	RBF/BMC/22
17.	Guidelines on use of curing compounds for concrete	Water curing even in special situation	—	Specially suitable in remote areas where water is not easily available for curing of concrete	—	—	RBF/BMC/23

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1		2	3	4	5	6	7
18.	Concrete repairs compounds	Ordinary cement-concrete	—	Bond aids for bonding old and new concrete surfaces, various compounds for quick repair, under water repair, etc have been detailed in the report	—	—	RBF/BMC/24
19.	Substitutes of wood for doors and windows	Natural Wood	—	Various products and their suitability for different locations has been discussed in detail	—	No 90/EDCE (G) Misc/11 dt 17.9.93	RBF/BMC/25
20.	S.M.C. Panel tank	Concrete and Steel tank	—	Quick and easy installation in emergency. Suitable for replacement of wornout steel tanks	—	—	RBF/BMC/26

IMPORTANT TERMS USED FOR RIVER TRAINING WORKS AND BRIDGES

1. **AFFLUX** (h) is the rise in water level upstream of a bridge as a result of obstruction to natural flow caused by the construction of the bridge and its approaches. Affux is to be taken into consideration while providing for "free board" and "clearance".
2. **CAUSE WAY** or Irish bridge is a dip in the railway track which allows foods to pass over it.
3. **CLEARANCE (C)** is the vertical distance between the water level of the design discharge (Q) including affux and the point on the bridge superstructure where the clearance is required to be measured.
4. **DEPTH OF SCOUR (D)** is the depth of the eroded bed of the river, measured from the water level for the discharge considered.
5. **DESIGN DISCHARGE (Q)** is the estimated discharge for the design of the bridge and its appurtenances. Generally 50 years return period is considered for estimation of design discharge.
6. **DESIGN DISCHARGE FOR FOUNDATION (Qf)** is the estimated discharge for design of foundations and training/protection work which is higher than design discharge by certain percentage depending on catchment area.
7. **FREE BOARD (F)** is the vertical distance between the water level corresponding to the design discharge (Q) including afflux and the formation level of the approach banks or the top level of guide banks. Free board of the at least 1.0 m should be provided while constructing a bridge.
8. **FULL SUPPLY LEVEL (FSL)** in the case of canals, is the water level corresponding to the full supply as designed by canal authorities.
9. **HIGHEST FLOOD LEVEL (HFL)** is the highest water level known to have occurred.
10. **LOW WATER LEVEL (LWL)** is the water level generally obtained during dry weather.
11. **IMPORTANT BRIDGES** are those having a lineal waterway of 300

m or a total waterway of 1000 sq m or more and those classified as important by the Chief Engineer/Chief Bridge Engineer, depending on considerations such as depth of waterway, extent of river training works and maintenance problems.

12. **MAJOR BRIDGES** are those which have either a total waterway of 18 m or more or which have a clear opening of 12 m or more in one span.
13. **PROTECTION WORKS** are works to protect the bridge and its approaches from damage by flood water such as marginal bund, launching aprons, etc.
14. **TRAINING WORKS** are works designed to guide the flow of a river such as guide bund, spurs, etc.
15. **GUIDE BUNDS** are meant to confine and guide the river flow through the structure without causing damage to it and its approaches. They also prevent out flanking of the structure. According to the form in plan they may be parallel or divergent or convergent and according to geometrical shape they may be straight or elliptical.
16. **SPURS OR GROYNES** : These are structures projecting outward from the bank into a stream for the purpose of protecting the bank from erosion, arresting sand movement along the bank, concentrating flow of a stream into a smaller channel. They also help to train the river along the desired course.
17. **HYDROGRAPH :** A graph showing discharge of water-flow past a section with respect to time is known as hydrograph.
18. **UNIT HYDROGRAPH :** The unit hydrograph of a drainage basin is defined as a hydrograph of direct surface run off resulting from 1 cm of effective rainfall generated uniformly over the basin area at a uniform rate through a specified duration known as unit period (generally 1 hour).
19. **SYNTHETIC UNIT HYDROGRAPH :** It is unit hydrograph derived for a catchment based on correlations that have already been developed between important parameters of representative unit hydrographs (RUH) and relevant catchment characteristics by gauging adequate number of

sites from a homogeneous region.

20. **REPRESENTATIVE UNIT HYDROGRAPHS :** The average of all available unit hydrographs capable of reproducing the flood hydrographs when applied to corresponding effective rainfall.
21. **LACEY'S FORMULAE FOR ALLUVIAL RIVERS :** If 'W' and 'D' are respectively the width and depth of flow in metres :

    $W = 4.835\ (Q)^{1/2}$

    $D = 0.473\ (Q/f)^{1/3}$

    or

    $1.338\ (q^2/f)^{1/3}$

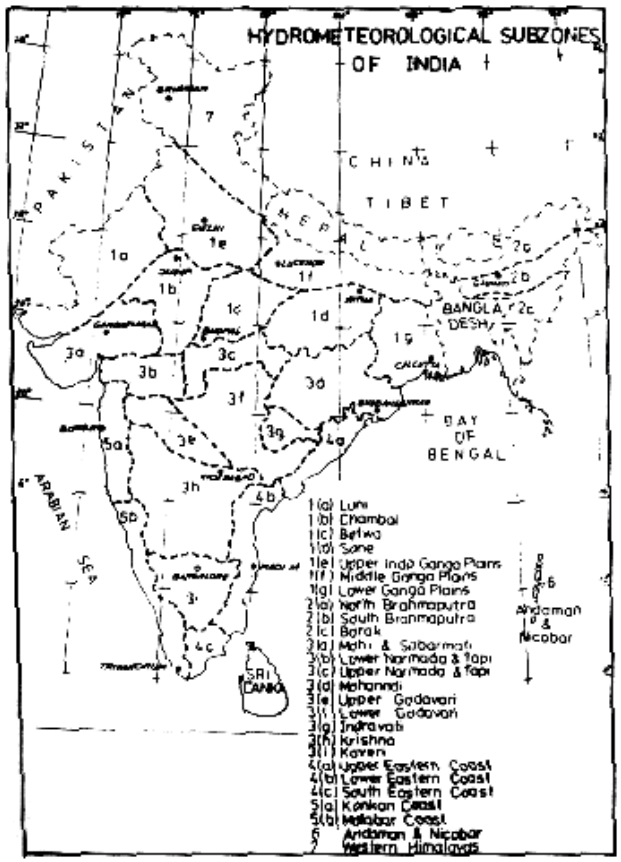
    Where 'Q' is the discharge in m^3/s, 'q' is the discharge intensity in m^3/s per metre width, 'f' is the silt factor which is $1.76\ (m)^{0.5}$ and 'm' being the weighted mean diameter of bed material in mm. Though these are empirical formulae arrived at by Lacey based on his observations on some of the alluvial rivers, these are very important in the design of water way and protection works of the bridges.
22. **Scour** : Estimation of scour depth is an important aspect of design of protection works and bridge foundation. Lacey's formula for calculation of depth of flow 'D' is employed for calculation of scour depth at bridge piers or along guide bund adopting suitable multiplying factor. According to IR Substructure Code, the depth of scour is taken as follows :

Nature of the river	**Depth of sour**
* Straight reach	1.25 D
* Moderate bend condition e.g. along apron of Gide bund	1.50 D
* At a severe bend	1.75 D
* At a right angle bend or at the nose of pier	2.0 D
* Against mole head of guide bund and in severe swirls	2.5 to 2.75 D

SUB–ZONAL FLOOD ESTIMATION REPORTS

On hydrometeorlogical homogeneity the country has been divided into 26 sub–zones (7 zones) as shown in Figure. Sub-zonal flood estimation reports valid for 25 sq km to 5000 sq km catchment area are based on synthetic unit hydrograph approach. Applicability of various reports for different zonal railways and river basins can be referred from table given below. Estimation of design discharge should be done based on methodology given in these sub–zonal reports.

Sub–zone	*Railway zones*	*River basin*	*CWC report number*
1 (a)	Western, Northern	Luni	L/20/1992
1 (b)	Central, Western	Chambal	C/16/1998
1 (c)	South Eastern, Eastern, Central	Betwa	B/17/1989
1 (d)	South Eastern, Eastern, Central	Sone	S/15/1987
1 (e)	Northern, North Eastern, western, Central	Upper Indo-Ganga Plains	UGP/9/1984
1 (f)	Northern, North Eastern Central	Middle Ganga Plains	GP/10/1984
1 (g)	South Eastern, Eastern	Lower Gangetic Plains	EG-1(g)/R-1/94
2 (a)	Northern Frontier	North Brahamputra	NB/18/1991
2 (b)	-do-	South Brahmaputra	SB/8/1984
3 (a)	Western	Mahi & Sabarmati	M5/13/1986
3 (b)	Central, Western	Lower Narmada & Tapi	LNT/4/1981
3 (c)	Central, South Central, South Eastern	Upper Narmada & Tapi	UNT/7/1983
3 (d)	South Eastern	Mahanadi	M/5/1981
3 (e)	Central	Upper Godavari	CB/12/1985
3 (f)	Central, South Eastern, South Central	Lower Godavari	LG-3 (f)/R-24/95
3 (g)	South Eastern	Indravati	I-21/1992
3 (h)	Central, Southern, South Central	Krishna Penner	K/6/1982
3 (i)	Southern	Kaveri	CB/11/1985
4 (a,b,c)	Southern, South Central, South Eastern	Eastern Coast 1986	EC/U, L&S/14
5 (a,b)	Western, Central, South Central Southern	Western Coast	K&M/19/1992
7.	Northern, North Eastern	Western Himalayas	WH/22/1994



Numerical rating system for inspection of Railway bridges

1. **Numerical rating system (NRS)**

1.1 The numerical rating system is essentially a method which gives by means of a single figure code, a quick appreciation of the physical condition of the bridge. The system would be supplemental to the existing method of recording the condition of bridge in a narrative manner in the bridge inspection registers. The main emphasis has been to ensure that the proposed system involves minimum additional work and yet gives the desired information for managerial decisions.

1.2 The system was discussed by the Bridge and Structures Standards Committee in its 66th meeting and the following recommendations were made:-

(i) Numerical rating system for inspection of brides as proposed by the sub-committee should be adopted by the Railways. This shall be in addition to existing specified inspection.

(ii) IRICEN should conduct short duration courses for AENs in which at least one AEN from each division should be trained about NRS and competency certificate issued to successful trainees.

1.3 The above recommendations of BSC were approved by the Railway Board vide letter No. 90/CE-I/BR-I/BR-1/20 dt. 19.9.1990.

2. **Condition rating number (CRN)**

2.1 A condition rating number is recorded for each of the bridge components in the bridge inspection register in the concerned column/SPACE. The CRNs have numerical values from 0 to 6. The 0 digit indicates that the component was not inspected whereas the numbers from 1 to 6 indicate the severity of deterioration in the physical condition of component in the descending order.

2. The following table gives the CRN and brief description of corresponding condition:

Condition rating number (CRN)	Description
1	A condition which warrants rebuilding/rehabilitation immediately
2	A condition which requires rebuilding/rehabilitation on a programmed basis
3	A condition which requires major/special repairs
4	A condition which requires routine maintenance
5	Sound condition
6	Not applicable
0	Not inspected

2.3 The condition rating attempts only to rate the physical condition of the bridge component. It cannot be used to derive the capacity to carry load.

3. **Overall rating number (ORN)**

In addition to CRN for different bridge components, an overall rating number (ORN) for the bridge as a whole is also proposed, which in general, will be the lowest number except 0, given to the bridge components.

4. **Unique rating number (URN)**

4.1 The physical condition of each major bridge is proposed to be represented by a unique rating number (URN) consisting of eight digits in which the first digit will represent the URN and each of the subsequent digits will represent the CRN of the different bridge components in the following sequence:-

i) Foundation and flooring
ii) Masonry/concrete in substructure
iii) Training and protective works
iv) Bed blocks
v) Bearings and expansion arrangement
vi) Super structure-girder/arch/pipe/slab, etc.
vii) Track structure

4.2 From the URN it will be possible to easily judge the condition or extent of distress (if any) in the bridge components and identify the attention required to be given. As an example, URN 20362544 indicates the followings :

Digit No.	Value	Indication
1	2	One or more components of the bridge require (s) rebuilding /rehabilitation on a programmed basis
2	0	Foundation and flooring were not inspected
3	3	Substructure requires major/special repairs
4	6	Not applicable, i.e. the bridge does not have any training or protective works
5	2	Bed blocks are cracked and shaking
6	5	Bearings and expansion arrangements are in sound condition
7	4	Superstructure requires routine maintenance
8	4	Track structure requires routine maintenance

DOs and DON'Ts in the fabrication of welded bridge girders

DOs :

1. Use only the weldable quality steel conforming to IS : 2062 Gr. B or Gr. C fully killed and fully normalised.
2. Obtain the steel testing certificate (material testing certificate) and check carefully the chemical composition and mechanical properties of steel to ensure that it conforms to IS : 2062 GR. B or C fully killed and fully normalised. In absence of steel testing certificate, get the steel samples analysed chemically and mechanically to ensure that it conforms to IS : 2062 Gr B or C fully killed and fully normalised.
3. Steel received from the rolling mills has generally punched heat mark numbers. These numbers should be legibly marked again with paint for easy identification. Heat mark numbers should be transferred to cut members with paints.
4. Store the steel in a safe place away from atmospheric action to avoid scaling, rusting and pitting, etc. In case of severe atmospheric exposure, apply a layer of rust proof coating to the steel to avoid corrosion before fabrication.
5. The welding electrodes must conform to IRS/M-28 for manual metal are welding, wire-flux must conform to IRS/M-39 and for CO_2 welding the RDSO approved procedure must be followed.
6. Welding consumables are only to be procured from RDSO approved manufacturers whose names and addresses are being periodically issued by M&C Dte of RDSO. The welding consumables should be stored properly and dried before use, as per the manufacturers' instructions as printed on the cartons of the consumables.
7. Before taking up the fabrication of each type of welding joint, the welding procedure specification sheet (WPSS) need be prepared which should be sent to RDSO for approval.
8. After the WPSS's are approved by RDSO, welders nominated for the job are to be got examined and qualified by RDSO according to IS : 7310 (Pt-1) — 1974. The qualified welders shall only be deployed for the welding works. For this, test pieces should be made by the welders according to the approved WPSSs in presence of M& C Inspector of RDSO. If the test pieces are found satisfactory, the welding procedure qualification record (WPQR) is approved and the welder is qualified. After the welder is qualified the fabrication of the girder can be taken up.
9. While fabricating the welded bridge girder, follow the guidelines and fabrication tolerance as laid down in "Code of practice for metal are welding in mild steel bridges carrying rail, rail-cum-road or pedestrian traffic (Welded Bridge Code)", and "Fabrication and erection of steel girder bridge, IRS BI-1979".
10. Maintain the same welding parameters like welding current, voltage, polarity of the electrode, speed and travel of welding heads, etc, as approved in the WPSS for particular type of welding work.
11. Do the welding work in a warm and dry place so that rain water or other atmospheric elements may not come in contact while welding is in progress.
12. While welding in cold weather, pre-heat the material before welding and apply post heating to prevent the weld joint from cooling and developing stress raiser due to sudden contraction.

13. Apply the proper sequence of welding, as mentioned in WPSS to control the distortion of the member to the minimum possible.
14. Use proper fixture and clamps to hold the members firmly at desired location while welding. The clamps and fixtures must be strong enough to prevent any distortion of the member while cooling of the welded joint. The clamps and fixtures are only to be removed when the joint is cooled to ambient temperature.
15. Welding must be done in proper welding position as already approved in WPSSs and WPQRs.

DON'Ts :

1. Do not use ordinary commercially available steel other than IS : 2062 Gr. B or Gr. C fully killed and normalised for the welding purpose.
2. Do not store the steel in open space under atmospheric exposure and in contact with weeds and vegetations to save them from corrosion, rusting and pitting.
3. Do not use ordinary welding consumables which are unappoved by RDSO. This will impair the quality of products.
4. Do not keep the welding consumables in open or in damp place, as these will absorb moisture. Weldings with damp electrodes will result in porosity and cracks in the welded joint and impair the quality and strength of the joint.
5. Do not allow any unqualified welder to carry out welding, as proper quality is not guaranteed.
6. Do not carry out the welding work in damp places, as the oxygen and nitrogen from the atmosphere will induce prospity, spatter and crack in the joint.
7. Do not do the welding in chilled weather as due to sudden cooling, welded joints are liable to become brittle and develop cracks. The joints may also suddenly fail under dynamic loading without any prior warning.
8. Do not weld with uncontrolled welding parameters. These will affect the quality of welding and make the joints weak which may yield under dynamic loading on the structure.
9. Do not weld the joints haphazardly without following the proper welding sequence. This will lead to uncontrolled and irreparable distortion of the components welded together.
10. Do not keep the components unclamped while welding, as the alignment and proper geometry of the joint can not be maintained due to distortion.
11. Do not apply hot flame and simultaneous accelerated cooling by water jet on the distorted components for the rectification, as this may become stress raiser due to formation of hot spots, and may lead to fatigue failure of the joint in service condition.
12. Do not hammer the distorted joints for rectification. It may lead to the development of cracks and failure of the joints.
13. Do not do the welding without proper protection like welding goggles, welding gloves, welding masks, etc. Without proper protection the hands may get burnt, eyes may become sore or lungs may be choked leading to serious health hazards.

Bridge Management System (BMS)

1. Bridges are key elements in the railway network and are very important from safety consideration. There are more than one lac bridges on Indian Railways and it is challenging task to maintain these bridges for smooth and safe train operation. In order to effectively monitor state of health of Bridges and accordingly priortise maintenance inputs, RDSO is developing computer software "Bridge Management System" (BMS) which will be very helpful tool to monitor bridges on Indian Railways.
2. Software is being developed for management of bridges at sub-divisional, divisional and Zonal level and will cover all aspects of bridge maintenance like technical, material, inspection, inventory & documentary etc. Software will also incorporate provision for fast and easy transfer of information from sub-divisional, divisional and zonal units.
3. Software is being developed using DBASE 4.2.
4. Work is in advanced stage and programme for sub-divisional and divisional units have almost been completed. After validation of these programmes, software along with user's manual will be sent to Zonal railways for use.

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GEOTECHNICAL ENGINEERING
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GEOTECHNICAL ENGINEERING

A. **OPEN LINE :**

1.1 ***Identification of weak formation*** : If any stretch of track needs frequent attentions, it may have weak formation. To confirm the same, Railway Board vide their letter No. 91/CE-II/SF/9 dated 4.7.1991 have laid down the following procedure known as 5-steps method :

i) Correct the cess level, width and side drains (in cuttings) to prescribed standards.

ii) Overhaul the ballast (shallow screening).

iii) Ensure Zero missing fittings.

iv) Increase ballast cushion even up to 350 mm by raising the track.

v) Increase the density of sleepers to 60 cm centre to centre (c/c) or even up to 55 cm centre to centre.

If the problem persists even after implementing the above said 5-steps, then the formation should be classified as 'weak formation' and the treatment should be decided in consultation with RDSO.

As per Railway Board's letter No. 91/CE/II/SF/9 dated 27.7.94, weak formation are those stretches where frequency of track attention is more than six per year and have speed restriction on account of weak formation. However, the best method to identify the weak formation is to take ballast penetration profile. If the ballast penetration profile is of 'W' shape and ballast penetration is greater than 30 cm over and above the normal ballast cushion provided, the formation at such location is weak,.

To plot the ballast penetration profile, ballast should be opened in its entire cross-section in between two sleepers up to depth of actual interface of ballast and subgrade soil. This interface shall then be plotted with respect to rail level.

Regarding enlisting probable locations of weak formations, identification of stretches, recording of ballast penetration profile and rehabilitation of identified stretches, the Guidelines circulated vide Railway Board's letter No 91/CE/II/SF/9 dated 27.7.94 should be followed & for strengthening of formation & Embankmant on existing/(CC+8+2)T/25T Routes Railway Board letter No. 2006/CE-I/Geo/235 dated 19.10.07 should be followed :

1.2 ***Formation Treatment :***

1.2.1.Formation problems and the remedial measures :

	Problems :	Remedy :
i)	Bearing capacity failure of the formation leading to well defined ballast pockets underthe rail seats.	Provide blanket of adequate thickness of coarse grained material on entire width of the formation as per specifications given in RDSO's "Guidelines for Earthwork in Railway Project, July 2003".
ii)	Mud-pumping having shallow ballast pockets and caked up ballast.	Provide 20-30 cm thick sand layer under the ballast

iii)	Trouble due to seasonal variation of moisture in formation top (expansive) soils).	Provide blanket of adequate thickness
iv)	Slope instability including creep i.e. slow but perpetual movement of the bank causing flattening of slope.	Slopes are to be designed based on residual/reduced shear parameters.

1.3 ***Drainage.*** Drainage is the single most important factor responsible for the general health of track and formation. The bearing capacity of soil in formation can reduce even up to 50% if the drainage gets vitiated. Drainage can be improved by making side drains of adequate size having bottom about 300 mm deeper than the bottom of ballast pockets as shown in Fig. I. Spacing of these drains may vary from 4m c/c to 10m c/c depending on the extent and severity of the problem. A typical layout of side drains in various conditions are also shown in Fig. 1.

1.4 ***SPECIFICATIONS FOR TRACK BALLAST :*** Correction Slip No. 1 dated 03.03.2005 & Correction Slip No 2 dated 12.06.2006 have also been issued subsequently. Salient features are given below :

1.4.1 General :

1.4.1.1. Basic Quality : Ballast should be hard durable and as far as possible angular along edges/corners, free from weathered portions of parent rock, organic impurities and inorganic residues.

1.4.1.2 Particle Shape : Ballast should be cubical in shape as far as possible. Individual pieces should not be flaky and should have generally flat faces with not more than two rounded/sub rounded faces.

1.4.1.3. Mode of Manufacture : Ballast for all BG main lines and running lines, except on 'E' routes but including 'E' special routes, shall be machine crushed. For other BG lines and MG/NG routes planned/sanctioned for conversion, the ballast shall preferably be machine crushed. Hand broken ballast can be used in exceptional cases with prior approval of Chief Track Engineer/CAO/C. Such approval shall be obtained prior to invitation of tenders.

On other MG and NG routes not planned/section for conversion hand broken ballast can be used for which no approval shall be required.

1.4.2.1. Ballast sample should satisfy the following physical properties in accordance with IS: 2386 Pt. IV-1963 when tested as per the procedure given in Annexure-1 & 2 of specification of track Ballast issued by RDSO.

	BG, MG & NG (planned/ sanctioned for conversion	NG & MG (other than those planned for conversion)
Aggregate Abrasion value	30 % Max.*	35% Max.
Aggregate Impact value	20% Max.*	30% Max.

In exceptional cases, on technical and/or economic grounds Aggregate Abrasion value and Aggregate Impact value are relaxable upto 35% and 25% respectively by CTE in open line and CAO/C for construction projects. The relaxation shall be given prior to invitation of tender and should be incorporated in the Tender document.

1.4.2.2. "Water Absorption" tested as per IS: 2386 Pt III-1963 and following the procedure given in Annexure 3 should not be more than 1%. This test however, *to be prescribed at the discretion of CE/CTE in open line and CAO/Con for construction projects.*

1.4.3. Size and Gradation :

1.4.3.1. Ballast should satisfy the following size and gradation :

a) *retained on 65 mm Sq. mesh sieve*	*5% Maximum.*
b) Retained on 40 mm sq. mesh sieve *	40%-60%
c) Retained on 20 mm sq. mesh sieve	Not less than 98% for machine crushed Not less than 95% for hand broken.

* For machine crushed ballast only.

1.4.3.1.1 In exceptional cases, where it is considered necessary on technical considerations, to reduce the maximum size of ballast for NG lines, CTE may modify the size & gradation of the ballast as defined above. In case of such modifications, provision given in para 1.4.3.2 to 1.4.3.4 below shall also be suitably modified. This will be finalized before invitation of tenders and should be incorporated in the tender documents. (Correction Slip No. 1)

1.4.3.2. Oversized Ballast :

i) Retention on 65 mm square mesh sieve.

A maximum of 5% ballast retained on 65 mm sieve shall be allowed without deduction in payment.

In case ballast retained on 65 mm sieve exceeds 5% but does not exceed 10%, payment at 5% reduction in contracted rate shall be made for the fulll stack. Stacks having more than 10% retention of ballast on 65mm sieve shall be rejected.

ii) In case ballast retained on 40 mm square sieve (machine crushed case only) exceeds 60% limit above, payment at the following reduced rates shall be made for the full stack in addition to the reduction worked out at (i) above.

5% reduction in contracted rate if retention on 40 mm square mesh sieve is between 60% (excluding) and 65% (including).

10% reduction in contracted rates if retention on 40mm square sieve is between 65% (excluding) and 70% (including)

iii) In case retention on 40mm square sieve exceeds 70% the stack shall be rejected.

iv) In case of hand broken ballast supply, 40 mm sieve analysis may not be carried out. The executive may, however, ensure that the ballast is well graded between 65 mm and 20 mm sieve.

1.4.3.3. Undersized Ballast : The Ballast shall be treated as undersize and shall be rejected if :

i) Retention on 40 mm square mesh sieve is less than 40%.

ii) Retention on 20 mm square mesh sieve is less than 98% (for machine crushed) or 95% (for hand broken).

1.4.3.4. Method of Sieve Analysis :

i) Sieve sizes mentioned in this specification are nominal sizes. The following tolerance in the size of holes for 65, 40 and 20 mm nominal sieves shall be permitted.

65 mm Square Mesh Sieve Plus Minus 1.5 mm

40 mm Square Mesh Sieve Plus Minus 1.5 mm

20 mm Square Mesh Sieve Plus Minus 1.0 mm

Mesh sizes of the sieves should be checked before actual measurement. The screen for sieving the ballast shall be of square mesh and shall not be less than 100 cm in length, 70 cm in breadth and 10 cm in height on sides.

ii) While carrying out sieve analysis, the screen shall not be kept inclined, but held horizontally and shaken vigorously. The pieces of ballast retained on the screen can be turned with hand to see if they pass through but should not be pushed the sieve.

iii) The percentage passing through or retained on the sieve shall be determined by weight.

1.4.4 To Carry out Impact Test on ballast, a test sample of ballast pieces (about 5 kg in weight) of size 10 mm to 12.5 mm will be required. Appropriate care should be taken by the railways that ballast selected for breaking down to 10 mm to 12.5 mm size for Impact test should be random from the ballast supply to avoid any subjectivity in selection of test sample. Alternatively, the test sample in the recommended range of size be got manufactured along with the ballast in sufficient quantity required for this test. ***(Correction Slip No. 2)***

1.5 ***WIDENING OF CESS :*** Board vide their letter No. 86/w5/misc/O/26 dated 1.7.1991 have Instructed all railways to ensure that a minimum cess width of 900 mm is available on all routes having concrete sleepers or are likely to have concrete sleepers. Existing banks having lesser width therefore need to be widened.

1.5.1. Steps to be followed in widening of cess :

i) Remove all ballast/boulder or other loose material lying on the existing slopes.

ii) Uproot all vegetations.

iii) Make benching in the existing slope as shown in Fig. 2.

iv) Do earthwork in layers duly compacted by small 2.2t, vibratory rollers so as to achieve 98% of MDD or at least the dry density equal to that of existing bank.

v) Provide turfing on the slope with doob/sarkanda and seeds of doob.

B. **CONSTRUCTION :**

2.1 ***Profile of bank/cutting :*** In all new constructions, the profiles as given in Fig. 3 shall be adopted (Railway Board's letter No. 86/W5/Misc./0/26 dated 1-7-1991).

2.2 **Soil Exploration & Surveys :**

These are mandatory and are to be done and reported as per Engineering Code Para E-409, E-425 and E-528 during preliminary and final location surveys. In order to ensure a trouble-free formation the adequate thickness of blanket material shall be provided based on soil classification as per provisions in Guidelines of Earthwork in Railway Project 2003, and following soils should be avoided.

2.2.1 Soils to be normally avoided are :

a) Organic clays, organic silts, peat, chalks, dispersive soils, poorly graded gravel and sand with uniformity coefficient less than 2.

b) Clays and silts of high plasticity (CH & MH) in top 3 m of embankment.

2.2.2. Some typical situations, as given below, may arise when in construction of formation such unsuitable types of soils (para 2.2.1) are not possible to be avoided for economy or any other reason. In such cases Railway may consult RDSO to decide special investigations and other measures to formulate suitable scheme of construction.

a) Cuttings passing through unsuitable soils (para 2.2.1) shales and soft rocks which become muddy after coming in contact with water.

b) Construction of embankment on subsoil of unsuitable types of soils.

c) Use of CH & MH type of soils even in top 3 of embankment.

2.3 Specification for Blanket Material :

The blanket should generally cover entire width of formation from shoulder to

shoulder (Fig. 5). The depth of blanket should be as per Guidelines of Earthwork in Railway Project, July 2003.

Blanket material should conform to the following specifications :

a) It should be coarse, granular and well graded.

b) Skip graded material is not permitted.

c) Non-plastic fines (particles of size less than 75 micron) are limited to a maximum of 12%, whereas plastic fines are limited to a maximum of 5%.

d) The blanket material should have particle size distribution curve more or less within the enveloping curves shown in Fig. 4. The material should be well graded with Cu and Cc as under :

Uniformity coefficient, $Cu = D_{60}/D_{10} > 4$ (preferably > 7)

Coefficient of curvature, $Cc=(D_{30})^2/D_{60}xD_{10}$ should be between 1 and 3.

e) The material for upper blanket layer shall be well-graded sandy gravel or crushed rock within the enveloping curves for upper blanket layer as shown in Fig. 4.

2.4. ***Backfill behind Abutments, Wing walls and Return walls :***

Behind abutments, wing walls and return walls, boulder filling and backfill materials shall be provided as shown in Fig. 6.

2.5. ***Guidelines for Earthwork*** **:** Latest "Guidelines of Earth work in Railway Projects, July 2003" alongwith correction slip no. 1 dated 23-7-2004 should be referred for earthwork in newlines, doubling & conversion projects.

2.6. ***Erosion Control :*** Adequate measures against soil erosion shall be taken to ensure better maintainability of the slopes of embankment/cutting. These can be as follows :

2.6.1. In areas where rainfall is adequate to sustain vegetation round the year and soil is less erodible, vegetative turfing with deep rooted grass, such as doob, etc on the exposed slope can meet the requirement.

2.6.2. In areas where rainfall is adequate but soil is so erodible that rate of erosion is much faster than the growth of net is 2.5 to 5 cm^2, and the material gets decomposed within 2 to 3 years periods which thereafter provides good nourishment to the growing grass.

2.6.3. In arid areas where rainfall is scanty, geosynthetic net having projections upto 20

to 25 mm which provides protection both against wind and rain erosion, can be used. The seeds, used in such cases, have a life of 3-4 years and one good monsoon in 3-4 years would be sufficient for the growth of the vegetative cover. Further Guidelines for application of jute Geotextiles in Railway Embankment and Hill slope Feb-2007 No. RDSO/2007/GE:G-0008 may be followed.

2.7 **Mechanical production of Blanket Material :** To meet the specification of blanket, blending of two or more naturally available material may be required. Alternatively, crushing of stones can also produce specified blanket material. Specification No.: GE: IRS -2 (Final) lay down specifications for mechanically produced blanketing material for railway formations including guidelines for blending & laying.

2.8 **Construction of Embankment over Soft Soil :** Stage construction method should be adopted for construction where soft soil data existing (having Cu i.e. undrained cohesion) strength less than 25 kpa. For details, "Guidelines On Soft Soils-Stage Construction Method" (Guideline No.: GE: G-5) may be referred.

Fine-grained, compressible soils have a low permeability and therefore, take a very long time to consolidate. This problem can be overcome by installing prefabricated vertical PVC drains, which provide a shorter and easier drainage path through which the water can escape. For details, "Prefabricated vertical PVC Drainage System for Construction Of Embankment on Compressible Soft Soil" (Report NO. GE- R-68) may be referred.

Figure 1

NOTES:

1. SIDE DRAINS SHALL BE PROVIDED IN ALL CUTTINGS AND ALSO IN FILLINGS HIGHER THAN 1.5 M, IRRESPECTIVE OF THE DEPTH OF BLANKET OR THE DEPTH OF BALLAST POCKET.
2. THE MINIMUM DEPTH OF DRAINS SHALL BE AS UNDER
   a) 30 cm. BELOW THE BOTTOM OF BLANKET
   b) 15 cm. BELOW THE BOTTOM OF BALLAST POCKET.
   c) 30 cm. BELOW THE BOTTOM OF BALLAST POCKET.
3. SECTION OF THE SIDE DRAINS SHALL BE ADEQUATE TO CARRY REQUIRED DISCHARGE
4. LONGITUDINAL GRADIENT OF THE DRAIN SHALL ENSURE DEVELOPMENT OF SELF CLEANSING VELOCITY
5. SIDE DRAINS SHALL HAVE OFF-SIDE BERM OF 300 mm. WIDTH TO PREVENT MATERIALS ROLLING DOWN THE SLOPES INTO THE DRAIN AND ALSO PROVIDE SPACE TO KEEP THE MUCK DURING THEIR CLEANING.
6. KUTCHA DRAINS ARE DESIRABLE FOR EFFECTIVE DRAINAGE OF FORMATION. PUCCA SIDE DRAINS WITH BASE AND SIDES CONSTRUCTED MONOLITHICALLY , PROVIDE CONFINEMENT TO FORMATION INCREASING ITS BEARING CAPACITY.
7. PUCCA SIDE DRAINS MUST HAVE WEEP HOLES OF 75 mm. DIA. AT 3.0 m c/c. WITHOUT ANY OBSTRUCTION AT 75 mm. ABOVE BED LEVEL.
8. SIDE DRAINS SHALL HAVE PROPER OUT-FALL WHICH MAY FALL INTO A LAKE OR CUTS THROUGH EMBANKMENT AT GROUND. CARE SHALL BE TAKEN TO ARREST THE FALL END EROSION
9. KUTCHA DRAINS IF DEEPER THAN 0.6m SHALL BE FILLED BY LOCALLY AVAILABLE GRANULAR MATERIALS WITH COARSER MATERIAL IN MIDDLE TO PROVIDE INVERTED FILTER EFFECT.
10. COARSE GRAINED MATERIAL SHALL BE PLACED BEHIND WEEP HOLES FOR EFFECTIVE DRAINAGE.
11. ALL DIMENSIONS ARE IN MILLIMETRES.

C.L OF TRACK.
300
SIDE DRAIN IN CUTTING

C.L OF TRACK
300
WEEP HOLES 75 Ø
BLANKET
BALLAST
SIDE DRAIN WHERE BLANKET PROVIDED

C.L OF TRACK
300
WEEP HOLES 75 Ø
BALLAST POCKET
PUCCA DRAIN
SIDE DRAIN IN CUTTING OF HEAVY BALLAST PENETRATION

C.L OF TRACK
L
WEEP HOLES 75 Ø
BALLAST POCKET
G
PUCCA DRAIN
SIDE DRAIN IN FILLING

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PROVISION OF SIDE DRAINS

SCALE 1:150 | DRG. NO. GE/SD/0003/Rev.0/1994

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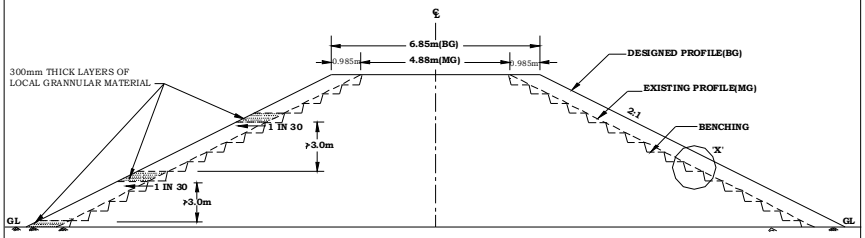
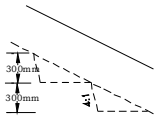
Figure 2



PROPOSED BANK SHOWN _____

EXISTING BANK SHOWN - - - - - -



Details at 'X'

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GUIDELINES FOR EARTHWORK IN RLY. PROJECTS	
SCHEME FOR BANK WIDENING SHOWING BENCHING & SANDWICH CONSTRUCTION	
NOT TO SCALE	DRG.NO: GE/GL/259/Rev.0/2003

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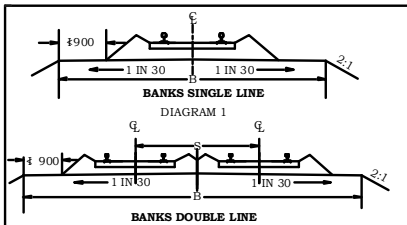
Figure 3

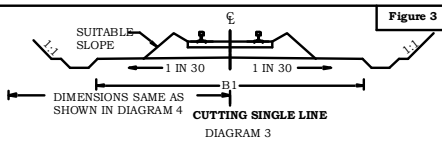


BANKS SINGLE LINE

DIAGRAM 1

BANKS DOUBLE LINE

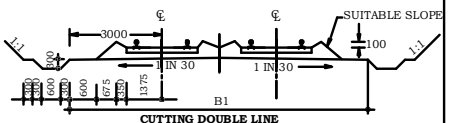
DIAGRAM 2



DIMENSIONS SAME AS SHOWN IN DIAGRAM 4

CUTTING SINGLE LINE

DIAGRAM 3



CUTTING DOUBLE LINE

DIAGRAM 4

NOTES:

1. ALL DIMENSIONS SHOWN IN THE DIAGRAMS ARE IN mm.
2. ON BG AND MG DOUBLE LINES, THE MINIMUM FORMATION WIDTH IS BASED ON DISTANCE (S) BETWEEN TRACK CENTRES OF 5.30m AND 3.96m RESPECTIVELY.
3. IN FLAT TERRAINS THE HEIGHT OF BANK/DEPTH OF CUTTINGS SHOULD PREFERABLY BE NOT LESS THAN 1m FOR ENSURING GOOD DRAINAGE, FORMATION STABILITY AND TO AVOID TRESSPASSING.
4. THESE DIMENSIONS ARE BASED ON A BALLAST CUSHION OF 30cm.
5. THESE DIMENSIONS ARE ALSO APPLICABLE IN CASE OF ALL NEW LINES BECAUSE OF THE POSSIBILITY OF USE OF CONCRETE SLEEPER AT A LATER DATE.
6. ON CURVES THE FOLLOWING INCREASE IN FORMATION WIDTHS SHALL BE MADE:-
   (1) FOR EXTRA BALLAST CUSHION ON OUTERSIDE OF THE CURVE 0.15m ON SINGLE LINE AND 0.30m ON DOUBLE LINE (INCLUDING 0.15m INCREASE IN TRACK CENTRES).
   (2) FOR EXTRA CLEARANCE REQUIRED ON DOUBLE LINE DUE TO EFFECT OF SUPER-ELEVATION ETC. AS STIPULATED IN APPENDIX TO THE SCHEDULE OF DIMENSIONS FOR BG./MG.
7. FORMATION WIDTH HAS BEEN CALCULATED ASSUMING A BALLAST SIDE SLOPE OF 1:1.
8. WIDTH OF CUTTING WILL HAVE TO BE ADEQUATELY INCREASED TO ACCOMODATE DESIGNED FILL OF BLANKET MATERIAL.

GAUGE	MINIMUM FORMATION WIDTHS			
	IN BANKS (B)		IN CUTTINGS (B1)	
	SINGLE LINE	DOUBLE LINE	SINGLE LINE	DOUBLE LINE
BG 1676	6.85m	12.16m	6.25m	11.55
MG 1000	5.85m	9.81m	5.25m	9.21m

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GUIDELINES FOR EARTHWORK IN RLY. PROJECTS	
MINIMUM RECOMMENDED FORMATION WIDTHS FOR BANKS/CUTTINGS FOR CONCRETE SLEEPER TRACK	
NOT TO SCALE	DRG.NO: GE/SK/GL/128/Rev.1/2002

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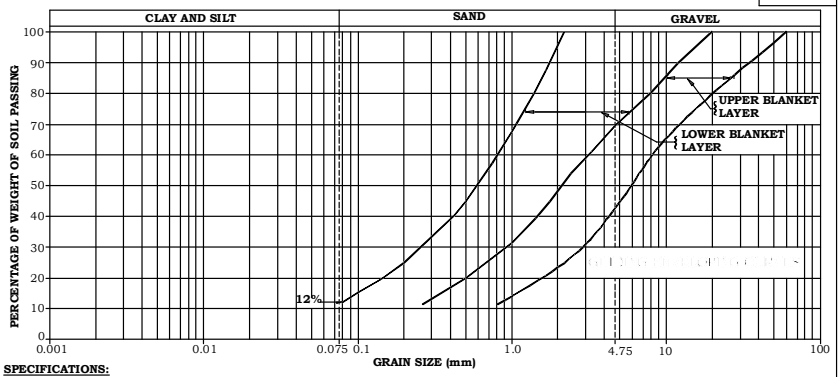
Figure 4



SPECIFICATIONS:

1. THE BLANKET MATERIAL SHOULD BE COARSE,GRANULAR AND WELL GRADED.
2. SKIP GRADED MATERIAL IS NOT PERMITTED.
3. PARTICLES FINER THAN 75 MICRONS CAN BE PERMITTED UPTO 5% IF FINES ARE PLASTIC AND THE LIMITS CAN BE INCREASED TO 12% IF THE FINES ARE NON PLASTIC.
4. UNIFORMITY COEFFICIENT (D60/D10), IN NO CASE SHOULD BE LESS THAN 4. PREFERABLY IT SHOULD BE MORE THAN 7.
5. THE COEFFICIENT OF CURVATURE (D30)²/D60 x D10, TO BE WITHIN 1 & 3.
6. THE PARTICLE SIZE GRADATION CURVE SHOULD LIE MORE OR LESS WITHIN GUIDING ENVELOPING CURVES.
7. LOWER BLANKET LAYER WILL BE PROVIDED FOR AXLE LOAD UPTO 22.5t AND UPPER BLANKET LAYERS ARE REQUIRED FOR HIGHER AXLE LOADS.

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GUIDELINES FOR EARTH WORK IN RLY. PROJECTS

SPECIFICATIONS FOR BLANKET MATERIAL

DRG.NO: GE/SD/0011/Rev.2/2006

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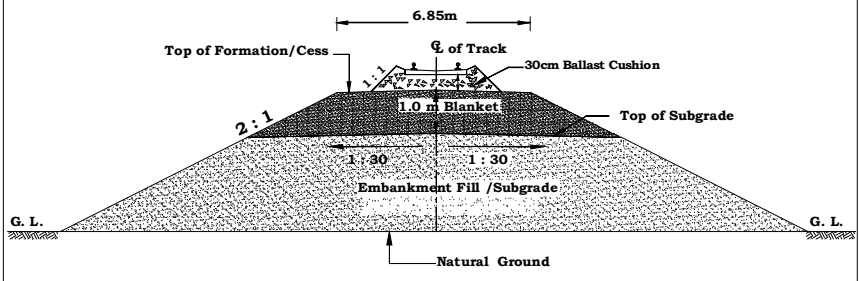
Figure 5



TRACK STRUCTURE - RAIL, SLEEPER, FASTENING

TRACK FOUNDATION - BALLAST, BLANKET & OTHER CONSTITUENTS

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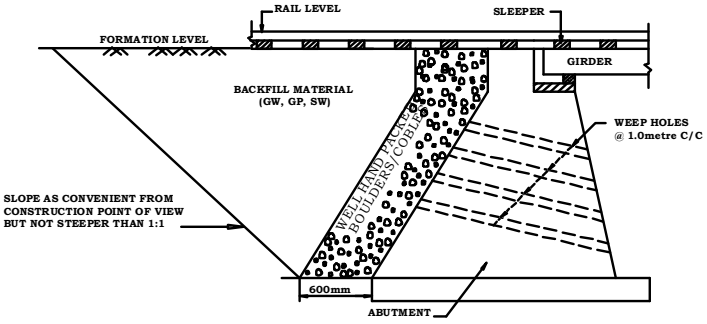
GUIDELINES FOR EARTHWORK IN RLY. PROJECTS

BG TRACK SHOWING THE NOMENCLATURE OF VARIOUS ITEMS

NOT TO SCALE

DRG.NO: GE/SD/0010/Rev.1/2002

Figure 6



NOTES:

1. BEHIND ABUTMENTS, WING WALLS AND RETURN WALLS, BOULDER FILLING AND BACKFILL MATERIALS SHALL BE PROVIDED UPTO FULL HEIGHT.
2. THE BOULDER FILLING SHALL CONSIST OF WELL HAND PACKED BOULDERS & COBBLES TO THICKNESS NOT LESS THAN 600mm WITH SMALLER SIZE TOWARDS THE BACK. BEHIND THE BOULDER FILLING, BACKFILL MATERIALS, SHALL CONSIST OF GRANULAR MATERIALS OF GW, GP, SW GROUPS AS PER IS: 1498-1970.

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GUIDELINES FOR EARTHWORK IN RLY. PROJECTS
DETAIL OF BACKFILL BEHIND BRIDGE ABUTMENT
NOT TO SCALE — DRG. No: GE/SD/0006/Rev.1/2002

Blank

GENERAL
Contents

Blank

SCHEDULE OF DIMENSIONS–SOME IMPORTANT ITEMS

		BG	*MG*
I.	**General**		
1.	Spacing of tracks :		
	(i) Minimum distance centre to centre of tracks	4265 mm	3660 mm
2.	Curves :		
	Minimum radius of curves :	175 m	109 m
3.	Rails :		
	(i) Minimum clearance of check rails for a curve:	44 mm	41 mm
	(ii) (a) Minimum clearance of check rail at a level crossing	51 mm	51 mm
	(b) Maximum clearance of check rail at a level crossing	57 mm	57 mm
4.	Tunnels, through and semi-through girder bridges :		
	Minimum distance centre to centre of tracks	4725 mm	–
5.	Safety refuges :		
	Maximum distance apart of refuges in tunnels	100 m	100 m
6.	Maximum distance apart of trolley refuges :		
	(i) On bridges with main spans of less than 100 m.	100 m	100 m
	(ii) On bridges with main spans of 100 m or more	A refuge over each pier	A refuge over each pier
7.	Station yards :		
	Maximum gradient in station yards unless special safety devices are adopted and/or special rules enforced to prevent accidents in accordance with approved special instructions.	1 in 400	1 in 400
8.	Platforms :		
	(i) Horizontal distance from centre of track to face of platform coping	1680 mm maximum 1670 mm minimum	1345 mm

		BG (1676 mm)	*MG* (1000 mm)
	(ii) Horizontal distance from centre of track to face of any platform wall	1905 mm maximum 1675 mm minimum	1345 mm
	(iii) Height above rail level for high passenger platforms	840 mm maximum 760 mm minimum	405 mm of any passenger platform, 305 mm minimum
	(iv) Maximum height above rail level for low passenger platforms	455 mm	—
	(v) Maximum height above rail level for goods platforms (except horse and end loading platforms)	1065 mm	685 mm
9.	Points and crossings :		
	(i) Maximum clearance of check rail opposite nose of crossing	48 mm	44 mm
	(ii) Minimum clearance of check rail opposite nose of crossing and at heel of switch rail	44 mm	41 mm
	(iii) Maximum clearance of wing rail at nose of crossing	48 mm	44 mm
	(iv) Minimum clearance of wing rail at nose of crossing	44 mm	41 mm**
	(v) Minimum clearance between toe of open switch and stock rail	95 mm	89 mm
	(vi) Minimum radius or curvature for slip points, turnouts or cross over roads,	218 m	116 m
II	***Electric traction***		
10.	Direct current :		
	Minimum distance between live conductor wire and any structure	130 mm	152 mm

** Note : In case of 1 in $8^{1}/_{2}$ diamond crossing the minimum clearance between nose and check rail/check flat obtuse crossing shall be 38 mm

		BG	*MG*
11.	25 kV ac 50 cycles : Electrical clearances : Minimum vertical distance between any live bare conductor (overhead equipment or pantograph) and any earthed structure or other bodies (rolling stock, over bridges, signal gantries, etc) :		
(a)	When the conductor is at rest	250 mm* 320 mm	320 mm
(b)	When the conductor is not at rest	270 mm 200 mm*	270 mm
III Rolling stock (carriage & wagon)			
(i)	Wheel gauge or distance apart for all wheel flanges :		
	Maximum	1602 mm	932 mm
	Minimum	1599 mm	929 mm
(ii)	(a) Maximum diameter of the tread of new carriage or wagon wheel measured at 63.5 mm (57 mm for MG) from wheel gauge face	1092 m	725 mm
	(b) Minimum diameter of the tread of new carriage or wagon wheel measured at 63.5 mm (57 mm for MG) from wheel gauge face	914 mm	711 mm

* Note : These clearances may be adopted with prior approval of concerned CEE (Principal)/Electrical inspector.

DIESEL-ELECTRIC LOCOMOTIVES COMMONLY IN USE ON INDIAN RAILWAYS

Traction	Class	Wheel arrangement	Wheel Dia. (mm)	Overall dimension in Length (m)	Breadth (mm)	Height (mm)	Horse Power	Maximum starting Tractive Effort (t)	Maximum speed (km/h) (t)	Axle load (t)
				Broad Gauge						
Diesel	WDM2	CO-CO	1092	17162	2914	4185	2600	30.45	120	18.80
Diesel	WDM3A	CO-CO	1092	17162	2914	4185	3100	30.45	120	18.80
Diesel	WDM7	CO-CO	1092	16238	2914	4185	1977	25.92	105	16.00
Diesel	WDP3A	CO-CO	1092	19122	2996	4184	3100	29.25	160	19.5
Diesel	WDS4	O-C-O	1092	11030	3100	4160	600	9.50	65	20.00
Diesel	WDS5	CO-CO	1092	16522	2864	4115	1065	31.50	109	21.00
Diesel	WDS6	CO-CO	1092	17212	2864	3980	1400	34.00	71	21.00
Diesel	WDG3A	CO-CO	1092	19150	3000	4180	3100	40.60	100	20.5
Diesel	WDG4	CO-CO	1092	21264	3158.2	4264	4000	53.00	100	21.0
Diesel	WDP1	BO-BO	1092	16110	3016	4191	2300	20.00	120	20.00
Diesel	WDP4	A-A-1-1-A-A	1092	21264	3158.2	4264	4000	27.55	160	19.5
Diesel	WDM 3D	CO-CO	1092	18650	3090	4138	3300	38.61	120	19.5
Diesel	WDM 3B	CO-CO	1092	18650	3090	4138	3100	38.61	120	19.5
Diesel	WDG 3D	CO-CO	1092	19150	3000	4180	3300	40.6	100	20.5
Elec AC	WAM1	BO-BO	1140	18650	3109	4165	2870	25.00	105	18.64
Elec AC	WAM2	CO-CO	1090	19150	3152	4165	2790	25.24	105/120	19.17
Elec AC	WAM4	CO-CO	1092	19974	3055	4162	3640	33.84	105/110	18.80
Elec AC	WAG1	BOBO	1140	17092	3100	4165	2895	29.76	80	21.30
Elec AC	WAG2	BO-BO	1140	16882	3050	4165	3260	31.50	80	21.30
Elec AC	WAG3	BO-BO	1140	17092	3090	4165	3150	37.50	80	21.83
Elec AC	WAG4	BO-BO	1140	17216	3100	4165	3150	28.80	80	21.90
Elec AC	WAG5	CO-CO	1092	19974	3055	4162	3350	20.60	75	20.00
		ABC1								
Elec AC	WAG5H	Co-Co	1092	19974	3055	4165	3850	37.8	80	21.0
Elec AC	WAG6A	Bo-Bo-Bo	1092	20600	3184	4170	6280	46.0	100	20.5
Elec AC	WAG6B	Bo-Bo-Bo	1140	20600	3184	4235	6050	45.0	100	20.5
Elec AC	WAG6C	Co-Co	1140	20600	3184	4235	6050	45.0	100	20.5
Elec AC	WAG7	CO-CO	1092	19100	3055	4162	5000	42.00	100	20.5
Elec AC	WAG9	CO-CO	1092	20562	3152	4255	612	46.90	100	20.5±2%
Elec AC	WAG9H	CO-CO	1092	20562	3152	-	6000	52.0	90	22.5±2%
Elec AC	WAP1	CO-CO	1092	18794	3055	4235	3800	13.80	130	18.80

LOCOMOTIVES COMMONLY IN USE ON INDIAN RAILWAYS

Traction	Class	Wheel arrange -ment	Wheel Dia. (mm)	Overall dimension Length (m)	Breadth (mm)	Height (mm)	Horse Power	Maximum starting Tractive Effort (t)	Maximum speed (km/h) (t)	Axle load (t)
				Broad Gauge						
Electric AC	WAP3	CO-CO	1092	17500	3055	4235	3800	3249	140	18.80
"	WAP4	CO-CO	1092	18794	3179	4235	5050	30.8	130	-
"	WAP5	BO-BO	1092	18162	3130	4235	5442	26.3	160	19.5+2%
"	WAP6	CO-CO	1092	18794	2970	4470	5000	-	105	18.87+2%
"	WAP7	CO-CO	1092	20562	2480	-	6120	32.9	130	20.5±2%
AC-DC	WCAG1	CO-CO	1092	20980	3000	4237.5	4600	44.0	100	21.3
AC-DC	WCAM1	CO-CO	1092	20954	3055	412	3640	33.84	100	19.50
"	WCAM2	CO-CO	1092	20980	3000	4162	5000	-	105	19.5+2%
"	WCAM3	CO-CO	1092	20980	2980	4255	5000	-	60	20.2
DC	WCG2	CO-CO	1090	19974	3055	4238	1640	30.00	80	22.50
"	WCM1	CO-CO	1220	20834	3169	4292	3170	31.30	106 In	20.83
"	WCM2	CO-CO	1092	20066	3245	4293	2810	31.30	passenger	18.80
"	WCM3	CO-CO	1220	19583	3199	4264	2530	28.70	Train &	19.47
"	WCM4	CO-CO	1220	20000	3050	4282	3200	31.20	65 with	20.60
"	WCM 5	CO-CO	1220	20168	3200	4293	3170	31.30	Goods Train	20.83
"	WCM 6	CO-CO	1092	20394	3179	4255	4600	39.6	105	20.0
				Metre Gauge						
Diesel	YDM2	BO-BO	865	12390	2745	3425	700	14.40	75	12.00
"	YDM4	CO-CO	965	15208	2730	3407	1380	18.94	96	12.00
"	YDM4A	CO-CO	965	15208	2730	3407	1380	18.94	96	12.00

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COACHING STOCK COMMONLY IN USE ON INDIAN RAILWAYS

Type of coach	Axle load (approx.) (t)	Overall dimensions Length (mm)	Breadth (mm)	Height (mm)	Bogie wheel base (mm)	Bogie centres (mm)	Wheel dia (new) (mm)	Maximum speed (km/h)
			Broad Gauge					
ICF Non A Conditioned & Air Conditioned Coaches (BG)	13/16.25	22297	3250	4025/ 4250	2896	14783	915	105/110$ 130/140$$
BEML (BG)	13	22297	3250	4025	2896	14783	915	105/110
LHB Coach (BG)	16.25	24000	3240	4039/ 4250	2560	14900	915	160
Double Deck Coach (BG)	16.25	22297	3050	4265	2896	14783	915	105/110
EMU Jessops 17D.C.	18.50	21756	3658	3810	2896	14630	952	100
AEMU/ICF a.c./d.c.	20/18.50	21756	3658	3813	2896	14630	952	100
OHE Car 8 wheeler	16	22296	3200	4265	2896	14783	915	100
OHE car 4 wheeler	16	9770	3200	4265	-	-	952	75
HPDMU	20.0	22221	3245	3586	2896	14783	915/952	100
EMU ICF ac	14.25	20283.50	2740	3355	2300	13715	725* 838**	70
Garib Rath Coach BG	14.195	22297	3250	4381	2896	14783	915	130 C&M Vol-I 105 Others C&M Vol-I
Meter Gauge ICF	10.00	20183.5	2740	3355	1980	13715	725	75/100

** for motor coaches
* for trailor coaches
$ for main line
$$ for Rajdhani/Satabdi Express

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Freight Stock commonly in use on Indian Railways

S. No.	Type of wagons/ Description	Length over Hd. Stock	Length over buffer/ couplers	Length inside	Width inside/ overall	Height inside/ from rail	Bogie Centres	Journal Centres	Wheel Dia On tread	Nominal max. axle load	Tare	Pay Load	Ratio pay Load/ Tare	Gross Load	No. of wagons per rake	Throughput per rake	Loading Density	Cubic Capacity	Speed	Type of Coupler	Type of Bearing
		mm	mm	mm	mm	mm	mm	mm	mm	t	t	t	t	t	no	t	t	cum	kmph		
1	O OPEN	5944	7214	5934	2845/3055	1600/2836	3504	2235	1090	16.3	10.31	22.19	2.152	32.5	86	1908	4.5	27	75	SC	PB
2	BOXC/OPEN COAL	12800	13729	12790	2852/3136	1880/3161	8800	2240	1000	20.32	25	56.28	2.251	81.28	45	2532	5.925	68.58	75	CBC(T)	CRB
3	BOXN/BOXNHS	9784	10713	9784	2950/3200	1950/3233	6524	2260	1000	20.32	23.2	58.08	2.503	81.28	58	3368	7.59	56.3	75/100	CBC	CTRB
4	BOXNHA	9784	10713	9784	2950/3200	2175/3450	6524	2260	1000	22.1	23.17	65.23	2.81	88.4	58	3783	8.25	62.8	100	CBC	CTRB
5	BOXN(LW)	9784	10713	9784	3022/3250	1990/3263	6524	2260	1000	20.32	20.41	60.87	2.98	81.28	58	3530	7.59	58.84	65	CBC	CTRB
6	BOXNAL	9784	10713	9784	3022/3250	2066/3341	6524	2260	1000	20.32	18.26	63.02	3.45	81.28	58	3655	7.59	61.09	---	CBC	CTRB
7	BOXNHL	10034	10963	10034	3022/3250	2028/3301	6690	2260	1000	22.9	20.8	70.8	3.4	91.6	58	4106	8.35	61.05	80	CBC	CTRB
8	BOXN25	9784	10713	9784	2957/3135	2333/3606	6524	2260	1000	25	23	77	3.35	100	58	4466	9.33	67.5	75/100	CBC	CTRB
9	BOI/OPENGONDOLA	10700	11629	10690	2850/3100	1050/2331	6700	2240	1000	20.32	22.8	58.48	2.564	81.28	53	3099	7	32	75	CBC	CRB
10	BOY/IR BOY/IRON ORE Spl	11000	11929	10990	2924/3134	1175/2450	7330	2260	1000	22.9	20.71	70.89	3.422	91.6	52	3686	7.678	37.8	65	CBC	CTRB
11	BOY25	9784	10713	9784	2907/3135	1334/2607	6524	2260	1000	25	21	79	3.76	100	58	4582	9.33	37.94	75/100	CBC	CTRB
12	CR/COVERED	7162	8432	7162	2946/3081	2445/3746	4572	2235	1090	16.3	10.77	21.73	2.017	32.5	74	1608	3.85	51.4	75	SC	PB
13	CRT/COVERED	7890	8822	7890	2946/3081	2675/3977	4900	2240	1000	20.32	13.1	27.54	2.102	40.64	70	1927	4.61	61.9	75	CBC (ALL)	CRB
14	CMR/CATTLE/MILLITARY	7162	8432	7162	2946/3081	2445/3746	4572	2235	1090	16.3	11.23	21.27	1.894	32.5	74	1573	3.85	51.4	75	SC	PB
15	CE/COVERED EXPLOSIVE	5943	7213	5772	2672/2978	2295/3746	3505	2235	1090	16.3	11.38	21.12	1.855	32.5	86	1816	4.51	32.7	75	SC	PB
16	BCX MK-II/Cov. Bogie Special	14500	15782	14494	2944/3199	2446/3792	10000	2240	1000	20.32	28.5	52.78	1.851	81.28	39	2058	5.15	104	75	CBC(T)	CRB
17	BCN/COVERED BOGBIE	14500	15429	14494	2944/3100	2446/3787	10000	2260	1000	20.32	27.2	54.08	1.988	81.28	40	2163	5.268	104	80/75	CBC	CTRB
18	BCNA/BCNAHS	13521	14450	13515	2944/3200	2677/4014	9500	2260	1000	20.32	24.55	56.73	2.31	81.28	43	2439	5.625	103.4	75/100	CBC	CTRB
19	BCNHL	10034	10963	10034	3340/3450	3060/4385	7153	2260	1000	22.9	20.8	70.8	3.4	91.6	58	4106	8.35	98.3	80	CBC	CTRB
20	BOBY/BOBYN	10718	12000	9000	2863/3189	1781/3050	7470	2260	1000	20.32	27.04	54.24	2.005	81.28	52	2820	6.77	40.3	75	CBC(T)	CTRB
21	BOBX/HOPPER	10668	11938	7672	2910/3050	-2819	7112	2260	915	22.9	25.15	66.45	2.642	91.6	52	3455	7.67	26.9	56	SC	PB
22	BOBS MK-II	10668	11597	9296	2743/3020	- /3304	7112	2260	1000	22.9	30.4	61.2	2.013	91.6	53	3243	7.9	34	70	CBC	CTRB
23	BOBSN25	9784	10713	9784	2925/3199	1941/3213	6524	2260	1000	25	28	72	2.57	100	58	4176	9.233	34.63	75/100	CBC	CTRB
24	BOBR	10671	11600	8732	3340/3500	2461/3735	7571	2260	1000	20.32	26	55.28	2.126	81.28	53	2929	7	57.2	80	CBC	CTRB
25	BOBRN	9671	10600	9327	3340/3500	2466/3735	6790	2260	1000	20.32	25.6	55.68	2.175	81.28	59	3285	7.67	56.78	65	CBC	CTRB

Freight Stock commonly in use on Indian Railways

S. No.	Type of wagons/ Description	Length over Hd. Stock	Length over buffer/ couplers	Length inside	Width inside/ overall	Height inside/ from rail	Bogie Centres	Journal Centres	Wheel Dia On tread	Nominal max. axle load	Tare	Pay Load	Ratio pay Load/ Tare	Gross Load	No. of wagons per rake	Throughput per rake	Loading Density	Cubic Capacity	Speed	Type of Coupler	Type of Bearing
		mm	mm	mm	mm	mm	mm	mm	mm	t	t	t	t	t	no	t	t	cum	kmph		
26	BOBRNAL	9671	10600	9327	3316/3500	2466/3735	6790	2260	1000	20.32	22.4	58.88	2.62	81.28	58	3414	7.67	56.6	---	CBC	CTRB
27	BOBRN25	9784	10713	9422	3460/3500	2756/4205	6903	2260	1000	25	24.4	75.6	3.1	100	58	4437	9.33	66.68	75/100	CBC	CTRB
28	TO/OIL TANK	7010	8280	6156	2362	- /4108	4572	2235	1090	16.3	13.9	18.61	1.338	32.51	75	1395	3.93	25.65	75	SC	PB
29	TORX/OIL TANK	7010	8280	6156	2362	- / 3975	4572	2235	1090	16.3	12.1	20.4	1.685	32.5	75	1530	3.93	26.04	75	SC	CRB
30	TP/PETROL TANK	7010	8280	6156	2362	- /4024	4572	2235	1090	16.3	12.85	17.53	1.364	30.48	75	1314	3.68	25.65	75	SC	PB
31	TPR/PETROL TANK	7010	8280	6766	2362	- /3990	4572	2235	1090	16.3	11.84	20.66	1.744	32.5	75	1549	3.921	28.64	75	SC	CRB
32	TPGL/LQD.PET.GAS	8382	9652	8000	2000	- /3978	4877	2235	1090	16.3	20.66	11.84	0.573	32.5	64	757	3.37	24.1	75	SC	CRB
33.	TPGLR/LQD.PETGAS	8382	9652	8350	2300	/4125	4878	2235	1090	16.3	18.2	14.3	0.78	32.5	64	915	3.37	33.1	75	SC	CRB
34.	BTALN/AMMONIA	16600	17529	16325	2200	- /4265	11570	2240	1000	20.32	49.13	32.13	0.65	81.26	35	1124	4.63	60.66	65	CBC	CRB
35	BTPN	11491	12420	11434	2850	- /4265	8391	2260	1000	20.32	27	54.28	2.01	81.28	50	2714	6.54	70.4	75	CBC	CTRB
36	BTPGLN	18000	18929	17994	2400	2400/4285	12970	2260	1000	20.32	41.6	37.6	0.9	79.2	33	1240	4.19	79.48	75	CBC	CTRB
37	BVG/BRAKE VAN GOODS	5943	7213	-	- /3200	2396/3755	3505	2235	1090	16.3	10.77	-	-	10.77	-	0	1.5	-	75	SC	PB
38	BVGT/BRAKE VAN GOODS	5944	7226	-	- /3197	2447/3735.6	3505	2235	1090	16.3	-	-	-	-	-	0	-	-	75	CBC(T)	PB
39	BVZC/BRAKE VAN GOODS	8540	9469	-	- /3200	2448/3894	5400	2240	1000	20.32	13.803	-	-	13.803	-	0	1.48	-	75	CBC	CRB
40	BVZI	13540	14469	-	- /3200	- /3894	9026	2159	915	5.875	23.5	-	-	23.5	43	0	1.624	-	100	CBC	SRB
41	BOST	12800	13729	12800	2850/3100	1805/3080	8800	2260	1000	20.32	25.5	55.78	2.18	81.28	45	2510	5.92	65.84	80/75	CBC	CTRB
42	BFNS	13716	14645	13716	2845/3045	- /2785	9144	2260	1000	20.32	23.629	57.651	2.43	81.28	42	2421	5.55	-	100	CBC	CTRB
43	BRH/RAIL HEAVY	13716	14986	13716	2845	-	9144	2240	1000	20.32	24.38	56.9	2.333	81.28	41	2332	5.42	-	75	CBC(T)	CRB
44	BRNA/BRNAHS	13716	14645	13716	2845	-	9144	2260	1000	20.32	23.543	57.74	2.45	81.28	42	2425	5.55	-	75/100	CBC	CTRB
45	BRN25	13716	14645	13716	2930/3130	1274	9144	2260	1000	25	23.5	76.5	3.25	100	42	3210	9.33	-	75/100	CBC	CTRB
46	BLCA	13625	14566	-	2200 max	1009	9675	2260	840	20.32	19.1	61	3.19	80.1	42	2562	5.5	-	100	CBC/SDB	CTRB
47	BLCB	12212	13165	-	2200 max	1009	8812	2260	840	20.32	18	61	3.39	79	47	2867	6	-	100	SDB	CTRB
48	Cement/Flyash	9784	10713	10085	3129/3245	- /4165	6684	2260	1000	22.13/17.25	22	66.5/47.11	3.02/2.14	88.5/69.11	58	3857/2732	0.95/0.67	70	75/100	CBC	CTRB

Metre Gauge

Type of wagon	Axle load (t)	Wheel dia (new) (mm)	Bogie wheel base (mm)	Bogie centres (mm)	Overall dimensions			Maximum speed (Km/h)
					Length (mm)	Breadth (mm)	Height (mm)	
MBOC	12.20	725	1448	9449	14340	2442	2043	48
MBC	12.20	725	1448	7620	12511	2391	3359	48
MBR	12.20	725	1448	9449	14340	2489	—	48
MO	12.20	725	3657	—	7786	2445	2043	48
MC	12.20	725	3048	—	6719	2391	3359	48

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