CHAPTER 6

BOGIES AND SUSPENSION

At present, following four types of bogies are in service:-

- CASNUB Bogie
- BOX Bogie (UIC Bogie)
- Cast Steel Bogie
- Diamond Frame Bogie

601. CASNUB BOGIE

A. GENERAL DESCRIPTION

This bogie was first fitted in BOXN wagons and was designated as CASNUB 22W. This was later modified as CASNUB 22W(M) to take care of high wheel wear reported on earlier version. Subsequently CASNUB 22NL (Narrow jaw) and CASNUB 22 NLB (Narrow jaw with fish belly bolster) versions were introduced. The CASNUB 22 HS bogie has been developed for high-speed operation with maximum permitted speed up to 100 km/h. All CASNUB 22W bogies are to be converted to CASNUB 22W (Retrofitted) by the maintenance depots and workshops. The various bogie versions developed are as under :

- CASNUB -22W
- CASNUB -22W (Retrofitted)
- CASNUB -22W(M)
- CASNUB -22NL
- CASNUB -22NLB
- CASNUB -22HS

These bogies are now used in the following wagons:-

BOXN	BOBR
BCN	BOBRN
BCNA	BOBY
BRN	BOBYN
BTPN	BFK
BTPGLN	

601 B. CONSTRUCTIONAL DETAILS

- The bogie comprises of two cast steel frames and a floating bolster. The bolster is supported on the side frame through two nests of springs. This also provides a friction damping proportional to load. A fabricated mild steel spring plank connects the side frames.

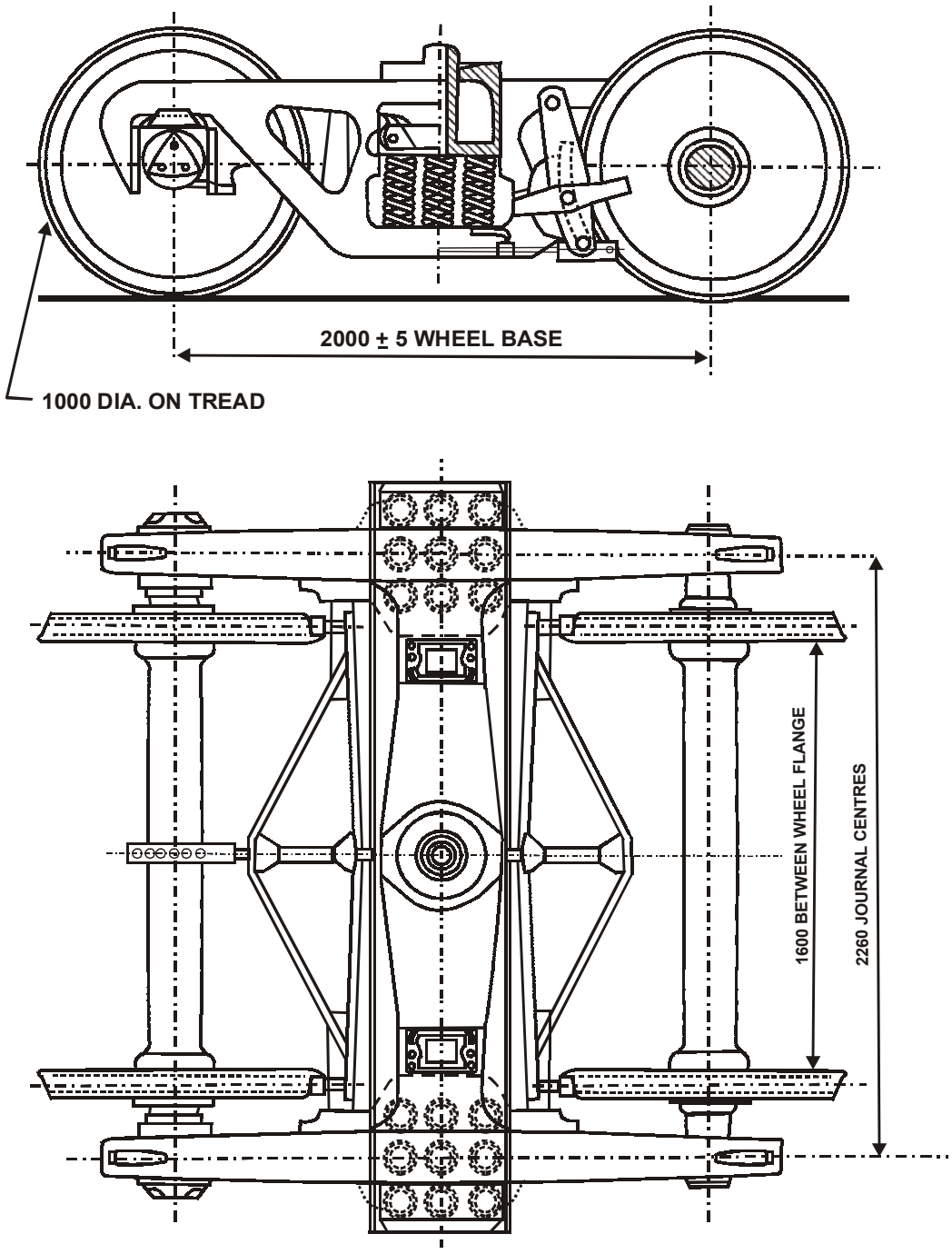


FIG. 6.1 BOGIE GENERAL ARRANGEMENT CASNUB-22W BOGIE

The salient features of CASNUB bogie are given below.

Sr. No	Features	Description
1.	Gauge	1676 mm
2.	Axle load	20.3 t, However all bogies except CASNUB 22 HS can be upgraded up to 22.9 t.
3.	Wheel diameter	1000 mm (New) 956 mm (New) for Retrofitted CASNUB 22 W
4.	Wheel base	2000 mm
5.	Type of Axle bearing	**CASNUB 22W & 22W(M)** (i) Cylindrical Roller Bearing Axle Box in a limited number of CASNUB 22W Bogies only. (ii) Standard AAR Tapered Cartridge Bearing Class E suitable for 144.5 x 277.8 mm wide jaws. **CASNUB 22NL, 22NLB & 22HS** (i) Standard AAR Tapered Cartridge Bearing Class E suitable for 144.5 x 277.8 mm narrow jaw
6.	Distance between journal centres	2260 mm
7.	Distance between side bearers	1474 mm
8.	Type of side bearers	**CASNUB 22W** Roller Type (Clearance Type) **Retrofitted CASNUB 22W, CASNUB 22W(M), 22NL, 22NLB** Constant contact type (Metal bonded rubber pad, housed inside side bearer housing) **CASNUB 22HS** Spring loaded constant contact type side bearer.
9.	Type of pivot	**CASNUB 22W** IRS Type TOP Pivot- RDSO Drg. No. W/BE-601 Bottom Pivot – RDSO Drg. No. W/BE-602 or similar mating profile integrally cast with bolster. **CASNUB 22W(M), 22NL, 22NLB, 22 HS** Spherical Type RDSO Drg. No. WD-85079-S/2
10.	Anti rotation features	Anti rotation lugs have been provided between bogie bolster and side frame
11.	Type of brake beam	**CASNUB 22W, 22NL, 22NLB, 22 HS :** Unit type fabricated brake beam supported and guided in the brake beam pockets. **CASNUB 22W(M) :** Unit Type Cast Steel brake Beam suspended by hangers from side frame brackets.
12.	Suspension details	Long travel helical spring
13.	Elastomeric pads	On all types of bogies except CASNUB 22 W.

The CASNUB bogie assembly consists of the following components:

i. Wheel set with Cartridge Bearing
ii. Axle Box/ adapter, retainer bolt & side frame key assembly
iii. Side frames with friction plates and brake wear plates
iv. Bolster with wear liners
v. Spring plank, fit bolts & rivets
vi. Load bearing springs and snubber springs
vii. Friction shoe wedges
viii. Centre pivot arrangement comprising of Centre pivot top, Centre pivot Bottom, Centre pivot pin, Centre pivot retainer & locking arrangement
ix. Side Bearers
x. Elastomeric Pad
xi. Bogie Brake Gear
xii. Brake Beam

a) WHEEL SET WITH CARTRIDGE BEARING

The initial batch of CASNUB bogie was fitted with cylindrical roller bearing axle box and matching wheel set. However standard AAR taper cartridge bearings have been subsequently standardised for these bogies. Maintenance requirement of cartridge taper roller bearing have been issued under "Instruction for inspection and maintenance of Cartridge Taper Roller Bearing fitted on Cast Steel Bogies", Technical Pamphlet No. G-81 by RDSO.

M/S NEI Jaipur to their Drawing No. 92-4289A supplies cylindrical roller bearing axle boxes fitted on CASNUB bogies. The maintenance Instructions to be followed as indicated in Drg. No. M 33128.

Wheel profile used had been standard 1 in 20 taper after the root radius, earlier. However, currently a worn wheel profile has been prescribed to reduce wheel wear and increase wheel life. The worn wheel profile for new wheel is as per Drg No. WD-88021. During re-profiling, wheels should be turned as per intermediate profile having varying wheel flange thickness selecting the appropriate flange thickness out of the four flange thicknesses so that minimum material is removed at the time of turning. These are as per Drg. No. WD-89060- S/2.

Wheel diameter for new wheel is 1000 mm. However, for CASNUB 22W (retrofitted), maximum permissible wheel diameter is 956 mm. Condemning wheel dia is 906 mm for all versions but with suitable packing.

b) AXLE

Axles have to be subjected to ultrasonic testing during ROH/POH or whenever the wagons are sent to the shops. Wheel sets whose axles have under gone ultrasonic testing shall be stamped on the hub fillet as per RDSO's drawing no. WD-81089-S/1.

Axle end holes should be properly cleaned and lubricated before reuse. Threads should be checked with standard thread gauge. Reclamation of axles with defective cap screw holes shall be carried out as per instructions given in RDSO letter MW/WA/Genl dated 8.5.92.

Some axles on CASNUB bogies have been reported to have grazing on account of Main pull rod. This can be reclaimed in case notches/scratch/nicks are less than 5 mm as per instructions issued vide RDSO's letter No. MW/WA/GENL dated 20.12.91. The reclamation of the axle, for reasons not indicated in the above quoted letter, is not permitted.

Whenever axles are renewed, the workshop shall punch the following particulars in 5 mm letters on the axle end :-

i. Serial No.
ii. Workshop code where pressing has been done
iii. Date of pressing
iv. Journal centre
v. Pressing on pressure in tonnes (Both ends)

After rediscing, the stamping shall be as per RDSO Drg No. WD-87080/S-1.

c) AXLE BOX ADAPTER, RETAINER BOLT & SIDE FRAME KEY ASSEMBLY

CASNUB 22W

Initial lot of CASNUB 22W type bogies were provided with cylindrical roller bearing axle box on the wheel sets. However, cartridge taper roller bearing was soon standardised having adapter & adapter retainer bolt. The CASNUB 22W bogies are provided with wide jaw adapter as per RDSO sketch No. Sk-78527 but without elastomeric pads with wheel sets to Drg. No. WA/WL-4902, Sk-68512 and WD-89025-S/1 with retainer bolts to Drg No. SK-69594.

CASNUB 22W(M)

Wheel sets are with wide jaw adapter, cartridge roller bearing and adapter retainer bolt (WA/WL-4902/WD-89025-S/1 for wheel sets).

CASNUB 22NL, 22NLB & 22 HS bogies

Wheel sets are provided with narrow jaw adapter, cartridge roller bearing (WD-89025-S/1 for wheel sets).

CASNUB 22W (Retrofitted)

Bogies are provided with modified wide jaw adapters but these are not interchangeable with CASNUB 22W and CASNUB 22WM.

The wear limits are given in Table 6.1.

d) SIDE FRAMES WITH FRICTION PLATES

Side frame column has been provided with 10 mm thickness Silico Manganese Steel wear liners to IS: 3885 Pt.-I Gr. IV welded on the columns. It must be ensured that the liners permitted in service up to a thickness of 6 mm only.

The new friction plate is to be held tight against the column face during welding which should be done in down hand position. Start welding at diagonal ends of the plate and work towards the centre. No paint or grease should be applied on the friction plate.

The side frame should be checked for its wheelbase (distance between centre lines of the jaw openings) and ensure whether the correct button marking is left on the side frame. While pairing the side frame for a bogie, it should be ensure that there should not be any difference between the numbers of buttons on the two-side frames.

The wear limits are given in Table 6.1.

e) BOLSTER WITH WEAR LINERS

Bolster pocket has been provided with 8 mm thick silico manganese Steel liners welded with pocket slope. The liners may be permitted in service upto a thickness of 3 mm. The welded liners should be chipped off to prepare the surface for welding new liners. No paint or grease should be applied on the plate.

Some bogie bolsters such as those of CASNUB 22NLB &22HS bogies have been provided with 5mm thick wear liners on land surfaces & same are to be required to be replaced after 3mm wear.

The wear limits are given in Table 6.1.

f) SPRING PLANK, FIT BOLTS & RIVETS

Spring plank is a member made of solid steel (flanging quality). It joins two side frames of CASNUB bogie by eight 24 dia rivets and four M24 "fit" bolts to keep bogie frame square.

Spring plank should be examined for defects like loosening of rivets/cracks/bending, welding failure of spring spigot etc. Whenever, spring plank is renewed, the leading dimension of the bogie as per Drg no. SK-69599(W), WD-85054-S/6(22WM), WD-90042-S/1(NLB), WD-92058-S/7(HS) must be measured. Special care is to be taken regarding the use of fit bolts as well as quality of riveting. Fitment of spring plank with side frames should be done on suitable fixture.

g) LOAD BEARING SPRINGS AND SNUBBER SPRINGS

The bogies are fitted with two groups of long travel helical spring nests. The spring details are shown in WD-83069-S/1 (Common for all versions except CASNUB- 22HS Bogie). The spring details of CASNUB 22HS are shown in WD-92058-S/5.

DAMPING

The suspension is provided with load proportional friction damping arrangement with the help of manganese steel cast wedge supported on the snubber springs. The springs are manufactured out of silico Manganese steel, chrome vanadium, chrome molybdenum.

The matching of load and snubber springs is important. It is recommended that the springs should be so grouped that the free height variation in the group is not more than 3 mm. Mixing of new and old springs should be avoided. The nominal free height and condemning height are given in Table 6.1.

h) FRICTION SHOE WEDGES

Friction shoe wedges are fitted on snubber springs. Its vertical surface is with side frame and slope surface is in contact with bolster pocket liners.

A table containing wear limits on vertical surface and slope surface nominal and recommended is placed at Table 6.1.

i) CENTRE PIVOT ARRANGEMENT

Centre pivot arrangement for CASNUB 22W bogie is as per RDSO Drg No. W/BE-601 for top centre pivot and W/BE-602 for bottom centre

pivot for separate cast bottom pivot. For CASNUB bogies other than CASNUB 22W, centre pivot bottom and centre pivot top are as per RDSO Drg No. WD-85079-S/2.

Centre pivot pin for CASNUB 22W bogie is a headless pin while for other versions, a special type of pin is provided with castle nut/shackle lock for locking.

To determine the seat wear, the gauge should be placed in position. If the pivot surface starts touching the surface on the gauge at any point, repair to be made by welding. The gauge should be moved on the complete worn surface to be measured. The surface after reclamation shall be the original dimension as per the respective drawings for proper matching of surfaces with top centre pivot.

The repairs should be carried out if a 9 mm thick shim in CASNUB 22W bogie (7 mm thick for other bogies) can be inserted for the full depth between the worn surface and the gauge at any point on the vertical wall of the bowl with gauge in position.

During POH/ROH the wear on the vertical side of the bowl, seat of the bowl should be built up by welding. Preheat the surface to be reclaimed up to a maximum temperature of 250^0 Celsius. After welding, it should be allowed to cool slowly by covering the welded portion with asbestos/sand.

j) SIDE BEARER

CASUNB 22W Bogies are fitted with roller type side bearers, which are free to move in cast steel housing, riveted on the bogie bolster. CASNUB 22W(Retrofitted), CASNUB 22W(M), 22NL, 22NLB Bogies are fitted with constant contact type of side bearer rubber pads located in cast steel housing which is riveted to the bogie bolster. CASNUB 22HS Bogies are fitted with helical spring loaded constant contact type side bearer, riveted/bolted on the bogie bolster.

k) ELASTOMERIC PAD

Elastomeric pads are provided in all versions of CASNUB bogie except CASNUB 22W. The main purpose of providing elastomeric pad is to reduce wheel flange wear.

Elastomeric pads to 95005-S/4, Wd-92058-S/8 (for HS) & WD-95005-S-1 and side bearer rubber pads to WD-85076-S/1 shall be condemned and replaced by new ones on the following grounds :-

i. If the top of the bottom plates or intermediate plate in case of side bearer pads show any crack in service.

ii. If any crack of more than 50 mm is developed at any surface of rubber.

iii. If a bond failure giving way more than 40 mm in any direction is developed in service.

iv. If any sign of crushing of rubber is noticed.

v. When in free condition, the pad has taken a permanent set of the order given in Table 6.1.

l) BOGIE BRAKE GEAR

The brake gear mainly consists of Brake Beam (with brake head and brake block assembly), equalising levers, Push rod, End pull rod, Brake Beam hangers (in CASNUB 22WM bogies). The bushes provided are case hardened or through hardened and pins are made from steel. The maximum permissible wear on the pin diameter and bush inside diameter is limited to 1.5 mm.

In service as the tread diameter of wheel decreases due to wear, pins located in End Pull Rod with underframe to be relocated. The brake beam of CASNUB 22W is of a purely fabricated (structural steel member) design with integrally fabricated brake head. In case of CASNUB 22WM bogies it is of cast steel and Brake head and Block assembly is a separate assembly. This assembly attached with the circular end of a cast steel Brake beam by means of a pin.

In case of CASNUB 22 NL/22NLB/22HS bogies, the brake beam is fabricated, brake beam strut and end piece casting are of cast steel. Brake head is integral part of "End Piece Casting".

The standard brake shoe to Drg No. WA/BG 6158 which, is used on BOX wagon can be locked in position on the brake head by means of a key. The brake shoes should be replaced when worn to 48 mm thickness i.e. when 10 mm metal is left from the base of the shoe.

m) BRAKE BEAM (CASNUB 22W, 22NL, 22NLB & 22HS) AND BRAKE WEAR PLATES

Bogies are fitted with unit type fabricated brake blocks that slide in the guide cavity provided in the side frame.

Cavities are provided with silico manganese steel liners. The brake heads are integral part of the brake beam. brake beam is shown in WD-89033-S/1, however the brake block to WA/BG-6158 is common for all versions.

CASNUB 22W(M) Bogies

The bogie is fitted with unit type suspended cast steel brake beam. The brake head is a separate sub assembly which is fixed with brake beam circular end by means of pin passing through brake beam end and brake shoe adjuster along with spring loaded brake head. Assembly provides rotational flexibility to brake head. Details are shown in Drg No. WD-85084-S/1, WD-88012-S/1 & WD-86034-S/1.

n) RECLAMATION OF BRAKE BEAM ON ACCOUNT OF WORN OUT BRAKE HEADS

Reclamation procedure for different versions of CASNUB bogie brake beams shall be as follows.

I) CASNUB 22W Bogie

Brake heads are welded with brake beam channel, side rest and outer stiffener plate as shown in Drawing No. SK 69596. The repair procedure for worn out brake heads is as follows.

REPLACEMENT

i. Remove worn out brake heads by gas cutting the welds indicated in drawing SK 69596 with as little damage to other members as possible. Other part, if damaged should be built up by welding by using electrode and taking precaution followed by proper cleaning and finishing operation.
ii. Weld new brake head at correct position with brake beam channel, outer stiffener plate and side rest by fillet welds of sizes indicated in Drawing SK 69596.

REPAIR BY WELDING

Depending upon extent of wear on brake head it is optional for repairing shop/depots to either go for total replacement of worn out brake heads or to build up worn out portion by welding followed by proper finishing operations.

II) CASNUB 22 W(M) Bogie

Brake heads are fitted on brake beam with the help of brake shoe adjuster as shown in drawing no. WD-88012-S/1. Brake heads are further secured on brake beam-ends by washer and split pin.

Procedure for replacing worn out brake heads is as under;

i. Remove split pin and washer from brake beam end. Remove pin securing brake shoe adjuster with brake beam by removing split pin.
ii. Take brake heads out of brake beam along with brake shoe adjuster.
iii. Disengage brake shoe adjuster from brake head by providing bolt after disengaging split pin, nut cover, spring and adjusting piece.
iv. Assemble new brake head with brake shoe adjuster by using items mentioned in para (C) as shown in RDSO Drawing No. WD-88012-S/1.
v. Slide new brake head assembled with brake shoe adjuster on brake beam end. Engage brake shoe adjuster with brake beam by using pin and split pin as shown in RDSO Drawing No. WD-88012-S/1.
vi. Further secure brake heads on brake beam end by putting washer and split pin as shown in RDSO Drawing No WD-85054-S/4.

III) CASNUB 22 NL, 22NLB & 22HS Bogie

Brake head is integrally cast with end piece casting, which is welded with structural steel brake beam channel and Truss flat at ends as shown in RDSO Drawing No WD-89033-S/1. Depending upon the extent of wear, worn out brake heads can either be built up by welding or worn out brake heads can be replaced by new brake head.

601 C. REPAIR AND MAINTENANCE IN SICK LINE

In order to obtain optimum life from the bogie, it is desirable to maintain the various clearances within recommended limits. Prescribed clearances are given in para 601 E.

a. Due to wear of the mating components, increase in clearances should be monitored. Whenever the component reaches the condemning limits, repairs should be undertaken for either building up the wear on such surfaces or changing their liner, as the case may be.

b. Due to the wear in bolster/side frame liners and wedge surface, the wedges shall move upwards. If the holes of bolster pocket wall and wedges starts crossing, repair shall be under taken. The gauge shall be used for determining the wear.

c. The class of electrode, gauge of electrode, welding current and welding precautions to be taken while repairing the surfaces by welding.

601 D. REPAIR AND MAINTENANCE DURING ROH & POH

In addition to all the work prescribed at para 601 C above, the following work is also to be done in ROH/POH :-

a. The bogie should be dismantled. Dismantling and assembly procedure is given in para e. The bogie clearances and tolerances should be checked and rectified, if found necessary.

b. Position the job for down hand welding and carry out the repairs. Ensure that suitable manipulators are used.

c. After the repairs the repaired surface should be checked with relevant gauge for correctness. Excess material, if any, should be removed by grinding or machining.

d. All the wearing surfaces of bogie shall be brought to "As New" condition.

e. Assembly and disassembly of the bogie

I. DISASSEMBLY

- Disconnect bogie brake rigging attachment to underframe and brake gear and raise car body. Run out the bogie.
- Inset assembly pin (12mm dia x 250 mm long) to retain friction shoes.
- Raise bolster to connect top member of side frame.
- Remove outer, inner and snubber springs.
- Remove assembly pins and lower wedge blocks to take them out.
- Lower bolster to rest on the spring plank.
- Slide the bolster to one side to take it out.
- Take out the key from side frame to release the wheel sets.
- Take out the side frames and spring plank assembly.
- Remove the adapter retainer bolt to release the adapter.

II. ASSEMBLY

- Re-assemble the bogie by re-raising the procedure as above.

  Important: Inspect all the load and snubber springs for proper seating after wagon body is on bogies.

- Matching of both load and snubber spring is important. It is recommended that springs having upto 3 mm free height variation should be assembled in same group. Mixing of new and old springs should be avoided.

- The centre pivot of the bogie shall be lubricated with graphite flakes to IS:495 at the time of assembly. No other mating surface in the bogie shall be lubricated.

For detailed description of each item and its maintenance procedure, refer to RDSO publication No. G-95 (Rev.1); March 1997.

601 E. NOMINAL CLEARANCES

The nominal clearances and the tolerances of the bogie assembly are given below.

Sr. No.	Description	**Type of CASNUB Bogie**			
		22W(M) & 22W (Retro)	22W(M)	22NL NLB	22HS
1.	Lateral clearance between side frame & bolster	18 mm	18 mm	18 mm	25 mm
2.	Lateral clearance between side frame & adapter	25 mm	25 mm	16 mm	16 mm
3.	Longitudinal clearance between side frame & adapter	2mm	10 mm	9 mm	9 mm
4.	Longitudinal clearance between side frame & bolster	6mm	6mm	6mm	6mm
5.	Clearance between anti- rotation lug & Bolster	4mm	4mm	4mm	4mm

TABLE 6.1
WEAR LIMITS FOR BOGIE COMPONENTS

Sr. No.	Description	New or Renewed	Worn	Wear Limit
1.	**AXLE BOX**			
	Axle Box Crown lugs (Cylindrical Roller Bearings)	159 mm	167 mm	4 mm
	Axle Box Crown seat (Cylindrical Roller Bearings)	36.5 mm	33 mm	3.5 mm
	Axle Box side lugs (Cylindrical Roller Bearings)	130 mm	136 mm	3 mm
	Axle Box sides (Cylindrical Roller Bearings)	268 mm	262 mm	3 mm
2.	**ADAPTER**			
	Adapter Crown lugs (Wide Jaw)	156 mm	164 mm	4 mm
	Adapter Crown lugs (Narrow Jaw)	155.5 mm	163.5 mm	4 mm
	Adapter Crown seat	3.5 mm		
	Adapter bore seat to crown seat			
	Wide jaw adapter	48.5 mm	45 mm	3.5 mm
	Modified wide jaw adapter	25.5 mm	22 mm	3.5 mm
	Narrow jaw adapter	26.2 mm	22.7 mm	3.5 mm
	Adapter Side Lugs			
	Wide Jaw	130	136	3
	Narrow Jaw	97	103	3
	Adapter Sides			
	Wide Jaw	268	262	3
	Narrow Jaw	181	175	3
3.	**Side Frames**			
	Side frame wear friction plate	10	6	4
	Side frame column sides	216	206	10
	Side frame anti rotation lug	522	528	6
4.	**Pedestal Crown Roof**			
	Key Seat to Pedestal Crown Roof 22W	273	278	5
	Key Seat to Pedestal Crown Roof 22W(M)	318	323	5
	Key Seat to Pedestal Crown Roof 22NL/ NLB/HS	323	328	5

5.	**Pedestal Crown Sides and Sides of the Pedestal**			
	All Bogies – Crown Sides	152	144	4
	Pedestal Sides 22W,22W(M)	105	101	2
	Pedestal Sides 22NL,NLB, HS	81	77	2
6.	**Distance between Outer & Inner Pedestal Jaw of CASNUB Bogies**			
	22W & 22W(Retrofitted)	270	278	4
	22W(M)	278	286	4
	Pedestal Jaw (Short) for 22NL/NLB/HS	190	198	4
	Pedestal Jaw (Long) for 22NL/NLB/HS	236	244	4

Description	**New**	**Worn**	**Wear Limit**
BOLSTER			
Pocket	35 degree on slope		
Liner	8 mm	3 mm	5 mm
Bolster land surface	444 mm	438 mm	3 mm
Rotation stop lug	518 mm	512 mm	3 mm
BOLSTER COLUMN GIBS			
Outer gib	234/241 mm	244/251 mm	5 mm
Inner gib	136 mm	146 mm	
CENTRE PIVOT			
Wear limit vertical side			
CASNUB 22W	-	-	5.5 mm
Others	-	-	4 mm
SEAT			
CASNUB 22W	-	-	4 mm
Others	-	-	4 mm
FRICTION SHOE WEDGE BLOCK			
Vertical Surface from Centre line of spigot	61 mm	54 mm	7 mm
Slope surface by gauge	-	-	3 mm

ELASTOMERIC PADS		
Type of pad	Nominal Dimension	Dimension after permanent set
Elastomeric pad	46 mm	42 mm
Side bearer rubber pad	114 mm	109 mm

SPRINGS

Bogie Type		Spring free height nominal (mm)	Recommended free condemning height (mm)
All version except CASNUB 22 HS	Outer	260	245
	Inner	262	247
	Snubber	294	279
CASNUB 22 HS	Outer	260	245
	Inner	243	228
	Snubber	293	278

It is recommended that springs having less than 3 mm free height variation should be assemble in the same group. Mixing of new and old spring must be avoided. The bogie is fitted with two groups of long helical spring nests. The spring groups per bogie for various axle load applications are as under:

Axle Load	**Number of Springs**		
	Outer	**Inner**	**Snubber**
22.9 t	**14**	**10**	**4**
20.3 t	**12**	**8**	**4**
20.3 t (22HS)	**14**	**12**	**4**
16.3 t	**8**	**8**	**4**

601 F. REFERENCE DRAWING NUMBERS FOR COMPONENTS

Sr.No.	Components	Drawing No./Pamphlet No.
1.	AAR taper cartridge bearing	BP-200923-1-NBC G 81,1st revision issued by RDSO
2.	Worn Wheel Profile	WD-88021, or as per drg.
3.	Wide jaw adapter for CASNUB 22w & CASNUB 22 W(M)	RDSO Sketch No. Sk- 78527
4.	Wheel set and retainer bolt foe CASNUB 22W (without Elastomeric pad)	WA/WL-4902, Sk-68512, WD-89025-S/1, Sk-69594 (retainer bolt)
5.	CASNUB 22 W(M) wheel set	WA/WL-4902/WD-89025-S/1
6.	CASNUB 22 NL,22NLB & 22HS with wheel set	WD-89025-S/1
7.	Leading dimension and tolerances	Sk-69599(W), WD-85054-S/6(22WM), WD-90042-S/1(NLB), WD-92058-S/7(HS)
8.	Load bearing Springs & Snubber Springs	WD-83069-S/1(All versions except 22HS Bogies) WD-92058-S/5 (22HS Bogies)

Sr.No.	Components	Drawing No./Pamphlet No.
9.	Springs	Silico Mangnese steel to IS : 3195 Gr 60 Si7, Gr 60 Cr4V2 Gr. 51 CrMoV4, IRS specification R2 and RDSO specification WD-01-HLS-94 (rev.1)
10.	Centre pivot CASNUB 22W	W/BE-601 for top pivot W/BE-602 for Bottom pivot
11.	Centre pivot other than CASNUB 22W	WD-85079-S/2
12.	Elastomeric Pads	WD-89067-S/10, WD-92058-S/8 (for HS), WD-95005-S/1
13.	Side Bearer Rubber Pads	WD-85076-S/1
14.	Brake Block	WA/BG-6158
15.	CASNUB 22W(M) bogie, brake beam, brake head & block assembly	WD-85084-S/1, WD-88012-S/1, WD-86034-S/1
16.	Brake beam [22W, 22NLB & 22HS]	Sk-69596, WD-89033-S/1

602. FABRICATED BOX BOGIE (UIC BOGIE)

602A. GENERAL DESCRIPTION

These bogies are used on BOX, BCX, BCXT, BRH, BRS wagons. It is also known as UIC bogie.

The BOX bogie is designed for an axle load of 20.3t. It is an all welded, plate fabricated bogie having a fixed bolster with hemispherical centre pivot and primary suspension incorporating four laminated bearing springs with long links supported by mild steel stones. The suspension arrangement and axle box design with liberal lateral and longitudinal clearance are intended to permit the wheel set to "float" relative to the bogie frame, with the object of improving the riding characteristics of the bogie. The roller bearing axle boxes are provided with "L" type lugs, so that in its lateral movement, wheel set is constrained by only one axle box at a time and there is no reversal in bending of bogie sole plate.

602 B. CONSTRUCTIONAL DETAILS

A limited number of mark 'O' type bogies were applied on BOX, BRH and BRS type wagons during their initial production. The bogie frame of the Mark 'O' type is of a riveted cum welded construction whereas Mark-I has an all welded plate fabricated bogie frame. Apart from this basic change in the construction of the bogie frame, there is no change in any of the general design features between Mark-I and Mark 'O' bogies. Both of them are interchangeable. Mark 'O' bogies has withdrawn from service.

The bogie consists of the following important parts :-

a) Bogie frame including integral bolster, head-stock and trimmers
b) Centre pivot arrangement
c) Side Bearer arrangement
d) Spring suspension arrangement
e) Horn cheeks
f) Roller bearing axle boxes
g) Wheel sets
h) Bogie Brake gear

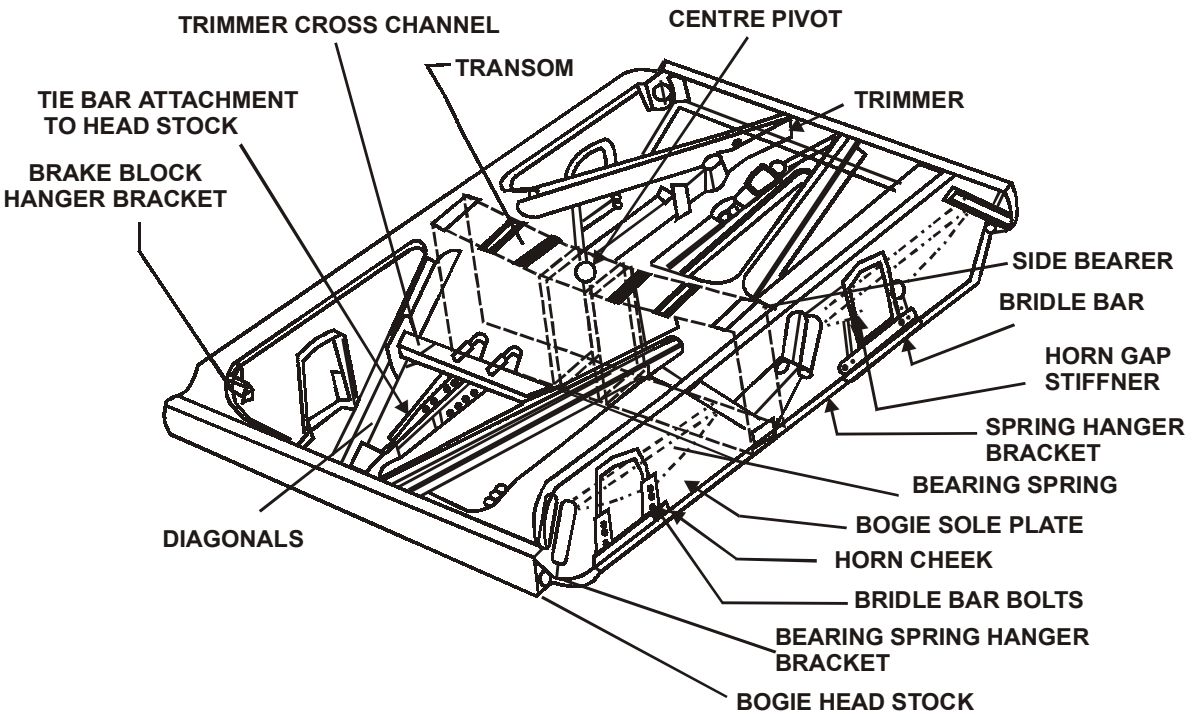


FIG. 6.2 : ISOMETRIC VIEW OF BOX TYPE WAGON BOGIE FRAME (B.G.)

a) SIDE FRAME

This acts as a sole plate of the bogie frame. It runs parallel to the track, two side frames are joined together at the centres by bolster and by two head stocks at the ends. They maintain correct distance between the side frames as well is squareness and alignment of the bogie. On each side frame, two horn gaps are provided near the ends for fixing axle boxes. In the central position, control spring hanger bracket is fitted. Two inner and two outer cap pressings have been provided to strengthen the opening of the sole plate provided for the insertion of shackle pins. Spring stops have been welded on sole plate/top flange.

The sole plate is made of 8 mm thick plate. Other plates are also made of this material. The trolley frames were found to be having many welding defects. RDSO has issued detailed instruction vide No. R-7 for rectification of these welding defects on bogie frame.

b) BOLSTER

Bolster is welded at right angles to the two side frames. It alongwith head stock, keeps them at correct distance and maintain squareness and alignment of the bogie. It is a fabricated construction consisting of one top plate and one bottom plate and two vertical side plates.

These are joined together to form a box section. In the centre where centre pivot is fitted, two stiffener plates have been provided at a distance of 360 mm. Perpendicular to the vertical side plates. In the ends, near the side bearers it is strengthened suitably. The top and bottom plates are 12 mm thick and side plates are 8 mm thick made out of plate. Other plates used in the assembly are mostly 8 mm and 10 mm thick. The top plate is bent in the centre and the side plate is at suitably forming a well in the centre. In the centre portion the bogie pivot is welded and on both ends the side bearers are welded.

c) HEAD STOCK

The head stocks are welded at right angles to the sole plates at both ends. Head stock and bolster together maintain the required distance between the two sole plates and also ensure squareness and alignment of the bogie frame. The head stock is a channel section of 200x75 x 7.5 mm. It is suitably joined with the sole plate at both the ends. Two diagonals (one each on RH and LH) are also attached with it. The safety loop brackets are also welded to it in the central portion.

d) DIAGONALS

To absorb draw and buffing force, the bogie has been strengthened by providing two diagonals between the head stock and the bolster on its either ends. Thus there are total of 4 diagonals, 2 left handed and 2 right handed. The diagonal is made of the channel section of 125x65x6 mm web. They are suitably notched at both ends to fit the head stock and transoms. The diagonal is inclined. Its height from the rail level is higher near the bolster and lower near the head stock.

e) SAFETY LOOP BRACKETS

It is made of steel plate 8 mm thickness out to a suitable shape. At one of the ends it has got 13.5 mm dia hole. It is welded to the head stock channel near its central portion. Two brackets are fitted on each head stock. Thus a total of four brackets have been provided.

f) BOGIE TRIMMER (OUTER & INNER)

In the initial builds of MK-I and MK 'O' bogies the trimmer arrangement consists of a pipe between the diagonals, two cantilever arms and one tie attached to the pipe trimmer on one side and on the other side to head stock, in the case of outer trimmer. In case of inner trimmer, two pairs of cantilever arms are attached to the pipe trimmer. Due to welding failures in the regions, the design was altered and all the bogies, manufactured since 1963-64, have been provided with channel type of trimmers. In this design, the outer trimmer consists of one cross channel connected in between two diagonals and two channels running between cross channel and bolster. There is also an additional pressing running transverse over the two longitudinal channels and one pair of brake suspension flats. In the case of inner trimmer, it consists of one cross channel between two diagonals and two longitudinal channels running between bolster and cross channel. This carries two pairs of brake suspension brackets.

g) SAFETY LOOP BRACKETS

Two safety loop brackets have been provided on outer trimmer and two on inner trimmer arrangement. It is a trapezium shaped plate of 8 mm thickness with a hole of 13.5 mm dia. in the centre. It is attached at suitable locations in the bottom of the longitudinal trimmer channel.

h) CENTRE PIVOT ARRANGEMENT

Centre pivot is of hemispherical design. The whole load on the centre point is borne by a fixed bolster that distributes the load directly to the laminated bearing springs and to the journals. There is no secondary suspension in these bogies. The centre pivot arrangement consists of the following :-

I. Retaining ring
II. Bogie centre pivot top
III. Bogie centre pivot bottom
IV. Centre pivot retainer
V. Washer
VI. Bogie centre pivot top (Bolts & nuts) - 4 Nos.
VII. Dust shield for bogie centre pivot

Bogie centre pivot is fitted centrally on the fixed bolster. The bolster is suitably strengthened from below at the centre to take the weight of the body. Similarly, the underframe of the body has been suitably strengthened from top at the centre.

I. RETAINING RING

The retaining ring is given a special shape to afford sufficient strength against impact loads and also to provide requisite length of welding. The outer periphery of the ring is finished machined. The retaining ring is welded to the gusset plate of the under frame from inside. The retaining ring outer periphery fits closely in the internal circular recess of the centre pivot top. The head of the centre bolt comes between the bottom lugs of the retaining ring.

II. BOGIE CENTRE PIVOT TOP

It is made of cast steel, hemispherical shape at the bottom and at the top flange portion it is a square when the corners are rounded off to liberal radius. There are four holes of 26 mm dia. to enable fitment of centre pivot bolts. There is a recess of 270 mm dia. Close tolerance (+0.5/-0) for fitment of retaining ring. Lubricating groove has been provided over the hemispherical surface. The centre pivot is rough machined over the top flange surface and the pivot bearing surface is finish machined. The sides of the top flange are rough ground.

It is secured with the body of the wagon by means of 4 Nos. of M-25 bolts, 90 mm long with nuts. After fitting, the nut should be tack welded with the bolts. The other hemispherical surface rests on the centre pivot bottom.

III. CENTRE PIVOT BOTTOM

It is made of cast steel, hemispherical in shape with a circular flange near the top. It has a boss at the centre. Its top hemispherical surface is of 200 mm radius. The outer diameter of the circular flange is 430 mm and its total height is 125 mm. The boss has a hole of 60 mm dia. The external dia. of the boss on top is 100 mm and at bottom 130 mm. On the bottom surface of the circular flange, there is a recess of 380 mm outer dia, 310 mm inner dia & 9 mm depth. The vertical surface of the internal dia. fits in the opening in the bolster. The bottom surface of the circular flange rests on the bolster. A semicircular grease groove of 5 mm radius and depth is provided on the hemispherical surface near the boss. The top surface of the boss is 30 mm below the top surface of the pivot. The top surface of the boss, the hemispherical surface, the centre hole on the vertical surface of the internal recess are finished machined. The outside surface of the boss having 100 mm dia. is rough machined. The top circular flange surface is rough ground.

The centre pivot bottom fits in internal opening provided in the bolster opposite to its internal vertical surface of the bottom recess. The bottom surface of the flange rests on the bolster and is tack welded all round at its outer most periphery. The centre pivot top rests on the hemispherical surface of the centre pivot bottom.

IV. CENTRE PIVOT RETAINER

Its top surface is circular and lateral surface is hemispherical with flat surface in the bottom. Both top and bottom surfaces have circular recesses in the centre. The depth of the top recess is 15 mm and dia. 175 mm. The depth of the bottom recess is 12 mm and dia. 110 mm. The top surface is 240 mm in dia. It has been chamfered at 45^0 for a depth of 2 mm. The dia. of the bottom surface is 130 mm. The total height of the retainer is 42 mm. There is a centre hole of 60 mm dia, 15 mm long. The hemispherical surface has a radius of 168.5 mm. The top surface, the top recess surface, bottom flat surface are rough machined. The hemispherical surface, the central hole surface and the inner surface of the bottom recess are finish machined. The chamfered surface is rough machined.

The centre pivot retainer rests on the top surface of the boss of the bogie centre pivot bottom. Thus a small clearance is left between the inner hemispherical surface of the bogie centre pivot top and the retainer. The washer is made to rest on the top recess of the centre pivot retainer.

V. CENTRE PIVOT WASHER

The washer assembly has 2 different parts glued together. The thickness of each pivot is 10 mm with 170-mm external dia. and 60 mm internal dia. The top is made of steel and the bottom part is made of either Buna synthetic rubber or India rubber. The latter is glued to the former and both together are stocked as washer.

The bottom rubber portion of the washer rests on the top recess of the retainer. The head of the centre bolt rests on its top steel surface.

VI. CENTRE PIVOT BOLT

It is made of steel size 227 mm long x 56 mm dia. The length of the threaded portion from bottom is 79 mm. The circular head is of 80 mm dia., 25 mm thick. The circular head has been machined to two flat edges opposite to each other kept at a distance of 70 +0/ -1.2 mm. An undercut of 8 mm width x 3 mm depth has been provided at a distance of 79 mm from bottom. The thread is of M-56 size. A hexagonal castle nut to suit M-56 thread of 74 mm height is used on this bolt. The material of the castle nut is same as that of the bolt130 mm external dia. 58 mm internal dia. and 10 mm thick washer is used before the nut.

The head of the bolt fits between the bottom lugs of the bogie centre pivot retaining ring. The head rests on the metallic surface of the composite washer. It then passes through the hole of the washer, retaining and the bogie centre pivot bottom. The washer and the castle nut is fitted below the bottom surface of the boss of the bogie centre pivot bottom. A clearance of 2 mm is maintained between the bottom surface of the boss and the washer.

The flat surface of the bolt head fitting between the bottom lug of the centre pivot retainer ring prevents it from retaining. As the nut is fitted at a place, difficult to access, the bogie should be run out by opening the four bolts of the bogie centre pivot and lifting the body by about 150 mm.

VII. DUST SHIELD FOR BOGIE CENTRE PIVOT

It is made of mild steel sheet. The plate is of 2 mm thickness. It is bent like a circular ring having inclined surface. The height of the ring is 50 mm. The outer dia. at top and bottom are 385 mm and 405 mm respectively. The ring is large enough to cover the important surface of the centre pivot assembly and surface is welded around to the bottom surface of the square its top flange of the bogie centre pivot top, just inside the bolt heads. It protects the centre pivot assembly from dust and dirt.

i) SIDE BEARERS

The two bogie side bearers are fitted at a distance of 1940 mm, i.e. 970 mm from the centre of the bogie. The bogie side bearer is welded along its length of top plate on the bolster 12 mm thick. At this location, the bolster plate has been strengthened from below. The top side-bearer is secured with the under frame plate by two nos. of M-20 CSK bolts. Below the nut a spring washer is provided and the nut is secured by 6.3 dia, 32 mm long split pin. At this location, the under frame plate has also been suitably strengthened from above.

j) BOGIE SIDE BEARER

It is a rectangular plate of size 300 x90x20 mm. At the bottom, it is flat and on top it has a radius of 1 metre long its length. In the centre, the bottom surface has a recess of 40 dia. x 9 mm. The thickness at the sides is 9 mm and at the centre is 20 mm. On the covered surface, 2 rectangular recesses of size 40 x 100 mm have been provided at both ends. Towards the centre end the recess has been curved to a semicircle of 40 mm dia. The thickness of the plate at the recessed portion is 9 mm. The bottom surface of the side bearer is rough machined and the curved surface rough ground.

k) SIDE BEARER (TOP)

It is a plate of 300 x 100 x 25 mm size with two countersunk bolt holes size M-20 at a distance of 240 mm. The chamfered height of the bolt hole is 12 mm. This plate is fastened to the underframe by means of two countersunk bolts of M-20 size.

l) SPRING SUSPENSION ARRANGEMENT

The spring suspension arrangement on BOX wagon is an improvement over the suspension of 4 wheeler wagons. The shackle plate has been replaced by long shackles and stones. The split cotter replaced by shackle pin retainer and split pin. The scroll iron replaced by brackets attached with the bogie frame. The spring buckle has a spigot at the bottom, which engages in a bush seat located at the crown of the Axle Box. For each spring, 4 vertical spring stops have been provided to restrict its movement in the vertical direction in the event of breakage.

The load of the wagon Body including its contents and under frame is transmitted to the bogie frame through the central pivot arrangement. On the bogie frame, one central and two head stock brackets have been provided. The load is transmitted to the spring from these brackets through shackle pin, stone, shackles followed by stones on the spring and pin and the spring eye. From the top plate of the spring eye, the load is transmitted to the Axle box crown through spring plates buckle and its spigot.

m) SHACKLE PIN

It is secured in position by Retainer and split pin. The dia. of the shackle pin is 35 +0/ -0.5 mm. Starting from the head end of the shackle pin the stone is inserted followed by spring Eye/Bush Eye, stone again and shackle pin Retainer. Each shackle pin Retainer, which has a rectangular fork shape is further secured by a split pin. The Retainer fits on the two flat and parallel recesses of the shackle pin.

n) SHACKLE STONE

It is a solid block having a hole of 36 (+0.5/-0.0) mm dia. in the centre. On both sides, it has a semicircular forked end perpendicular to the axis of the hole. The radius of the circular portion of the forked end is 13.5 (-0.0/+0.5) mm. The shackle pin passes through the hole of the stone. The shackle stone has been made reversible so that both ends thereof can be used for longer life. One stone is provided on either side of the spring Eye/Bush of the spring suspension Bracket. The spring shackle sits on the circular portion of the stone.

o) SPRING SHACKLE

It has a circular cross section of 25 +1.0/ -0.5 mm. It should not be finished. A shackle can also be made out of a bar by bending it to two 'U' pieces and joining the ends by resistance welding. The effective length of the shackle is connected from the inner edges along its width. The top and bottom inner edges & side inner edge upto a length of 25 mm from top and bottom edges should be rough ground to a circular form to ensure proper contact with the stone.

p) SHACKLE PIN RETAINER

It is made in a forked shape that has varying cross section at different locations. The inside edges of the fork end is made to a rectangular shape having a semicircular closed end and on open end. The rectangular portion of the edges fit on the two flats of the shackle pin and the circular edges match the curved portion of the shackle pin. The open end has a split pin hole of 8 mm dia. After fastening the stone in the assembly, the retainer is fitted on the shackle pin and is secured by the split pin.

q) LAMINATED SPRING

The weight of the wagon body including its contents, under-frame, bogie frame, is transmitted to the spring eye through the shackle suspension arrangement. From the spring eye, the weight is transmitted to the Axle Box crown, through the spring plates, Buckle and its spigot. The various aspects of the laminated spring viz. its material, cleanliness, maintenance and manufacturing practices, the rejection defects, defects noticed in service, precautions are to be taken. These are applicable to the laminated spring fitted on UIC Bogies. The special features of laminated Bearing spring for BOX/BCX and other similar type of wagons are given as under:-

Ten plate bearing spring to IRS Drg.No.WA/SN-6302/WD-86007-S/1 has been provided on BOX wagons. The spring buckle has a spigot at its bottom, which engages in the bush seat provided in the crown of Axle Box. The spring, as such, directly bears on the Axle Box Crown. In the original design, the top plate had rib and groove. Now, the Bearing spring has been modified to incorporate flat top plate with a clip at either end.

r) SOLE PLATE TROLLEY FRAME

It is a plate of 8 mm thickness.

s) RIVETING STRIP

It is made of a plate of 6 mm thickness, 240 mm long and 45 mm wide with 4 mm chamfer at 45^0 on one of the vertical edges. It has 4 rivet holes of 17.5 mm dia. at a distance of 16 mm, from the chamfered edge having pitch of 60 mm. It is fitted on the inner surface of the sole plate. The snap head of the rivet bears on its other surface. The edge has been chamfered to enable the Horn gap stiffener to be fillet welded to the sole plate. The other edge should be tack welded with the sole plate.

t) HORN CHEEK PACKING

It is 240 mm long and 38 mm wide. It has a 8 mm chamfer at 45^0 on its vertical edge to enable fillet welding of horn gap stiffener with the sole plate. It has four rivet holes similar to the riveting strip except that they are at a distance of 18 mm from the chamfered edge. It is fitted on the outer surface of the sole plate. On the surface opposite to this surface, the horn cheek is secured. The vertical edge opposite the chamfered edge is fillet welded to the sole plate.

u) HORN CHEEK

It is an 'L' shaped part made of steel. Its short leg is kept perpendicular to the track and the long one parallel to the track. The long leg is secured with the sole plate by four counter shunk rivet of 16 mm dia. with horn Cheek packing between the two and the riveting strip placed behind the sole plate. The four parts are riveted together. The thickness of the long leg is 17.5 (+0/-0.5) mm and short leg 15 ± 0.5 mm.

v) HORN GAP STIFFENER

It is a inverted 'U' shaped block of 25 mm thickness and 65 mm width at most of the places. At the top, the width increases to 80 mm and the bottom decreases to 45 mm. Its outer surface is kept perpendicular to the sole plate and welded to it on both sides through out its periphery. The inner straight edge is kept at a distance of 37 mm from the inner surface of the sole plate. The outer edge opposite the horn cheeks is at a distance of 20 mm from outer surface of the sole plate.

w) PACKING BEHIND SOLE PLATE (FOR HORN GAP TIE BARS)

Its vertical edges near the horn gap stiffener is inclined and chamfered. It is fitted just after the horn gap stiffener keeping its bottom longer side 20 mm above the bottom edge of the sole plate. It is tack welded to the inner surface of the sole plate along its longer sides. It has two rivet/bolt holes, which are drilled in position after tack welding with sole plate.

x) HORN GAP BRIDLE BAR

The horn gap bridle bars were secured to the bogie sole plate by means of four bolts and stock put in service initially. Now the bridle bars to be secured by riveting. Special attention should be paid to the security arrangements of the bridle bar at the time of maintenance or when wagons are received in sick-line for repairs. Slack tie bar can induce cracks in the bogie sole plate.

y) CENTRE SPRING HANGER BRACKET

It is centrally welded to the sole plate of the bogie. Two brackets are required for each trolley. On the brackets ferrules and two bushes are provided. The shackle pin passes through the bush hole. On both sides of the bush, shackle stones and shackles are fitted. The load transmitted from the trolley frame to the bracket thus gets transmitted to the spring.

The bracket consists of four parts, viz. hanger brackets, pressing, ferrule and bush. The hanger bracket is made of 8mm thick steel plate. Its front view is like a trapezium. Its all four side are bent at 90°. At both the top corners suitable openings have been provided to fit pressing. The pressing is also made of 8mm thick steel plate bent at right angle. One side is welded to the sole plate and the other side to the hanger bracket.

The ferrule is made of steel of size 75 mm outer dia (46 + 0.039/ -0.0 mm inner dia.) X (120 + 0 / -0.5 mm length). The outside surface of the ferrule is welded to the bracket and pressing. Its inside surface is fine finish machined whereas outside and both side surfaces are finish machined.

The bush is made of steel having internal dia. as 36 +0.2/-0.5mm and length 120 +0.0/ -0.5 mm. Its outer surface is fine finish machined. The inside and two side surfaces are finish machined. Its out side dia. is in four sizes as under:

Normal size	46	+ 0.10 mm + 0.07 mm
Over size	46.5	– 0.05mm – 0.09 mm
Step size	47.5	+ 0.10 mm + 0.07 mm
Over size	48	– 0.05mm – 0.09 mm

z) HEAD STOCK SPRING HANGER BRACKETS

It is fitted to the headstock of the trolley frame. Four brackets are required for each trolley. It consists of following parts:

Sr.	Name of the Part	No. Per Trolley	Material
1.	Side plate outer	4	Steel 42WC to IS : 2062
2.	Side plate inner	4	--do--
3.	Cover plate	4	--do--
4.	Top ribs	4	--do--
5.	Bottom ribs	4	--do--
6.	Ferrule	4	--do--
7.	Bush	4	--do--

Side Plate Outer: It is 8 mm thick plate cut to a polygon having five sides and welded to the channel of the head stock perpendicular to it. One of the sides out of the five is circular in shape.

Inner Side Plate: It is similar to outer plate except that near the vertical end, it has been joggled to triangular shape towards the sole plate of the trolley frame.

Cover plate: It is made of 6 mm thick plate bent to angular shape matching the profile of 3 sides of the inner and outer plates. It has been welded to the inner and outer plates joining them together.

Top Ribs: It is made of 12 mm thick plate and cut to polygon shape having six sides. It is welded in the center to the cover plate at right angle. One of its other side is welded to the end plate of the bogie side frame.

Bottom Rib: It is made of 12 mm thick plate cut to a polygon shape having the five sides. It is welded to the cover plate similar to the top rib and of its other side is welded to the bottom end plate of the bogie side frame.

One end of the spring is attached to the Centre spring hanger bracket and the other end to the head stock spring hanger through the shackle assembly. Shackle pin of shackle assembly passes through bush of ferrule & transfers load.

602 C. MAINTENANCE OF SUB-ASSEMBLIES

a) MAINTENANCE OF CENTRE PIVOT ASSEMBLY

The inner surface of the centre pivot bottom and the outer surface of the centre pivot top are liable to wear in service. After certain period the surfaces may no longer be hemispherical. These two hemispherical surfaces have a common radius of 200 mm. It can be reduced in thickness by 3 mm. In

order to restore uniform hemispherical shape, it should be machined to the same radius of 200 mm by bringing the centre nearer for the bottom pivot and furthering it away for the top pivot to a maximum extent of 3 mm. This will lower the height of top side bearer to a maximum extent of 6 mm. Replace centre pivot if the wear exceeds 3 mm on each. If the wear is within permissible limit, in order to keep the prescribed side bearer clearance between 4 mm to 7 mm, a liner ring of not more than 3 mm thick has to be used between the under frame bolster bottom gusset and centre pivot top.

Wear will also take place between top surface of the retainer and bottom surface of the washer. As rubber washers are used, the wear on the top surfaces of the retainer will be negligible. When the thickness of the rubber portion of the washer reduces to 7mm the washer on the rubber should be replaced. Wear may also take place between the bolt head and the metallic portion of the washer. The ridges at this location should be removed.

b) MAINTENANCE OF SIDE BEARER CLEARANCE

The prescribed clearances are:

	Clearance on one side	**Total Clearance**
Minimum	**4 mm**	**8 mm**
Maximum	**7 mm**	**14 mm**

The initial clearance provided is 4 mm. In service, both the side bearers wear. The bottom side bearer should be built by welding when it is worn out by 3 mm.

c) MAINTENANCE OF SHACKLE PIN AND SHACKLE STONE

The diametrical clearance between the shackle pin and the spring Eye should not exceed 1.25 mm when new. The clearance between the shackle pin and bush hole of the spring suspension bracket should not exceed 1.5 mm when new. The maximum permissible diametrical clearance for these two locations is 3 mm. For one BOX bogie 16 and for one BOX wagon 32 shackle pins are required.

The radius at the corner of the shackle and stone have been increased from 6 mm to 10 mm reduce the stress concentration at the corners of the shackles. A stone having 10 mm to radius may be used in conjunction with shackle having 10 mm radius. In such cases, the corners of the stone should be machined to 10 mm radius. Since, these modifications were issued long ago, very few shackle and stone of 6 mm radius will be in use now. It should be ensured that the spring shackle freely articulate on shackle stone without binding at corners.

When new, the effective length of spring shackle should be 332 (+1.0/-0.0) mm. The maximum permissible wear at this place is 2 mm. The shackle should be replaced when the diameter is reduced below 23 mm at this location. While pairing the shackle on either end of the spring, it must be ensured that variation in effective inside length does not exceed 2 mm. Excessive variation in effective length can lead to uneven loading of the two shackles and the heavily loaded shackle may fail. Inside width of the shackle is 62 (+1.0/-0.0) mm. It is necessary to ensure this dimension is less than the shackle else it will not clear the sides of the stone.

The radius at the corners of the shackle has been increased from 6 mm to 10 mm to reduce undue concentration of stress at this place. The shackles manufactured with 10 mm radius should be printed yellow with two coats of paint to distinguish if from shackles having 6 mm radius. Either ends of the shackles can be used in the spring end or Bush-end of the bracket. It is important that the inside edges of the retainer is made to correct dimensions and the shackle pin hole is drilled at correct locations.

d) MAINTENANCE OF HORN CHEEK & GAP STIFFENER

Both the legs of the horn cheek wear in service. All the six vertical edges along the length of the horn cheek have been given a radius of 1.5 mm.

The lateral play between axle box lug and horn cheek, when the both are new is 20 mm and when worn out is 25mm. The lateral clearance available between spring buckle and horn gap stiffener is 25 mm. In view of this clearance, the Horn cheek must be replaced if reduced to 13 mm in thickness, i.e. worn out by 4.5 mm or when total wear on axle box lug and horn cheek reaches 5 mm to avoid spring buckle coming in contact with horn gap stiffener.

Longitudinally, a total of 12 mm clearance is provided in between the axle box and horn cheeks when new. This clearance, when axle box and horn cheeks are worn out, should not exceed 18 mm or the short leg of horn cheek should not be permitted below 12 mm in thickness.

Special attention should be paid to lateral and longitudinal clearance between axle box and bogie frame, since these clearances govern the above mentioned floating characteristics of the wheel set.

e) MAINTENANCE OF AXLE BOX LUGS

Normally, the faces of the lugs of axle box are not expected to wear fast. However, mainly due to improper alignment of the bogie frame some times wear takes place on axle box lugs. Whenever such wear is noticed, alignment of the bogie should be done as detailed in RDSO's Technical Pamphlet No. G-16 (Rev.2).

Worn out axle box may be reclaimed by using manual metal arc welding of Manganese steel liner (cast or rolled) of 3 mm or 5 mm thickness to the lugs of 3mm or 5mm thickness. In case wear exceeds more than 5 mm. no reclamation should be done.

Condemning size for horn cheek is based on the assumption that wear taken place on horn cheek. When Axle boxes are found to be worn, it has to be kept in mind that horn cheeks will have to be above the condemning dimensions so maximum limit of total longitudinal clearance of 18mm and lateral clearance of 24.5 mm do not exceed.

Whenever wear on axle box lug is more than 1.5 mm on any side, Manganese steel liner of size 6 mm or 5 mm thickness can be welded to the lugs of these boxes. After axle box is restored to its original dimensions. The surface of the axle box lugs should be machined or ground. The mill scale on the liner should be removed either by grinding or by the wire brushing. The liners should be flat and straight. While replacing the old Manganese steel liners by new one, care should be exercised to remove all old welding by chipping or grinding to ensure a smooth surface. The surface of the axle box should be thoroughly cleaned by wire brush. The surface of the axle box lugs and liners should be totally free of oil, grits and grease etc. before the welding is undertaken.

The longitudinal distance between lugs of the axle box is 265 +0 / -0.3 mm. When this distance reduces, the liners should be provided as given below.

Sr. No.	Longitudinal distance between lugs of the axle box	Distance from the centre of axle box to any side	Liner to be used
1.	Between 259 mm to 262 mm	between 129.5 to 131 mm	3 mm thick
2.	Between 259 and 254.7 mm	Between 127.35 mm to 129.5 mm	5 mm thick

The lateral distance of lug from the axle box is 65± 0.0/0.4mm. When this distance reduces, the following liners are to be provided.

Sr. No.	Lateral distance between lugs of the axle box	Liner to be used
1.	Between 62 and 63.5 mm	3 mm thick
2.	Between 60 mm to 62 mm	5 mm thick

The condemning dimensions are as under:

- Longitudinal distance between lugs — Below 254.7 mm
- Longitudinal distance between lugs from the centre of the axle box on side — Below 126.35 mm
- Lateral distance of the lugs from the centre of the axle box — Below 60 mm

Detailed instruction on the procedure of manual metal arc welding of Manganese steel liners to the lugs of axle box is given in RDSO Technical Pamphlet No. WT-77-1 Appendix (VI).

f) SPRING

The spring is designed to give reverse chamber at full gross load and is made to the following dimensions:-

i) Length between Eye centre when straight	=	1200 ± 3 mm
ii) Width of plate	=	120 ± 0.6 mm
iii) Thickness of plate	=	16 + 0.32 mm - 0.24 m
iv) Size of Eye	=	36 (+ 1 mm –0)
v) Free camber	=	47 (+ 6 mm –0)
vi) Estimated camber at tare	=	35 mm
vii) Estimated camber under gross	=	- 4 mm
viii) Deflection per ton	=	5.58 mm

The Buckle should be heat shrunk with 875 + 25^{0}C and at 50.8 Tonnes pressure. The maximum variation permitted in the camber of two springs on a bogie truck is 12 mm.

g) HORN CHEEK ASSEMBLY

The axle box horn cheek assembly of Box type wagon have 'L' type lugs on the axle box. The horn cheek assembly consists of the following parts:-

S. No.	Name of Parts	Nos. per Bogie
1.	Sole plate of the Bogie Frame	2
2.	Riveting strip	8
3.	Horn Cheek packing	8
4.	Horn Cheek	8
5.	Horn gap stiffener	4
6.	Countershunk rivets 16 mm dia.	32

602 D. REPAIR AND MAINTENANCE IN SICK LINE

i. Examine and attend the repair of the centre pivot and centre pivot pin. as given in para 603 C(a).

ii. Keep the side bearer clearance between 4 mm to 7 mm by inserting a liner ring (3 mm thick) between the under frame bolster bottom gusset and centre pivot top.

iii. Maintain the side bearer clearance. In service, both the side bearers wear. The bottom side bearer should be built by welding when it is worn out by 3 mm.

iv. Shackle pin and shackle stone to be checked and replaced as given in para 602 C (c).

v. Horn cheek and Gap stiffener to be checked and attended as given in para 602 C (d).

vi. Free camber of spring to be checked. Spring must be changed if it is not as per the specification given in para 602 C(f).

602E. REPAIR AND MAINTENANCE DURING ROH & POH

In addition to the above repair work attended at sick line, the following additional work is also to be carried out during maintenance at the time of ROH and POH:-

i. Bogie is to be fully dismantled

ii. Wear between the inner surface of the centre pivot bottom and the outer surface of the centre pivot top to be checked and repaired as given in para 602 C(a).

iii. Clearance of side bearer is to be maintained as given in para 602 C(b).

iv. Maintenance of shackle pin and shackle stone to be done as given in para 602 C(c).

v. Maintenance of horn cheek & gap stiffener to be done as given in para 602 C(d).

vi. Maintenance of axle box lugs to be done as given in para 602 C(e).

vii. Spring to be checked as given in para 602 C(f).

For details of maintenance and repair procedures of various components, refer to RDSO publication No. G-16 (Rev.2), July 1978.

602 F. MATERIAL SPECIFICATION OF BOX (UIC) BOGIE

Sr. No.	Description of item	Material
1.	Bogie Sole Plate	8 mm thick plate to specification No. IS2062: ST-42-W
2.	Transom	Top & Bottom plate 12 mm thick; Side Plate 8 mm thick , specification no. IS:2062 : ST-42-WC
3.	Headstock	Channel Section of 200 x 75 x 7.5 mm, specification no. IS:2062 : ST-42-WC
4.	Diagonals	Channel Section of 125 x 65 x 6 mm, specification no. IS:2062 : ST-42-WC
5.	Safety loop bracket	Steel plate 8 mm thickness, specification no. IS:2062 : ST-42-WC
6.	Retaining Ring	Specification no. IS:2062 : ST-42-WC
7.	Bogie Centre pivot Top	Cast steel to specification no. IRS: M-2 CLA Gr I
8.	Bogie Centre pivot Bottom	Cast Steel Class A Gr I to specification No. IRS M2.
9.	Centre pivot Retainer	Steel Class IV to specification no. IS :2004.
10.	Washer Top	Steel ST-42-S to specification No. IS : 226
11.	Washer Bottom	Buna Synthetic rubber or India Rubber to specification No. IRS-B-20
12.	Centre Pivot Bolt	Steel St-42-S to specification No. IS-226
13.	Dust Shield for bogie centre pivot	Mild steel sheet grade “O” to specification No. IS-1079.
14.	Side Bearer (Bottom)	Cast steel class A grade I to specification no. M-2 IS-2004 or Class II ST-42-S to specification No. IS:226.
15.	Side Bearer (Top)	Steel ST-42-S to specification No. IS:226.
16.	Shackle pin	Steel Class IV , M4 (Normalised)
17.	Shackle Stone	Steel class II or class S gr.I to specification No. IS:2004 or IRS-M2.
18.	Spring Shackle	Steel class III to specification No. IS:2004 and normalised
19.	Shackle pin Retainer	Steel class II to specification No. IS:2004 and normalized
20.	Riveting Strip	Plate of 6 mm thickness to specification No. 2062 St-42-WC.
21.	Horn Cheek Packing	20 mm thick plate to specification No. No. 2062 St-42-WC.

Sr. No.	Description of item	Material
22.	Horn Cheek	Steel ST-42-SC or steel class II to specification No. IS:226 or 2004.
23.	Horn Gap stiffener	Steel 42 W to IS: 2062
24.	Packing behind Sole plate	Steel 42 WC to specification No. IS: 2062
25.	Centre Spring Hanger Bracket	8 mm thick steel plate of specification No. IS 3747
26.	Ferrule	Steel 42 WC to specification No. IS: 2062
27.	Bush	Steel class iv to specification No. IRS:M4.

603. CAST STEEL BOGIE

The cast steel bogies are used in BOB wagons.

A. GENERAL DESCRIPTION

The two side frames of cast steel are joined together by a spring plank, which is riveted to the side frames. The floating bolster rests on the nest of springs at either end of the spring plank. The load of the wagon is transferred through centre pivot to the floating bolster and then to the two side frames through the bearing springs. These bogies have thus only secondary suspension.

B. CONSTRUCTIONAL DETAILS

The bogie consists of the following main sub assemblies:

a. Cast steel side frame
b. Spring plank
c. Cast steel floating bogie bolster
d. Bogie centre pivot bottom
e. Bogie side bearer (Top& bottom)
f. Spring nest assembly
g. Spring plate
h. Axle box with side frame

a) CAST STEEL SIDE FRAME

Two side frames are required for each trolley. These act as sole bars in the trolley frame. Both are connected together by a spring plank. The spring plank keeps the two side frames at fixed distance as required in design and three together form the letter “H”. The spring plank also keeps the two side frames parallel to each other and ensures squareness of the trolley.

The side frame casting is hollow. In larger portion it forms a box section and in some portion a "C" section. In the central portion of the casting, there is an opening to accommodate the spring nest and floating bolster. On either end of the casting on top, there is an extended portion called pedestal, which rests over axle box top surface. It has two holes for axle box bolts. On both bottom ends, there is an integrally cast bracket to secure the side frame tie bar. The latter is secured to the frame by three rivets. The bottom portion of the axle box rest on the tie bar. On the inner side of the casting, two brackets are integrally cast in the central top portion to suspend the brake beam hanger.

The bottom surface of the top extended portion and the top surface of the bottom integrally cast bracket meant to secure axle box and tie bar respectively are finish machined. The centre opening, which receives the spring plank and bolster assembly, is filed rough ground at all places except on the top. The four axle box bolt holes in the extended portion are drilled. There are six holes in the central opening at the bottom to secure the spring plank by rivets. There are two holes in each of the integrally cast bracket to rivet the tie bar with it. Each of the four brackets meant to suspend the brake beam hanger has a hole. Bushes have been provided in the holes for wear and tear caused due to the pin.

b) SPRING PLANK

The spring plank is manufactured by pressing the steel plate of required thickness and size. The spring plank connects the two side frames and keeps the latter at a fixed distance. It ensures the squareness and correct alignment of the trolley.

The same type of spring plank is used on the cast steel bogie. The vertical sides of spring plank are attached to the bogie column. In the case of MG bogie, the two brake beam support plates are riveted to the spring plank while in case of BG, a brake support channel is riveted to the spring plank through angle cleats. The brake push rod safety loops are riveted to spring plank in MG bogie while these are riveted to brake support channel in BG bogie.

c) FLOATING BOGIE BOLSTER

The fabricated design of bogie bolster in lieu of cast steel bolster is in use. The fabricated design fulfils all the requirements of cast steel bolster and both are freely interchangeable. The same type of floating bolster is used on diamond frame and casts steel bogie. It is fitted in transverse direction, perpendicular to the track.

It is a hollow casting forming a box section for about 2/3 of its middle length and 'C' section for 1/3 of its length at the ends. Its ends sit on the spring nest through the spring plate. In the centre and on its top surface, bottom centre pivot is fixed with four counter-sunk rivets. Bottom side-bearers are fitted on its top surface at both the ends, each secured with the bolster by two bolts. Similarly bogie top centre pivot and top side-bearers are fitted in corresponding positions on the underframe of the wagons. The portion of the bolster, where centre pivot is fitted, is rough machined and the portions coming in contact with side- bearers are finish-machined. There are four holes in the bolster to rivet the bottom centre pivot and two holes on both ends to bolt the bottom side-bearers with it. Also, at each end, there are two blind holes to receive the nibbed portion of the spring plate. In the centre, an opening is left in the casting to receive the centre pivot pin. The pin goes to about half the depth of the casting.

In the central portion on both the sides, at about half the depth of the casting, four holes have been provided to fit the bogie brake fulcrum bracket with the bolster. One fulcrum bracket is fitted on the bolster towards the buffer end.

d) BOGIE CENTRE PIVOT (BOTTOM)

It is fitted on the top of the floating bolster, exactly in the centre, secured with the latter by means of four counter-sunk rivets. It is finish machined all round at all places except on the four vertical edges of the rectangular flange. There is a central hole to allow the fitment of bogie centre pin through it. The initial diametrical clearance between the hole and the pin is 2 mm. The top surface of the bottom pivot is in concave spherical shape (Radius: MG-710 mm, BG-495 mm). The corresponding convex spherical surface of the top pivot of equal radius rests on it. The vertical central pin like portion of the bottom pivot goes inside the corresponding hollow portion of the top pivot. The side surface of the pin portion is in convex spherical shape (Radius: MG - 115 mm, BG - 225 mm). There are circular grease grooves on the concave & convex surfaces of the bottom and top pivot respectively. The vertical inner edge of the bottom pivot has slight radius at the top. There are four rivet holes near the corners of the rectangular flange.

e) BOGIE SIDE BEARERS (TOP & BOTTOM)

Side bearers are provided on the wagons to limit the rolling movement. Two bottom side bearers are fitted on the bogie bolster, one at each end. Similarly two top side-bearers are fitted in corresponding position on the underframe. The bottom side-bearers are made of cast iron. Its cross section is like a box section with one side having a flange. Its longer edge is curved. It has a long rectangular hole in which oil soaked cotton waste is provided for lubricating the rubbing surfaces. The flanged side has two bolt holes to bolt it with the bogie bolster. Its top and bottom surfaces are finish machined.

It has the same construction as that of bottom side-bearers except that its flanges are inclined instead of being parallel to its bottom surface. The inclination has been given to match the profile of the underframe to which it is fitted.

The prescribed clearances for the side-bearers are as under:

	Clearance in one side	**Total Clearance**
New	**3 mm Nominal**	**6 mm**
Worn	**6 mm Maximum**	**12 mm**

As wagon body does not always rest horizontally, side-bearer clearances should be measured on both the sides by feeler gauge. Action should be taken on the basis of total clearance.

f) SPRING NEST ASSEMBLY

Spring nest assembly consists of two spring plates, four outer and four inner coil springs. The bottom spring plate rests on the spring plank. The nibbed portion of spring plate sits in the two holes provided in the spring plank. This arrangement keeps the spring plate in position. There are four washers riveted to each spring plate at suitable locations. At each of these locations, one inner and one outer coil spring is placed. The raised portion of the spring plank (made by riveting the washer) prevents displacement of the coil springs. The inner coil has opposite hand to the outer coil. On the top of these coil springs, the top spring plate rests. On the top surface of the top spring plate, the floating bolster is placed. In the floating bolster, there are two holes at each end to receive the nibbed portion of the top spring plate.

g) SPRING PLATE

It is made out of steel plate. On the outer side, it is bent at right angles. There are four holes at a suitable distance to rivet washers with it. Washer is made of steel. In the central position, the plate is nibbed at two locations. The nibbed portion sits against the holes in the spring plate/floating bolster and prevents the displacement of coil spring in service.

Generally four nests of springs are required on each side of the bogie/trolley. The number may vary with heavier axle load bogies. The same type of springs are used in the diamond frame and cast steel bogies. Each nest consists of an outer coil spring and an inner coil spring of circular section. The outer spring has left-handed coils while the inner one has right-handed coils. These springs are made of spring steel hardened and tempered. After manufacturing, the “IRS” part no., Maker’s name and year of manufacture should be stamped as specified in the standard drawing while the spring is hot.

h. COIL SPRING

The spring shall be manufactured as per the schedule of Technical Requirement for hot coiled helical springs WD-01-HLS-94 (Rev. I May, 95 with latest amendment) by the spring manufacturers approved by RDSO. Procurement of spring steel shall be done only from reputed manufacturers approved by RDSO. Only spring steel bars duly inspected and passed by RDSO shall be used for manufacture of springs.

TABLE 6.2

IMPORTANT DIMENSIONS OF COIL SPRING

Type	Coil Dia. (mm)	Free ht. (mm)	Height in mm Load (Tonnes) ½	1	1.25	2	3	4	5	Home ht. (mm)	Defle-ction per tonne in mm
MG											
Outer Drg.No. W/BE-816	26	252	-	239	-	226	213	-	-	195	13
Inner Drg.No. W/BE-761	14	252	229	207	-	-	-	-	-	191	45
BG											
Outer Drg.No. W/BE-606	30	225	-	217.5	-	210	202	194.5	187	180	7.6
Inner Drg.No. W/BE-607	16	225	211	197	190	-	-	-	-	180	28

i) AXLE BOX WITH SIDE FRAME

There are two bolt hole on each axle box to fit it rigidly with the frame. On both longitudinal ends, there are two projections in axle box casting, one on the top and another at the bottom. One common bolt hole is centrally drilled through both these projections. The outer surface of the projection is finish machined. The top surface of the projection rests below the corresponding machined surface of the extended portion of the side frame in case of cast steel bogies and below the bottom arch bar in case of diamond frame bogies. The bottom surface of the bottom projection presses the machined surface of the tie bars in both type of trolleys. The bolt passes through these holes connecting the three parts together and holds them rigidly. Two locking plates are inserted in each bolt, one after the bolt head on the top and the other before the nut in the bottom. After tightening the nut fully, the locking plates are bent at right angles against the edges of the nut/bolt head to prevent turning of nut or bolt.

On diamond frame bogies, in order to facilitate proper fitment of the axle box, the transverse edges on the top projections are chamfered to 3 mm x 45 degree on both sides as per latest modification.

603 C. MAINTENANCE OF SUBASSEMBLIES

a) MAINTENANCE OF CAST STEEL SIDE FRAME

It is very important that the axle box holes are drilled at correct distance from the centre of the casting. Also centre distance of the holes meant for the same axle box should be correct. Holes meant for riveting the spring plank should be correctly located and marked in the side frame as well as in the spring plank otherwise this will not give correct bogie alignment. After and before riveting, the holes alignment should be checked and corrected, if necessary. Similarly, after assembly of the tie bar, its alignment should be checked before final riveting it with the casting. For alignment, it is necessary to check whether the axle box bolt holes in the side frame & tie bar are in the same line and top and bottom holes are in alignment with each other. It should also ensured that tie bar is horizontal & parallel to the top surface and at correct distance from the top surface. The longitudinal edges of the tie bar should also be parallel to the top edge of the side frame otherwise, box will not fit properly.

At the time of POH as well as in sick line, side frame should be examined for cracks, distortion, excessive pitting etc. During POH, longitudinal, transverse and diagonal distances of the journal centres should be checked to ascertain the squareness and correct alignment of the trolley. The permissible variation is 3 mm in longitudinal and diagonal distances, and 2 mm in transverse distances. If the variation extends beyond these limits, the defects should be rectified.

During POH the central distance of axle box holes and the diameter should be checked. Normally wear takes place in the hole. However the holes should be built up by welding & drilled to correct distance, when the dia exceeds by 2 mm above the nominal size. The steel bushes in the bracket of the brake beam hanger should be checked for wear and replaced when dia exceeds 0.75 mm above the nominal size. The rivets of the spring plank and tie bar should be checked for soundness. It should be replaced if found unsound. The alignment of the tie bar with corresponding top surface and side frame should be checked If found defective, it should be rectified.

There is one drain hole in each of the top extended portion and two in bottom central portion of the side frame. During POH and in service, these holes should be cleaned and kept clear.

b) MAINTENANCE OF SPRING PLANK

It is important that the holes meant to secure the Cast Steel frame and Diamond frame bogies respectively are drilled correctly to ensure squareness and proper alignment of the trolley. Before finally riveting the squareness and alignment should be checked. In service, the spring plank is prone to corrosion and excessive pitting. The extent of pitting should be assessed at the time of POH. If necessary, the spring plank should be replaced.

c) MAINTENANCE OF FLOATING BOGIE BOLSTER

It is important that machining of the casting in the portion where the bottom pivot & side bearers fit is done correctly. Similarly corresponding surfaces of the top pivot and side bearers fitted on the under frame should be correctly machined. Four holes both in the bottom pivot and bolster should be drilled at correct distances otherwise there will be difficulty in matching the two parts. The two holes on either side for fitting the bottom side bearer should be drilled at correct distance from the centre of the bolster failing which necessary clearance to facilitate turning of bogie on curved track and matching with the corresponding top side bearers will not be possible.

It has been experienced in few cases that correct distances are not ensured. It should also be ensured that the two blind holes meant to receive the nibbed portion of the top spring plate are at correct distances. Also the centre line of the four vertical legs provided on each end of the casting (integrally cast) which fit in the side frame at about half the depth should be at correct distances from the centre line of the bolster. If these two conditions are not fulfilled there will be difficulty in assembling the bolster, in the side frame and the spring nest assembly. All the above important distances and points given should also be checked at the time on POH and if they are not up to the requirement, suitable corrective action should be taken.

After manufacture the casting should be thoroughly examined for distortion, cracks blowholes and thin-sections etc. Those found suitable should only be processed for machining At the time of POH as well as on open line they should be examined against cracks, distortion and excessive pitting etc. and suitable action should be taken as the case may be. The four blind holes meant to receive the nibs of the spring plate if found over should be brought to original dimensions be building up & re-drilling. All 4 rivets of the bottom centre pivot should be checked for soundness and replaced if found unsound. Similarly the side bearer bolts should also be checked against slackness, breakage etc. and should be renewed if found with these defects.

d) MAINTENANCE OF BOGIE CENTRE PIVOT

It is important that four rivet holes are drilled at correct distances to ensure its riveting with the bolster without any difficulty. It is important that the bottom & top centre pivots are finish machined to accurate sizes otherwise there will be difficulty in mating the corresponding parts.

The clearance between the central pin portion of the top pivots which plays main part in transmission of forces should not exceed the prescribed limit, otherwise the outer edges of the bottom and top pivots will be called upon to transmit the force. In service therefore, the maximum diametrical wear on the central vertical surface of the bottom pivot should not exceed 3 mm. in dia . In corresponding hollow in the top pivot 1 mm. The pivots should be replaced if clearance exceeds above limit.

During service wear takes place on the concave and convex spherical surface of the bottom and top pivots respectively thus reducing the side bearer clearances. In service minimum clearance should be ensured otherwise the transmission of the weight of the body will be through these surfaces which is not desirable. Also there will be obstruction in turning of trolley relative to the body. The workshops should turn out wagon at least with a minimum clearance as prescribed. This will permit sufficient wear up to next POH corresponding to permissible variation in side bearer clearance. The total wear on the pivots is not likely to exceed 3 mm in between the two POH of the wagon. The difference between actual clearance and initial clearance gives the total wear on the concave and convex surface of the bottom and top pivots.

The wear on concave and convex surface of the pivots is generally uneven. At the time of POH, these surfaces should be rough ground and their spherical shapes should be restored as for is possible. For checking the spherical profile standard gauge should be used. The rivets of top and bottom pivots should be checked for soundness and renew if required, pivots should also be checked for breakage and cracks.

e) MAINTENANCE OF BOGIE SIDE BEARER

In service, side bearer clearance increases due to wear of bottom and top pivots and increases on account of wear on rubbing surfaces of top and bottom side bearers. To adjust side bearer clearance step size liners of 1 mm and 3 mm thickness should be used in workshop and sick lines after loosening the bolts, the liners should be inserted below the bottom side bearers and then the bolts should be tightened up. Workshops should run out wagon stock with side bearer clearance of 4 to 5 mm on one side.

There is no necessity to insert liner on topside bearers. If the adjustment is not possible with insertion of liners, top and or bottom side bearer should be replaced as the case may be.

While machining both top and bottom side bearer height should be adjusted to give correct relative height of bogie centre and side bearers within tolerance provided.

At the time of POH and in the sick lines, care should be exercised to fill side bearers pockets with soaked cotton waste and sufficient oil to ensure adequate lubrication during service. Also bolts should be checked for slackness and breakage.

To prevent turning out of nut and consequent loosening of bolts, the fitting has been modified. A split pin is to be fitted after the nut by making corresponding holes in the bolt.

f. MAINTENANCE OF SPRING PLATE

It has to be noted carefully that four rivets are countersunk on the outer side so that it properly rests upon the spring plank and floating bolster. It is important that four holes meant for riveting the washer and the nibbed portion are kept at correct distances else there would be difficulty in assembling the coil springs.

During POH, it has to be ensured that the plate is not excessively corroded, the rivets are not loose and the nibbed portion is maintaining its correct shape. In case of excessive corrosion, the spring plank may be replaced. If the rivets are loose, these should be renewed. If the nibbed portion is not maintaining correct shape, it should be restored to correct shape.

g. MAINTENANCE OF COIL SPRING

It is recommended that springs having less than 3 mm free height variation should be assembled in the same group. Mixing of new and old spring must be avoided. If any spring is found broken or cracked, it should be replaced. The condemning dimensions of inner and outer springs are given below;

Gauge	Free Height	Condemning Height
MG	252	246
BG	225	219

603 D. REPAIR AND MAINTENANCE IN SICK LINE

i. Side frame should be examined for cracks, distortion and excessive pitting etc.

ii. The side bearer bolts should also be checked against slackness breakage etc. and should be renewed if found with these defects.

iii. To adjust side bearer clearance step size liners of 3 mm thickness should be used in sick lines after loosening the bolts. The liners should be inserted below the bottom side bearers and then the bolts should be tightened up.

iv. Care should be exercised to fill side bearers pockets with soaked cotton waste and sufficient oil to ensure adequate lubrication during service. Also bolts should be checked for slackness and breakage

603 E. REPAIR AND MAINTENANCE DURING ROH & POH

The following additional work also to be carried out during maintenance at the time of ROH and POH including the above repair work at sick line:-

i. Bogie is to be fully dismantled.
ii. Side frame should be examined for cracks, distortion, excessive pitting etc.
iii. Longitudinal, transverse and diagonal distances of the journal centres should be checked to ascertain the squareness and correct alignment of the trolley.
iv. Central distance of axle box holes and the diameter should be checked. Holes should be built up by welding & drilled to correct distance, when the dia exceeds by 2 mm above the nominal size.
v. The steel bushes in the bracket of the brake beam hanger should be checked for wear and replaced when dia exceeds 0.75 mm above the nominal size.
vi. The rivets of the spring plank and tie bar should be checked for soundness. It should be replaced if found unsound.
vii. The alignment of the tie bar with corresponding top surface and side frame should be checked If found defective, it should be rectified.
viii. There is one drain hole in each of the top extended portion, and two in bottom central portion of the side frame, these holes should be cleaned and kept clear.
ix. Maintenance of spring plank is to be done as given in para 603C(b)
x. Maintenance of floating bogie bolster is to be done as given in para 603C(c)
xi. Maintenance of bogie centre pivot is to be done as given in para 603C(d)
xii. Maintenance of bogie side bearer is to be done as given in para 603C(e)
xiii. Maintenance of spring plate is to be done as given in para 603C(f)

603 F. MATERIAL SPECIFICATIONS FOR BOGIE ITEMS (CAST STEEL BOGIE)

Sr.No.	Description of item	Material
1.	Cast steel side frame	Cast Steel class “C” grade 2 Specification No. IRSM2 and R- 13.
2.	Spring Plate	Steel plate to specification no. IS:226
3.	Floating Bogie Bolster	Cast Steel class “C” grade 2 Specification No. IRSM2 and R-13
4.	Bogie Centre pivot Bottom	Cast Steel class “A” grade 1 Specification No. IRSM-2 duly normalize
5.	Side bearer	Cast Iron grade 20 to Specification No. IS : 210
6.	Spring Plate	Steel plate to Specification IS:226
7.	Spring	Spring steel to specification No. IRS: R-2

604. DIAMOND FRAME BOGIE

These trolleys are used on BFR wagons.

A. CONSTRUCTIONAL DETAILS

These trolleys are made of three steel frames riveted to each other. The bogie consists of the following main sub-assemblies:-

a. Fabricated side frame including vertical column
b. Spring plank
c. Cast steel/fabricated floating bogie bolster including centre pivot and side bearer assembly.
d. Spring nest assembly.
e. Axle box assembly
f. Wheel set assembly
g. Bogie brake gear

Item b, c & d mentioned above have already been covered in cast steel bogie construction in Para 603 B.

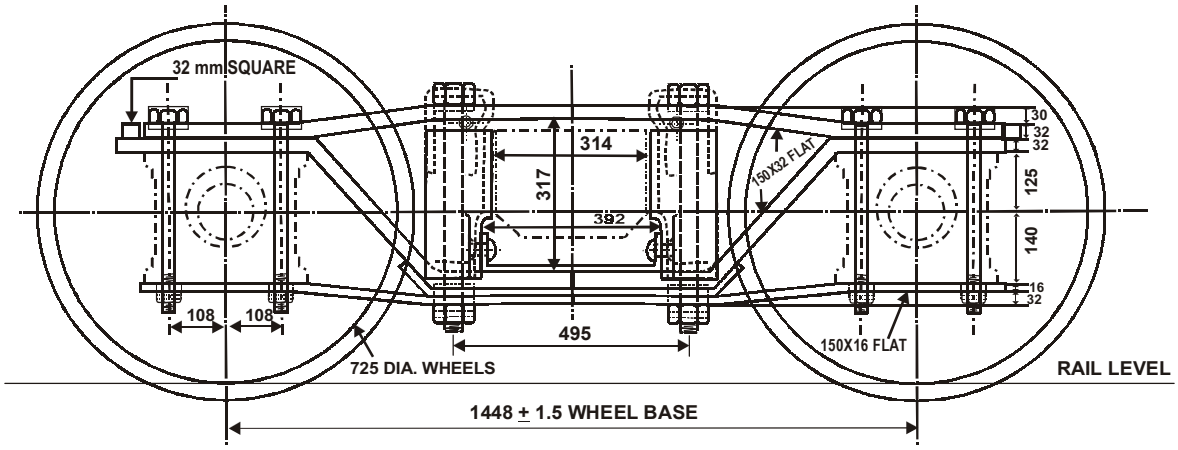


FIG. 6.3 DIAMOND FRAME BOGIE WAGONS

I. FABRICATED SIDE FRAME

It is an alternative version of cast steel side frame. It consists of top and bottom arch bars connected together by a tie in between. These are kept in position by axle box bolts and column bolts. In the central position on each side frame, two vertical columns are provided to maintain the distance between the top and bottom bars and to receive the spring nest assembly. The distance and squareness between the two side frames is maintained by spring plank. The vertical sides of the spring plank are secured with each column by two rivets. The column in turn is secured with top and bottom arch bars and tie bars by column bolts.

II. COLUMN

There are two columns on either side of the bogie frame, one is left handed and another right handed. Each of them contains two holes through which the column bolt passes. It has an integrally cast bracket at the top to suspend the brake beam hanger. The column and the spring plank are riveted together. The inner rivet is counter sunk as per latest modification to avoid the possible infringement with the brake beam and brake block assembly. Its top and bottom surface, where top and bottom arch are connect are finish machined. Its surface around the rivet holes is also finish machined. The two columns are kept at sufficient distance to accommodate spring nest assembly and connect it at proper locations with the spring plank.

The radius of column at bottom outer side on MG stock is 12 mm. It has now been increased to 16 mm, to avoid its infringement with central radius portion of the unmodified tie bars. As per latest modifications, the centre of the radius of the tie bar which is 38 mm have been shifted towards the end by 3 mm. Where modified tie bars are used, the radius of the column need not be increased.

III. TIE BAR

Tie bar is made of 250 x 32 mm flat in MG Bogies and 150 x 45 mm flat in BG bogie. Recently in order to remove the bogie column over the radius portion of tie bar, the centres of the radius has been altered.

IV. STRENGTHENING BAR

Due to large scale breakage of MG tie bars mostly at the bottom and top bends, a strengthening plate 10 mm thick and 125 mm wide has been provided at the bottom surface of tie bar. It covers the entire bottom and the radius portion of the bottom bends of the tie bar. The strengthening plate is secured with the tie bar by fillet welding at all the four edges. In the middle portion of the strengthening plate, two holes have been provided to plug weld it with the tie bar. Strengthening bar of section 125 x 22 mm is provided in the case of BG 22.9t bogie.

Very recently, the length of the MG tie bar has been increased from 1740 mm to 1830 mm. In the increased length portion, one square piece 32 mm thick and 126 mm long is required to be fillet welded at outer edge and two side edges. Similar modification has also been carried out on BG 22.9t bogie.

V. TOP ARCH BAR

It is made of steel flat. Its width and thickness are 150 x 32 mm for MG. For BG 22.9t bogie, it is 150 x 45 mm & for 16.2t bogie, it is 150 x 40 mm. In the central position, the plate is bent upward. At four bends, suitable radius is provided. Two holes have been provided for column bolt and four holes for axle bolts. While manufacturing, care should be exercised that the holes are drilled at correct locations.

The ends of the top arch bar rest on the end of the tie bar and the central portion upon the top of the column. These are secured together by axle box bolt & column bolts.

At the time of POH, if the dia holes are found exceeding 2 mm above the nominal dia, it should be built up by welding and re drilled to correct size. Normally no wear takes place on these holes. It should be checked for breakage and cracks and loss of off set. Arch bar found with these defects, should renewed/repaired. There are hardly any case of breakage or cracking of top arch bars.

VI. BOTTOM ARCH BAR

It is made of flat steel. Its width and thickness are 150 x 16 mm for MG. For BG 22.9t & 16.2t bogie the bottom arch size is 150 x 20 mm. It has two holes for column bolts and four holes for axle box bolts. At four bends suitable radius have been provided. It is important that the holes are drilled at correct locations.

The central portion of bottom arch bar is placed below the bottom surface of the tie bar (below the strengthening bar, where fitted). The end of the arch bar mate with the bottom surface of the axle box. Assembly is kept together by means of 2 column bolts and four axle box bolts.

On MG arch bar, the offset was 22 mm. When strengthening bar below tie bar was introduced as a modification, the off set was increased from 22 mm to 32 mm. As an interim measure where it was not possible to alter the off set of the top arch bar, packing plate of 10 mm thickness was permitted between the bottom arch bar and axle box. This interim arrangement is not permitted now. As it is economical and easier to alter the off set of the arch bar, practice of putting packing plate between axle box should not be resorted to.

At the time of POH, if the holes are found to exceed 2 mm in dia above the nominal dia, it should be built up by welding and holes should be drilled to correct size. Normally no wear takes place on these holes. At the time of POH and in service, the bottom arch bar should be checked for cracks breakage and loss in off - set. If these defects are found, it should be renewed/ repaired. There are hardly any case of cracking or breakage of bottom arch bar.

VII. BOGIE SPRING PLANK PACKING

Four numbers are required for each trolley. It is placed between the vertical side of the spring plank and column and these are secured together by rivets. Each packing plate has two rivet holes. The rivet holes should be drilled at correct locations. Packing plates are provided only if necessary on diamond frame bogies. It gives enough space for inserting and withdrawing the floating bolsters to and from the side frame.

e. AXLE BOX WITH SIDE FRAME

This is identical to Cast Steel Bogie axle box and side frame covered earlier in this chapter.

604 B. REPAIR AND MAINTENANCE IN SICK LINE

i. The tie bar should be checked for crack/breakage. Cracked tie bars should be changed.

ii. The column should be checked for cracks distortion etc. and necessary replacement/repairs should be done.

iii. The rivets should also be checked for cracks/breakage and slackness and renewed.

iv. The brake beam hanger bracket bushes should be checked for wear and be replaced if necessary.

v. Repair of Top & bottom arch bar to be done as given in para 604 A (a) V, VI..

604 C. REPAIR AND MAINTENANCE DURING ROH & POH

In addition to all the work mentioned above in para 604 B, the following work is also to be carried out in ROH & POH :-

a. The column should be checked for cracks, distortion etc. and replacement/repairs should be done. The four rivets should be checked for cracks/breakage and slackness and renewed.

b. It is important that the rivets and bolt holes are drilled at correct locations otherwise there will be difficulty in assembling the parts and ensuring correct alignment.

c. The brake beam hanger bracket bushes should be checked for wear and replaced if dia exceeds 0.75 mm above the nominal size. The dia of hole for the column bolt should be checked if exceed with nominal size by 2 mm, the holes should be built up by welding and drilled to correct size.

d. It is important that the off set of the tie bar is correct and the two projected portions are parallel to the bottom side. The profile of the tie bar should be checked with a master template.

e. Four axle box bolt and two column bolt holes to be drilled at correct distance from the central portion failing which correct assembly will not be possible.

604 D. MATERIAL SPECIFICATION (DIAMOND FRAME BOGIE)

Sr. No.	Description of item	Material
1.	Column	Casting made of steel to IRS M-2 Grade 1
2.	Tie Bar	150 x 45 mm flat and to specification no. 2062 St.42W (for 22.9 t bogie) 150 x 40 mm flat and to specification no. 226 St.42S (for 22.9 t bogie)
3.	Strengthening Bar	Flat steel 42-S to specification No. IS :226
4.	Top Arch Bar	Flat steel 42-S to specification No. IS :226
5.	Bottom Arch Bar	Flat steel 42-S to specification No. IS :226
6.	Bogie Spring Plank packing	Flat steel 42-S to specification No. IS :226

605. SUSPENSION

A. GENERAL

The suspension of a wagon includes the wheels, bearings, axle boxes springs, spring links and spring brackets/scroll irons. In the case of 4 wheeled wagons, the suspension is mounted directly under the wagon underframe whereas in the case of bogie stock, the under frame is carried on the bogies which in turn is supported by the springs, bearings and wheels.

The suspension system is required to cushion the vibrations of a vehicle due to irregularities in the track and other dynamic conditions owing to various parasitic movements of the vehicle.

B. FOUR WHEELER SUSPENSION

In four wheeler wagons the load is transmitted in the conventional arrangement via the sole bar, scroll iron, shackles or shackle plates to the springs and axle box, axle box key plates and bearing journal.

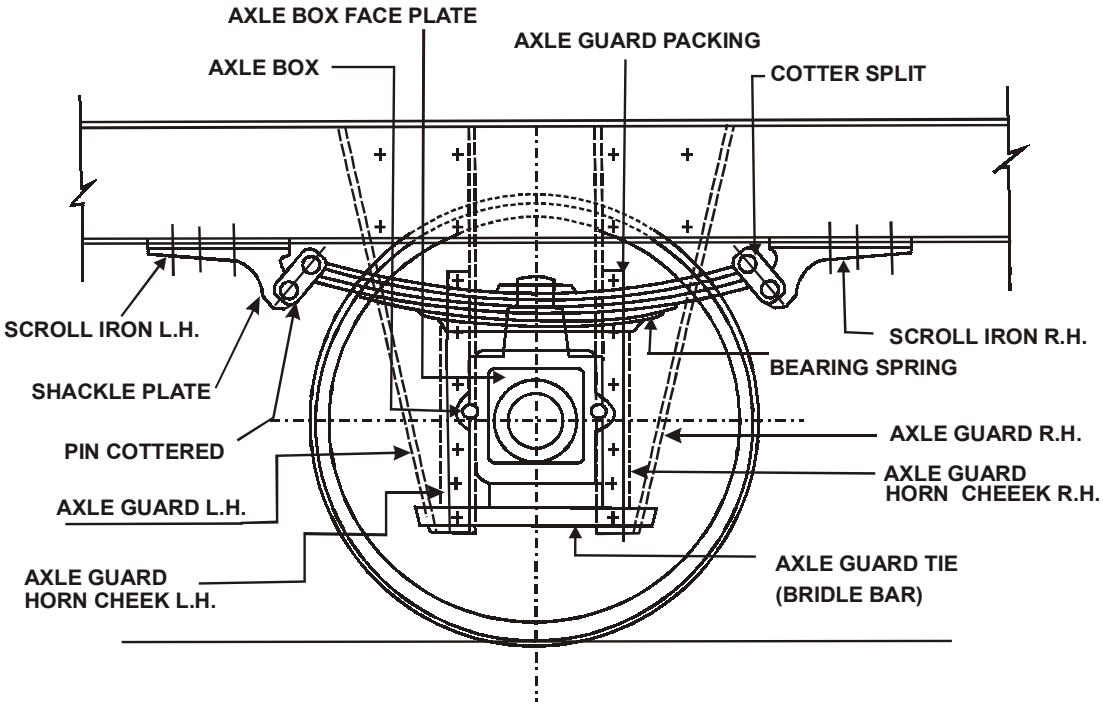


FIG. 6.4 : SUSPENSION ARRANGEMENT OF 4-WHEELER WAGON

The individual elements of four wheeler suspension are listed below:

Sr. No.	Name of the part	No. per assembly
a)	Scroll Iron	One RH & One LH
b)	Shackle pins	4
c)	Shackle plates	4
d)	Bearing Spring	1
e)	Shackle pin Washers	4
f)	Split Cotters/bulb cotters	4

a) SCROLL IRON

The Scroll iron is forged out of class II steel to IS-1875. It is secured to the bottom flange of the sole bar by means of 3 rivets.

The following defect may arise in scroll irons in service:-

(i) Rivets loose, deficient or broken
(ii) Scroll iron cracked or broken
(iii) Scroll iron shifted out of alignment
(iv) Eye hole worn over size or oval

Defects mentioned against item (i) to (iv) are rejectable defects. On noticing any of these defects the wagon should be marked sick and sent to sick line for repairs. The wagon should not leave workshops, wagon depots and NPOH depots with these defects. To determine quality, it has to be kept in view that the maximum permissible diametrical clearance between the scroll iron and shackle pin during service is 4 mm and 1.05 mm when new. If clearance more then 4 mm is noticed, the shackle pin should be replaced. Scroll iron should also be replaced.when the eye hole diameter exceeds 1 mm above the upper nominal size(viz 29.65 mm for BG 23.65 mm for MG).

The scroll iron may be repaired by electric welding & normalising in the workshop. The workshop code and date of welding must be stamped on the upper surface of the scroll iron close to the weld.

b) SHACKLE PIN

100% Shackle pin is made of steel class III. In view of the large scale breakage of shackle pins on M.G. stock, RDSO vide their letter No. MW/SNG/W dated 1.1.1976/10-3-76 have recommended the use of class IV M-4 steel instead of class III M-4 steel for MG only. Shackle pin is manufactured out of bars by forging process followed by normalising. Since Jan.'73, stamping on the top of the pin head of IRS part No., manufacture's initial, manufacturing month and year in 3 mm type has been introduced. Since December 1975, stamping as class IV on shackle pins manufactured out of class IV steel for M.G only has also been introduced Scroll iron and spring eyes are connected through shackle plates provided on either end of the eyes. One shackle pin connects the shackle plates with scroll iron and another shackle pin connects it with spring eye.

Shackle pin is a highly stressed part and its breakage and failure are very common. It should receive top most attention in workshops and in open lines. The following defects may arise or get noticed in service:-

- worn out in dia beyond permissible limits
- broken/cracked
- bent
- deficient or of wrong size
- having excessive lateral clearance in its assembly
- manufactured out of sub standard material

When new, diametrical clearance between the scroll iron and shackle pin, shackle plate and shackle pin should not exceed 1.05mm and between the spring eye and shackle pin should not exceed 1.15 mm. The maximum diametrical clearance permissible for the above is 4 mm. The lateral clearance when new should not exceed 1.5 mm and the maximum possible is 6 mm.

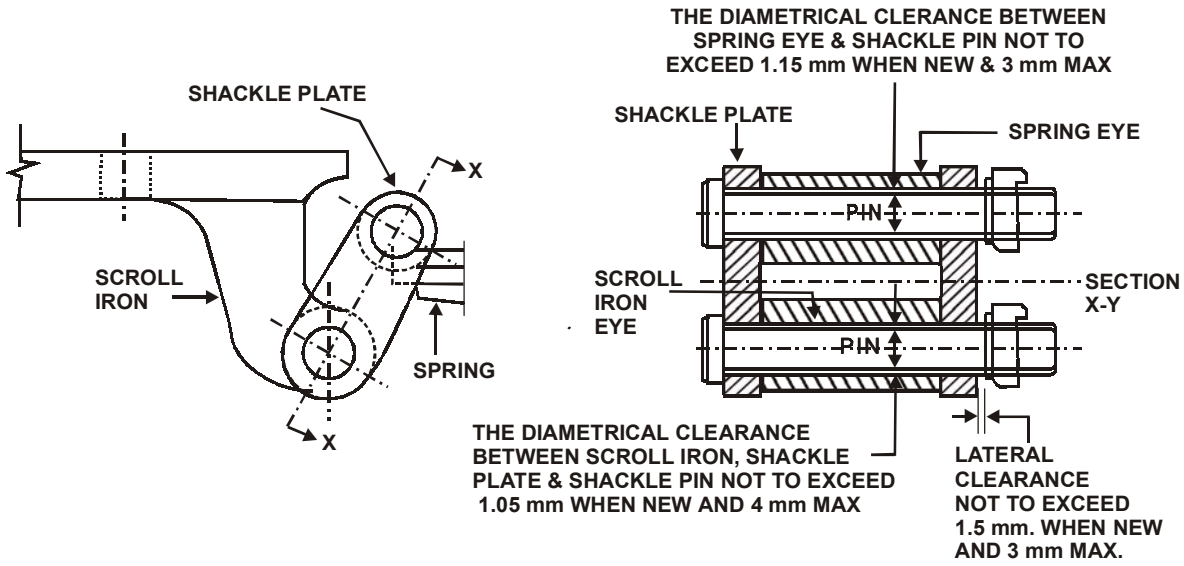


Fig. 6.5 SCROLL IRON AND SHACKLE PLATE

If the clearances are found beyond permissible limits; the shackle pin, shackle plate and scroll iron should be replaced as the case may be. The shackle pin normally be replaced when it is worn out 1 mm in dia. below the lower nominal size viz, at 26.6 mm for BG and 20.6 mm for MG. Broken/ cracked, deficient and wrong size shackle pins should be replaced/made good. Bent shackle pins should also be replaced. It is difficult to detect shackle pin manufactured out of wrong and sub standard material. In case of doubt, it should be sent to metallurgical laboratory for test and if necessary, the whole lot should be rejected. While manufacturing, 2 mm radius at the root of the head and 4 mm at the inner corners of the cotter hole should be ensured. The same should also be checked during service. In absence of there radii shackle pin will be prone to breakage. At the time of POH in the workshop, shackle pins must be replaced. Old shackle pins should be inspected and those up to & above 27 mm dia. for BG and 21 mm dia for MG and also suitable otherwise should be normalised and handed over to store department for open line use.

c) ACTION TO BE TAKEN BY CMT

i) He will make a regular programme to examine the shackle pins being procured from trade to ensure that the pins have been manufacture from correct material and specification and that there is no manufacturing defect.

ii) For the purpose of examination, every purchased lot along with the purchase order, particulars and firm address detected that they are correct to the sizes. Matter to be brought into the notice to Depot Officer, Works Manager, Controller of Stores and CWE.

iii) In case the pins are manufactured in Railway workshops. CMT should test a sample in raw material in advance to ensure that the correct raw material is being used for manufacturing the pins. The manufacture of shackle pins tested and certified fit by CMT.

d) SPRING SHACKLE

Spring shackle is a rectangular shaped plate made of steel 42-S to specification No.:IS 226 Its thickness for B.G is 25 mm and for M.G. is 20 mm. It is rounded at both the ends having two holes near the ends to receive the shackle pin. It is generally manufactured by profile gas cutting or by punching out. Two such plates are fitted one on each side of the scroll iron and spring eye. Shackle plate, eyes of the scroll iron/spring followed by shackle plate. The shackle pin is kept in position by washer and split cotter. This arrangement ensures transmission of load from scroll iron to spring providing adequate flexibility to the spring to move in relation to the wagon body.

Except elongation of holes no other defects are noticed on shackle plates in service. However, shackle plate should be examined visually for cracks/failures on open line and in workshops and replaced if these defects are noticed. Limits of clearances given should be observed. Shackle plate should normally be replaced when the eye hole dia exceeds 1mm above the upper nominal size viz., 29.65mm for BG and 23.65mm for MG. The distance between two holes of shackle plate, the diameter of the holes of shackle plate, the diameter of holes and the radius of 2mm on either end of the holes are very important. These dimensions should be ensured /checked while manufacturing and in service. If 2mm radius is not provided it will be difficult to ensure correct lateral clearance in shackle pin assembly.

e) WASHER

It is made of steel St 42-S to specification No:IS:226. On BG M-27 and on MG M-22 (and now M/SN-750) washer are in use. Its thickness is 4mm (and now 6mm in case of MG). It is fitted just after the shackle plate (outer) covering the radius portion of the cotter slot, ensuring correct fitment of split cotter in the slot. The washer ensures proper grip and minimises wear on the shackle plate. Use of two washers to make up the gap is not permitted. Worn out washers should be replaced as and when required.

f) SPLIT BULB

It is fitted in the cotter slot of the shackle pin just after the washer. It keeps the shackle pin secured in position and prevents its working out of the assembly. It is made of steel to specifications no:IS 2636 and IRS part drawing no: WD 94068-S/1 item 1 suitable for use on 20 to 28 mm dia pins. In service cotters are found to be broken deficient or wrong size, not split properly and some times fitted not in correct position. In the first three cases the cotter should be replaced and in the last two cases, it should be fitted properly or replaced where necessary.

g) SPRING

It is a laminated bearing made out of a number of spring steel plates of different lengths fastened together in the centre by means of buckle and other fastenings. Plates are nibbed at suitable locations or have "rib and groove" section. On some BG springs a few plates are clamped together near both the ends by means of clips and its fastenings. Similar clamping has been recently been introduced on MG spring also. The top plate is rolled at the both ends to form an eye which receives the shackle pin.

Bearing spring is a medium of transmitting wagon weight including consignment to the axle box. Any defect in the bearing spring would lead to undesirable loading of axle box and the bearing brass resulting in derailment or hot box. Bearing springs on both the ends are connected with the wagon underframe through the shackle pins, shackle plates and scroll iron. The central portion sits on the axle box crown.

Springs are manufactured/ repaired in the workshops. It involves proper heat treatment, inspection and testing. The springs should not be repaired on open line where adequate repair facilities does not exists. On open line, inspection and checking of camber of springs should be done, and defective springs should be replaced.

There are various types and sizes of springs in used on wagons, as different types of wagons were put on line from time to time. It is not possible to describe all types of spring here. Only standard types of springs are being described here. The factors causing difference in springs can be broadly classified as under:

(i) Difference in material of plate

They can be broadly classified as oil hardening and water hardening quality as indicated below.

Sr. No.	IS Spec. No.	Equivalent IR specification	Part	Grade	Type of steel	Quality
1	3885*	M-11	I	4	Silico manganese steel	Oil hardening quality
2	3885**	M-11	II	4	Silico manganese steel	Oil hardening quality
3	3885	M-11	I	3	Silico manganese steel	Water hardening quality
4	3885	M-10	I	1	Carbon spring steel	Water hardening quality

*-Used on all standard wagons except those given against Sr. No. 2.
**-Used on Std. BOX, BCX, BOI, BRH & BRS types of wagons using UIC type of bogies and BG 4 wheeled 16.3 tonnes axle load wagon (except for top plate).

(i) Difference in thickness and the length of the plates, number of plates used and number provided. In many designs of springs top plate is thicker than the other plates.

(ii) Method of securing the plates. Material specification of standard spring.

The material specification of the parts used in manufacturing springs for standard wagons are as under:

Sr.No	Name of the part	Specification
1	Spring steel flat	Already given above
2	Buckle (a) BG (b) MG	 Steel class II to IS :1875 & R-66 should be normalised after welding. (i) St. Class I for smithy weld (ii) St Class I or II for electric weld (iii) St Class II for without weld.
3	Spring buckle key	Steel ST 42 S to IS:226
4	Clip	Steel ST 42 S to IS:226
5	Ferrule	Steel ST 42 S to IS:226
6	Rivets of different sizes	IS:1148

h. REJECTABLE DEFECTS

The following are the rejectable defects in springs:

i. Any plate of laminated bearing spring cracked or broken.

ii. Bearing spring buckle loose, broken, cracked and/or packing plated loose or deficient.

iii. Any plates of buckle are displaced form its central position by 13mm or more.

iv. Bearing spring buckle not sitting square in the axle box housing or crown packing when fitted.

v. Incorrect type of bearing spring for particular design of wagon.

vi. Bearing spring eye or shackle plate touching the sole bar.

vii. On meter gauge wagon bearing shoe fractured or with a rivet bolt or stud broken or deficient or bolt stud or wrong size.

The following additional defects are also noticed in service:

i. Loss of spring camber

ii. Biting marks on rolled eye portion. There should be gap of 2mm between rolled and upper surface of the top plate other wise this may raise the stress and lead to fracture of the spring along the dent marks.

iii. Uneven bearing of pins on spring eye: this is due to use of worn out pin and may lead to fatigue crack or sudden fracture.

iv. The gap between any two plates exceeding beyond 0.5mm.

v. Lateral and diametrical clearance exceeding permissible limits. Spring should normally be replaced when the eye hole dia exceeds 1 mm above the upper normal size viz. 29.75 for BG and 23.75mm for MG.

vi. Wagons over and unevenly loaded or with shifted loads causing over stressing of spring and difference of cambers. This may cause failure of spring and or derailment.

NOTE:

(i) The goods stock is allowed to be over loaded beyond maximum carrying capacity inclusive of loading tolerance to the extent shown below subject to conditions laid down in IRCA Rules Pt.III 2000 edition.

	Four wheeler wagon	Bogie wagon
BG	2	4
MG	1	2

(ii) It has to be carefully noted that the overloading of tank wagons is not permitted. Also BOX, BOI, BRS, BRH, BCX, BOBX type BG bogie wagons and nonstandard BG BFRS are not allowed to be over loaded.

i. GRADING OF SPRINGS

Camber of spring plays a important part in the stability of wagons. Under ideal conditions, the camber of all the four springs used on the wagon should be equal and they should have the same load deflection characteristics. However it is not possible to manufacture springs of equal cambers. A variation of spring camber up to 5 mm and 6 mm for MG and BG respectively from the nominal size is permissible for new spring. In order to ensure that all the four springs of the wagons have almost equal camber, the springs are devided in four groups according to the camber. While fitting springs on wagons in the workshops and open line, it should be ensured that as far as possible, all should be of same group or one group higher or lower. The workshops shall ensure that after manufacture / repair testing and measuring of camber, the spring should be marked by paint on the buckle as A, B, C and D, as the case may be.

Following type of springs are commonly used:

BROAD GAUGE

Sr. No.	**Type of springs**	**Free camber**	**Plus 2mm**	**Plus 4mm**	**Plus 6mm**
		A	B	C	D
1	10 plated IRS type of BOX BCX type wagons etc.	47	49	51	53
2	13 plated IRS type for 4 wheeled wagon, 16.3t axle load (now being replaced by SK73560)	76.2	78.2	80.2	82.2
3	13 plated IRS type to Drg no. SK73560 for 4 wheeled wagon, (16.3t axle load)	75.5	77.5	79.5	81.5
4	9 plated laminated spring to Drg. No. WD-87024-S/1 used on CRT wagons.	58	60	62	64

METER GAUGE

SN	Type of springs	**Free camber**	**Plus 1.5 mm**	**Plus 3mm**	**Plus 5mm**
		A	B	C	D
1	7 plate IRS type for 4 wheelers wagons	50.8	52.3	53.8	55.8
2	7 plate IRS type for non standard wagons	76	77.5	79	81
3	9 plate IRS type for non standard 4 wheelers and 6 wheelers wagons	86	87.5	89	91
4	9 plate for IRCA type wagons	51	52.5	54	56

605 C. PROCEDURE FOR MANUFACTURE, REPAIR, TESTING & INSPECTION OF SPRINGS IN THE WORKSHOP

a. The correct procedure for manufacture of laminated bearing springs has been prescribed in Board's letter No: 76//M(W)/814/43 dated 12.3.64 and 3.6.68 RDSO letter no: M&C/STC/2/1 dated 26.3.75 and MW/II/Springs dated 18.7.77 (approved V, and IRS specification RS-68). The pamphlet "Laminated bearing spring failures- description classification and reporting" issued by RDSO in 1969, with a corrigendum in 1972, contains useful information on the subject and should be consulted.

b. All spring will first be given a scrag test and also their camber will be checked. Facilities for these two checks should be provided in the lifting shop so that the springs, which pass both these tests, need not be transported to the smithy/ spring shop. The springs fail to these test should be taken to smithy/spring shop where it should be dismantled and scrag plate visually examined for presence of any surface defects such as cracks, corrossion, pits, dent marks etc. Those which are free from these defects should be re-heat treated (hardnened and tampered) under controlled conditions. The defective plates, if found, should be replaced by new once, properly heat treated. The assembled spring should be given scrag camber tests.

c. Re-tempering of spring

i. For restoring lost tamper, it is necessary to first re-harden the plate.

ii. Water Hardening: The plates should be at a temperature of 810°C to 840°C at the time of quenching. If in resetting the plates to the required camber, the temperature drops below this limit, the plates should be re-heated. For quenching the plate should be dipped edgewise taking care that the plate is kept horizontal. The plate or the quenching medium should be kept vigorously agitated. The plate should be withdrawn when it has cooled down.

iii. Oil hardening: The plate should be at a temperature of 840°C to 870°C. the dipping of the plate should be done in the same manner as for water. The quenching medium would be quenching oil of an approved brand. The oil temperature should be prevented from rising abnormally be a water jacket in which water should be freely circulated. Aeration for the quenching oil would help in keeping down the temperature and also in keeping the oil in a state of agitation.

iv. Tempering.: For tampering the correct temperature is even more important than hardening. A salt/lead bath maintained between 380°C to 420°C for water hardening quality, and between 450°C to 500°C for oil hardening quality spring steel should ensure plates being tempered uniformly.

v. Temperature control: Hardening and tempering furnace should be provided with automatic pyrometric control to ensure correct hardening and tempering temperature.

vi. Rolled eye: It should be ensure that there is a minimum gap of 2mm between the rolled end and the upper surface of the top plate. This is necessary to prevent the end bearing hard against the top plate when the spring is deflected.

vii. Indentation: The malpractice of cold hammering of spring plate, as a result of which indentations are left should be seriously avoided as the indentations are potential stress raisers.

d) SCRAG TEST

a) Measure camber.
b) Press the spring home, six times.
c) Re-measure camber. The loss of camber must not exceed half the thickness of the top plate.

e) Load deflection Test

At least 5% of C&W springs must be subjected to load deflection test.

605 D. CAUSES FOR FAILURE OF SPRINGS

The spring may fail in service for reasons described below. Action/ precautions to be taken in each case are being indicated item wise:

i. **Incorrect composition of material:** Different grades of steel plates some times get mixed up. It should be avoided.
ii. **Abnormal surface de-carburisation**: This results in initiation of progressive cracks and hence reduction of spring life. This should be avoided during manufacture/repair.
iii. **Incorrect hardness of the plates:** Brinell hardness of the plate should be within the specified limit. For heat treated laminated spring plates to IS 3885, range is 380-420. In case the hardness is beyond specified limit of material used, the spring plate should be re-heat treated.
iv. **Sharp edges of nib/groove**: These act as stress raisers during service, causing cracks to originate from them. Sharp edges, if any, should be removed by grinding or other means. Nibbing tool should be properly chamfered to avoid sharp edges.
v. **Biting marks at the rolled eye portion:** Biting marks act as stress raisers leading to fracture along the dent marks. A minimum gap of 2 mm should be ensured.
vi. **Punch marks on plates**: These marks, particularly on tension side of plates, act as stress raisers during service and lead to early failure of springs. No punching should be done on spring plates.
vii. **Accidental injury to plate:** Sharp dents or notches caused during manufacture or in service act as stress raisers and reduce the life of spring. It should be avoided during manufacture/ repair. If necessary, plate should be replaced. If such defects come to notice in service spring should be replaced.
viii. **Quenching cracks:-**These are usually caused by (a) inadvertent use of wrong grade of steel for a given heat treatment procedure, (b) too drastic a quenching medium, (c) high hardening temperature, (d) insufficient soaking period, (e) surface defects such as seems laps, cluster of non-metallic inclusions occuring at or near the surface, (f) sharp grooves or dents on surface. In service, they act as stress raisers resulting in premature failure. Due care should be exercised during manufacture.

ix. **Corrosion**:- Corrosion occurs either locally or throughout the section in the form of small shallow pits (pitting corrosion). These act as stress raisers under alternating stress conditions during service. Such plates should be rejected during repair/manufacture. If springs with corroded plates are noticed in service, they should be replaced.

x. **Other causes**: The following causes may lead to either fatigue crack formation or sudden fracture (a) uneven loading of wagons, (b) uneven bearing of pins on spring eyes due to use of worn out pins, (c) lateral shifting of spring plates due to slackness of buckle.

Wagons unevenly loaded should not be allowed to run in service. Worn out pins should be replaced. Spring with shifted plates beyond limit should be replaced.

605 E. CAUSES FOR FAILURE OF BUCKLE

The buckle may fail for following reasons. Action to be taken has been indicated against each item:

i. **Wrong materials**: Correct material of buckle should be used.

ii. **Poor welding**: When buckles are made by bending flat to shape and are welded at the ends, welding should be sound and without defects.

iii. **Overheating**: At the time of heating for buckling ensure that they do not get overheated or over soaked both of which will cause brittleness in the steel.

iv. **Larger buckle**: (a) Too large a buckle compared to the cross sectional dimensions of the spring assembly results in folds being formed on the buckle especially at the corners which may open up immediately after or in service (b) Rigid inspection should be done while manufacturing. Buckles with such defects should be rejected.

v. **Cold buckling**: (a) Ensure correct temperature during buckling since cold working gives rise to crack/residual stresses resulting in cracking up of the buckle immediately after or during service. Insufficient buckling pressure or temperature can also cause the buckle to shift. (b) Ensure rigid inspection during manufacture/repair.

vi. **Sharp corners**: The edges of the packing or keyplates and the bottom plates should be grounded to a smooth radius. It prevents the formation of sharp corners in the buckle that may result in tearing of buckle or act as stress raiser in service.

vii. **Excessive nip on plate**: Ensure that excessive nip between plates is not provided to prevent building up of additional tensile stresses tending to crack the buckle either during manufacture or in service.

605 F. IMPORTANT Do's & Don'ts DURING REPAIR OF SPRINGS

Do

i. Ensure a minimum gap of 2 mm between the rolled end and upper surface of the two plates. .
ii. Ensure that the eye holes are laterally parallel within the specified dimension, smooth and free from burrs and are not bell-mouth.
iii. Ensure that stamping and punching is done on spring buckle only and not on plates.
iv. Ensure correct diametrical and lateral clearances in shackle assembly as explained above.
v. Ensure proper seating of bearing spring buckle in axle box housing or crown packing where fitted.
vi. All plates shall be so fitted that a 0.5 mm feeler should not enter the gap between the plates.

Don't

i. cold hammer plates and buckle: this results in indentations which are potential stress raisers.
ii. rough handle, springs.
iii. allow a spring in service with biting mark at the rolled eye.
iv. permit a wagon to be in service with sole bars resting on bearing spring buckles.
v. allow a spring in service with plate or buckle displaced from its central position by 13 mm or more.
vi. allow wagon to run, which are unevenly loaded/over-loaded or have shifted loads as explained above.
vii. allow a difference in excess of 13 mm in working camber between any two springs on a loaded wagon.
viii. allow springs in service with cracked or broken plate/plates.

605 G. AXLE BOX CROWN PACKING PLATE (SPRING SEAT)

It is made of steel 42-S to IS:226. It is used for raising the buffer height of wagons lost due to reduced wheel dia. It also makes good the height lost due to reduced brass thickness loss in camber of springs and reduced journal dia. It is placed on the top of the axle box crown. The spring buckle rests over it. The shape of packing plate is made to suit the shape of axle box crown and the spring buckle. Depending upon the height of the buffer to be raised, different step sizes of plates are used. On BG stock, the step sizes of plates raise the height by 11, 26, 37 mm as per IR part Drg. No. W/SN 1460, 1616 & combination of 1460 & 1616 respectively. On MG stock, step-size spring seats raise the height by 9, 19, 6 & 35 mm as per Drg. Nos. W/SM-1462, 1461, 1421 and combination of W/SN-1462 and 1421 respectively.

It should be ensured that packing plate sits properly on the axle box crown and the spring buckle rests properly over it and there should be no chance for them to come out of the crown.

605 H. AXLE GUARD HORN CHEEK ASSEMBLY

On 4 Wheeled stock, the axle guards are provided to keep the axle boxes in their correct aligned position. They are riveted to the sole bars except in MG weighted brake vans. On latter, use of bolts is permitted. The distance between the centres of the axle guard on the same side of the wagons is kept equivalent to the required rigid wheel base.

The axle guards are subjected to wear on the inner portions due to the relative movement between axle guard and axle box grooves in service. On portion where wear takes place, horn cheeks have been provided on the axle guard. After reaching condemning limit the horn cheeks can be replaced at lesser cost as compared to replacement of complete axle guards.

The axle guards are of various types and sizes, standard being the IRS and IRCA types. Axle guards get seriously damaged on account of hump or rough shunting. IRS type axle guards are built up of pressed steel and are robust in construction. Incidence of breakage in service of IRS type of axle guards is much less as compared to IRCA and other types.

To avoid widening of the axle guards jaw in service, a bridle bar is riveted to the axle guard at the lowest position. One end of the bridle bar is riveted to the left hand and the other end to the right hand leg of the axle guard. The two jaws of the axle guards on either side of the axle box are connected by bridle bar at the bottom and thus the widening is prevented.

The axle guard, horn cheeks and bridle bar are described below.

a) AXLE-GUARDS (PRESSED STEEL TYPE)

For one axle box, one right handed and one left handed axle guard is required. It is made of steel plate (8 mm thick for MG & 10 mm thick for BG) to specification IS: 3747 and pressed to shape. Its inner edge is vertical and the outer edge is inclined. Its top and bottom edges are horizontal. Its shape is like a trapezium having two right angles. The plate is bent at right angles along the vertical and inclined edges forming a channel. The bent side on outer edge has a tapering width, maximum at the top and minimum at the bottom. Similarly, the bent side at the inner edge has tapering width from top up to about half the height and thereafter, uniform width up to the bottom. Both the bent sides have been chamfered at the top at an angle of about 45 degrees.

There are ten rivet holes on MG & 11 on BG on each axle guard leg. The bottom hole/holes is/are meant for riveting briddle bar with axle guard leg. Its dia is 17.5 mm (for 16 mm rivet) starting from top two holes in the vertical row and 2/3 holes on the indicated row are meant to rivet the axle guard with the sole bar. The 3rd rivet hole in case of BG and 3rd & 4th rivet hole in case of MG, from top of the first row are chamfered on outer face of the axle guard to enable use of countersunk rivets, thus preventing infringement of bearing spring with axle guard rivets. The horn cheek is riveted to axle guard with a packing plate in between them through 3rd to 6th rivet hole in case of BG and 4th to 7th rivet hole in case of MG. In case of MG, the packing plate is riveted through the third rivet hole in addition.

The bridle bar is riveted to the axle guard through the 8th rivet hole in case of MG and 7th & 8th rivet hole in case of BG. In addition to the above, BG axle guards are further secured with the bottom flange of the sole bar channel by an angle cleat. Angle cleat is riveted to the sole bar and axle guard by three rivets on its each side.

It is very important that the 10/11th rivet holes are correctly drilled otherwise it will cause difficulty in securing the axle guard with the sole bar, horn cheek packing plate and bridle bar with axle guards.

b) AXLE GUARD (LEG TYPE IRCA)

It is made of steel plate Grade ST 42-S 'A' to specification No. IS:226. It has a vertical leg with a sloping arm branching upwards from about 1/3rd distance from the bottom. The sloping arm after certain distance is again bent to become vertical and parallel to the main vertical leg. All the three arms are made out of one plate with vertical arm and sloping arm close to each other. After cutting the sloping arm is hot bent to required shape. The important sizes of MG axle guard are :-

Thickness of the plate -	20 mm (MG)	25 mm (BG)
Width of the vertical leg -	70 mm (MG)	115 mm (BG)
Width of the small vertical & sloping arm -	57 mm (MG	102 mm (BG)
Dia of rivet holes	8 of 21.5 mm for 20 mm rivets(MG)	10 of 24 mm for 22 mm rivets (BG)
Dia of bottom rivet hole for bridle bar -	11.5 mm for 16 mm rivets.	

There are 7/8 rivet holes in the main vertical arm and 2/3 in short vertical arm. The bottom most rivet hole in the main vertical arm is meant for bridle bar, 2/3 rivet holes of the small vertical arm. Corresponding 2/3 rivet holes of the small vertical arm and corresponding 2/3 rivet holes in the main vertical arm are meant to rivet axle guard with the sole bar. The remaining four rivet holes in the main vertical arm are meant to rivet the horn cheek. Unlike pressed steel type, right handed and left handed axle guards legs are not required in this case.

c) HORN CHEEK

It is a "L" shaped piece made of steel to IS: 226 or IS: 1875 for wagon stock. One left-handed and one right-handed horn cheek is required for one axle guard. (On coaching stock, in addition to steel, cast iron Grade 17 horn cheeks are also used. Care should be exercised so that cast iron horn cheeks meant for coaching stock are not used on wagon stock). It is finish machined all over except on vertical edge of long leg and top and bottom surfaces. The shorter leg is fixed perpendicular to the track and the longer leg is riveted with a packing plate in between them. The top-most rivet is countersunk having chamfered edge on the outer surface of the axle guard (not on horn cheek). The horn cheeks have two suitable recesses on the top and one at the bottom. It is important that the rivet holes are drilled at correct locations. The important sizes of horn cheeks are :-

	MG	**BG**
Thickness	12 mm	19 mm
Leg Size	82 x 36(+0.5/-0.0) mm	95x45 mm
Height	317(+0.0/-3) mm	419 (+/-3) mm for CI and 406 mm for steel
Rivet hole dia	21.5 mm for 20 mm rivets (for both)	
Distance of centre line of rivet holes from bent corner	47 mm	57 mm

d) TIE BAR (BRIDLE BAR)

It is made of steel to specification No. IS: 226. BG Axle Guard tie is of angle section having rivet holes 2 at each end. MG tie bar made out of a plate and its ends are bent at 90^{o} and are inclined to match the inclined edge of the axle guard leg. It has 2 rivet holes one on either end. The bridle bar is riveted on either end to the jaws of left handed and right handed axle guards respectively. The turned ends of the bridle bar does not allow the bridle bar to fall in case one of the rivets break, because the same remains sticking with axle guard leg. The important sizes for Tie bars are :-

	MG	**BG**
Thickness	12 mm	ISS50 50X6
Dia of rivet hole	17.5 mm for 16 mm rivets	

e) AXLE GUARD PACKING

It is made of steel plate to specification No. IS:226. The size for BG is 586 x 75 x 10 mm & for MG is 387 x 55 x 12 mm thick. One edge out of 4 has a radius (6 mm on MG) (10 mm on BG). It is rectangular plate having 5 rivet holes. Distance from the rounded edge is 28 mm for BG and 27 mm MG. The dia of rivet holes is 21.5 mm to suit 20 mm rivets. This piece is fitted between the Axle Guard and horn cheek of pressed steel type axle guards.

605 I. CLEARANCES AND REPAIRS OF AXLE GUARD ASSEMBLY

The axle guards must be fitted true & square with the sole bar. The lateral and longitudinal clearances when new and at the time of POH and the maximum limit, have been given below ;

Clearances When New	At the time of POH in Workshops (Max.)	Maximum Limit
Lateral 6 mm	8 mm	10 mm
Longitudinal 3 mm	6 mm	Has not been laid down excepting that the axle guard leg should not work to out of the axle box groove.

Though the maximum longitudinal clearance has not been laid down, yet action should be taken to replace the worn out parts, viz., horn cheeks, axle box liners when this clearance reaches 8 mm. Non-detection of excessive clearance will throw the axle guard out of axle box grooves or make the axle box and bearing brass to cant, which is a dangerous condition. To ensure that the longitudinal and lateral clearances on horn cheeks are within limits 'not go gauge' and 'wear limit gauge' for condemning the horn cheeks should be used.

Bent and expanded axle guards are an undesirable feature and result in displacement of brass from its correct aligned position. The lateral clearance between the axle guard and axle box groove should be uniform throughout the entire length and an axle guard binding the groove at the top and free at the bottom or vice-versa must be rectified. There should be a free relative movement between the axle guard and axle box. Bent, twisted or expanded axle guards will not permit the foregoing movement.

To fulfil the above conditions, it is essential that the axle guards should be perpendicular to the sole bar, both on its side and main face. At the time of POH at least 5% underframe of wagons above 10 years age should be checked for alignment and squareness. The method of checking alignment of the under frame and the squareness of the axle guards have been shown in Fig. 6.6. The tolerances permitted at the time of manufacture have also been shown. These tolerances should be within limits.

The following defects should be specially checked at the time of POH :-

1. **Slack rivets**
2. **Misalignment**
3. **Cracks/Breakages**

a) REJECTABLE DEFECTS

The specified rejectable defects are as under:-

i. Axle guard worn or expanded sufficiently to permit either leg to work clear of its groove in the axle box.
ii. Any portion of the axle guard horn cheek broken or deficient beyond the limit.
iii. Axle guard so bent as to prevent free movement of axle box.
iv. Any crack on leg type axle guard extending through the section more than 25 mm unless repaired in accordance with methods prescribed below.
v. On Broad Gauge wagons leg types axle guard cross-racing without a full component of six rivets or with one or more rivets broken or deficient or wrong size.
vi. Pressed steel axle guard cracked unless repaired according to methods prescribed below.
vii. One or more rivets deficient or broken or of wrong size.
viii. Axle Guard fitted with one or more bolts.

(Note: On Metre Gauge weighted brake van axle guards will be allowed with bolts).

ix. Any axle guard leg shaking due to slack rivets.
x. One or more rivets broken or deficient in horn cheek.
xi. Bridle broken or deficient.
xii. Bridle without jaws or turned ends.
xiii. Bridle of a section less than 4 sq. inch. Thickness less than 13 mm.
xiv. Bridle of wagon not secured by rivets or with a rivet deficient or broken.

MANUFACTURING TOLERANCE FOR UNDERFRAME

1. Difference between longitudinal axle guard centre (A1-A2) is not to exceed 3 mm.
2. Difference between Transverse axle guard centre (B1-B2) is not to exceed 3 mm.
3. Difference between diagonals of axle guard (C1-C2) is not to exceed 3 mm.
4. The difference between specified and actual distance of the centres of the scroll iron (D) should not to exceed plus 1 mm.
5. The distance between the centre of the scroll iron and axle guard should not be more than 1 mm.

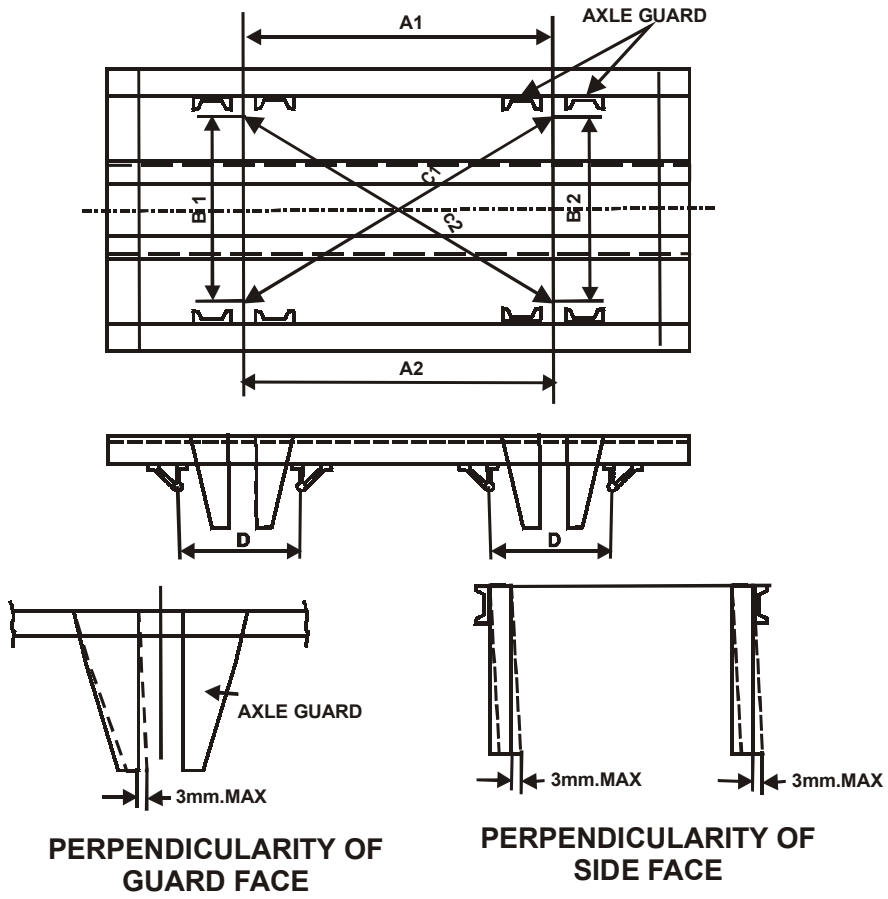


FIG. 6.6 SQARENESS OF GUARD

b) AXLE GUARD REPAIR

Axle guard should be checked for cracks, mis-alignment and slack rivets. In service, the rivet holes of the sole bars and axle guards get elongated, resulting in slack rivets and mis-alignment. Where necessary, the hole must be built up and should drilled to correct size ensuring proper alignment.

For repairing the cracked axle guards, following methods have been laid down:-

- **Oxyacetylene welding** - on leg type of axle guards only.
- **By patching only** - on leg type axle guards only.
- Electric Welding by grafting a new piece preferably **flash butt welding** - only on leg type axle guards.
- **Electric welding** only - on leg type axle guards and upto 25 mm length of crack on pressed steel axle guards.
- **Electric welding with patch** - only on pressed steel axle guards having cracks more than 25 mm and up to half width of the section. If crack length is more than half, the width of the section on pressed steel axle guards, it should be scrapped.

In addition to the methods, prescribed above, the following conditions should be ensured while repairing the axle guards :-

I. PRESSED STEEL AXLE GUARDS

For repair method given above at item No. (v), cracked area should be supported by mild steel patch plate of 10 mm thickness. It should be electrically seam welded on the reverse side of the axle guard covering the entire cracked portion, except the portion covered by the packing plate or horn cheek.

II. LEG TYPE AXLE GUARDS

(i) One axle guard leg should not be welded at more than two places.

(ii) When cracks more than half the width of the section or repaired by welding the station code and date should be stamped close to the welded spot.

(iii) If repairs are done as per method prescribed in item (v), it should be confirmed to workshops or approved maintenance depots with following conditions :-

- The original axle guard and make up piece should be of weldable quality with low carbon content.
- The edges to be welded should be prepared to double VEE, except in the case of flash butt welding.
- The weld should be ground flush. The cross section of the welded portion should be rectangular. Crater and under cuts should be avoided.
- Make up piece should be obtained preferably from a plate by oxy-cutting. If hot bending, make up piece is necessary. It should be ensured that no cracks or gathering of material takes place.
- The shop code and date of welding should be stamped on new piece close to the weld.

(iv) Repair by patching should be adopted only when the length of the crack is up to half width of the section. The minimum thickness of the patch plate should be 10 mm and equal to the width of the section being patched and should be secured with a minimum of 4 rivets of 16 mm dia. Where it is not possible to flush the patch with the inner edge of the axle guard, the patch may be extended to include 2 rivets in the leg and 2 rivets in the sloping arm. The patch should be only on one side of the axle guard. On one leg, the number of patches should not be more than one.

(v) The Broad Gauge leg type of axle guards, if repaired by welding or patching, should be provided with cross-bracing.

III. WELDING OF MANGANESE STEEL LINERS ON ROLLER BEARING AXLE BOXES.

The procedure to be followed at the time of welding manganese steel liners on axle boxes will be as under :-

(i) **Process** - Only manual metal arc process with RDSO approved brand of electrodes suitable for welding Manganese Steel should be used.

(ii) **Weld Position** - The welding shall be done in down hand position.

(iii) **Electric current characteristics** - The current used shall be direct current (D.C.) keeping the electrode positive and the work piece negative. The current value should be according to the electrode manufactures recommendations.

(iv) **Fit up and Welding Technique**

- Prior to welding, the liners shall be clamped squarely in place to hold them flat against the housing. Clearance between liners and the prepared lug surface before and after welding shall not exceed .006" (0.152 mm).
- Care must be taken to prevent cracking of liners.
- Clamp the liners, check the dimensions/alignment, adjust if required and tack weld if correctly aligned.

IV. The axle box body (casing) should be either preheated or immersed in water as detailed below:-

Procedure No. 1 : Pre-heating method –

- The axle box casing should be preheated uniformly to about 250^{o}C-300^{o}C before welding is undertaken and then placed in position to facilitate down hand welding.
- On completion of welding the axle box casing should be allowed to cool in still air.

Procedure No. 2: Submersion under water –

The axle box casing should be immersed under water in a suitable container duly earth. The level of the water should be such that only guide portion (lug) requiring welding remains above water-level.

V. Care should be taken to avoid heat build up. Factors within the control of the welder to reduce the heat build up of the base metal are :-

- Holding a short arc
- Short welding periods
- Lowest possible current
- Use of smallest diameter electrode (consist at) with thickness of the section to be welded
- The temperature of the material should not exceed 200^{o} C at a distance of ½" from the weld.

VI. A slight convex fillet weld profile is desirable.

VII. To eliminate cracking at starts and stops of weld, proper welding techniques shall be adhered to. The arc shall be struck slightly forward in the weld path and then the arc moved to the welding area. By this method, the arc strike will be re-welded when reached. Weld crater cracking will be eliminated by pausing at the end of the weld bead before with drawing the arc. All craters shall have the same throat thickness as the weld bead.

VIII At no time shall the arc be struck of the face of Manganese Steel liners or axle box casing except on those parts of the parent metal where weld metal is to be deposited.

IX. Welding current and manner of depositing of weld shall be such that there is no under cutting, cold laps or porosity, cavities, slag inclusions and other deposition faults.

X. Any weld cracking porosity or cold laps shall be ground to sound metal and re-welded.

XI. Electrode Care

- Electrode shall be stored in the original packets/cartons in a dry place and adequately protected from weather effects. If special protection during storage is recommended by the manufacturer of the electrodes,these shall be stored in accordance with the conditions detailed by the manufacturers.
- Drying oven shall be provided to ensure that the electrodes used are perfectly dry and free from moisture.
- Electrode effected by dampness but not otherwise damaged may be used after being dried out in a manner approved by electrodes, the same shall be dried out at temperature of 150^{o} C and maintained at that temperature for minimum period of half an hour as specified by the manufacturer.

Attention :- Electrodes must be kept dry after the original packet/carton has been opened and those which have been subjected to drying treatment .

- Electrodes, which are as of the flux covering broken away or damaged shall be discarded.
- Precautions must be taken by the welder to maintain the low moisture content. He must protect the electrode from exposure to rain humidity and other possible moisture pick-up.
- where the high humidity exists, the welder shall obtain from the drying oven, the amount of electrodes in accordance with his rate of usage for a period of two hours.
- The detrimental effect primarily in causing porosity and or causing in the weld metal and heat effected zone (under bead cracking).

Inspection

i). All welds shall be visually inspected.
ii) Any cracks porosity blowhole shall be repaired.

Repairs

Weld repairs shall be made to either Manganese liners welds by first removing defective area by grinding to reach sound metal and re welding in accordance with procedure detailed above.

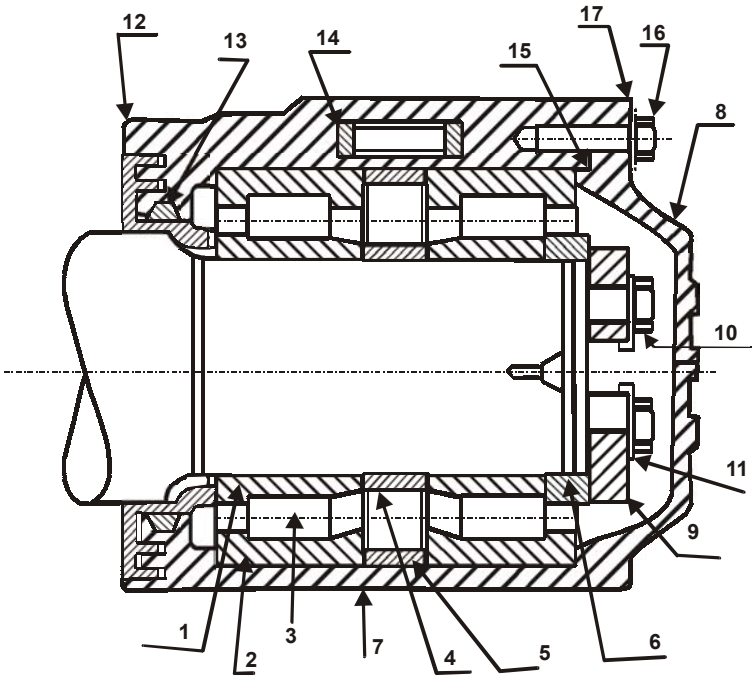
605 J. ROLLER BEARING AXLE BOXES

The type of Roller Bearing Axle boxes fitted on BG wagons are as under:

Sr.No.	Type of Bearings	Axle Load	Type of wagon on which fitted
1.	Cartridge Taper Roller Bearing	20.3/22.9 t	Wagon stock fitted with Cast Steel Bogies
2.	Cylindrical Roller Bearing	22.9 t	BOX,BWT/A, BOBX-MK-II, BWT (Jessop & Cimmco)
3.	Cylindrical Roller Bearing	20.3 t	Wagons fitted with UIC Bogies & CRT wagons
4.	Spherical Bearings	22.9 t	BOBS (German), BOBS(ISW) BWT(German)
5.	Spherical Bearings	20.3t	BWL Imported
6.	Spherical Bearings	18.1 t	BWS (Swiss)
7.	Tapered Roller Bearing	18.7	BWS (Japan)
8.	Tapered Roller Bearing	16 t	TCL Imported

The diagrams indicating main components of cylindrical roller bearing and cartridge tapered roller bearing are shown in Fig 6.6 A & 6.6 B respectively.

Normally roller bearing axle boxes will not need any attention from POH to POH.



1. INNER RACE
2. OUTER RACE
3. ROLLER
4. INNER DISTANCE RING
5. OUTER DISTANCE RING
6. RETAINER RING
7. AXLE BOX BODY
8. FRONT COVER
9. AXLE CAP
10. AXLE CAP BOLT
11. LOCKING WASHER
12. LABYRINTH RING
13. FELT SEAL
14. BUSH
15. FRONT SEALING RING
16. FRONT COVER BOLT
17. SPRING WASHER

Fig. 6.7A : ROLLER BEARING AXLE BOX

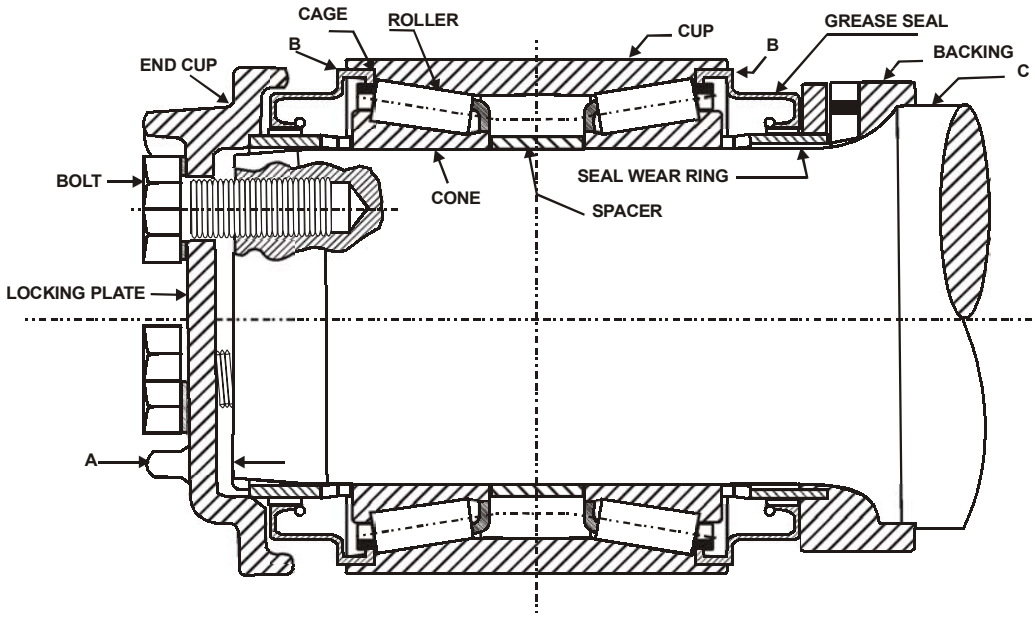


Fig. 6.7B- CARTRIDGE TAPERED ROLLER BEARING

605 K. IMPORTANT Do's & Don'ts DURING POH

a) Do's

i) At every POH , all the Roller bearing axle boxes fitted on BG freight stock shall be attended as per maintenance manual listed below:-

- **G-81-** Instructions for Inspection and Maintenance of CTRB fitted on Cast steel bogies
- **WT-77-1 (1st rev.1985)-** Instructions for Inspection and Maintenance of 20.3 Tonne Cylindrical roller bearing fitted on wagons
- **WT-79-1 (1st rev.1987)-** Instructions for Inspection and Maintenance of 16.3 Tonne Cylindrical roller bearing fitted on wagons

ii) Inspect the roller bearings and axle boxes after all parts are thoroughly cleaned and dried.

iii) Pay particular attention to inner and outer races, surfaces of rollers, rings and cages.

iv) Discard all parts with cracks without exception.

v) Replace the bearings, having reached the condemning limits.

vi) Protect all parts of bearings, after cleaning, against corrosion with a coat of preserving oil.

vii) Replace all seals and gaskets.

viii) Proper tools should be used. Improvised tools should not be used. Use of cotton waste is prohibited.

ix) The Roller bearing section should be adequately protected, glazed and provided with pucca paved floors.

x) Protect the roller bearings and axle boxes mounted on axles before the wheel-sets are sent for tyre turning by dummy faceplate.
xi) Charge fresh grease of approved Brand and recommended quantity in the axle boxes, before mounting.
xii) Change the wheel set fitted with roller bearing whenever a warm/hot box is detected.
xiii) Short circuit the roller bearing while carrying out welding repairs on the bogies or wagon-body fitted with roller bearings.
xiv) The date of POH & Shop code shall be stamped on the axle box.
xv) Axle-Cover bolts of cylindrical RB axle boxes should be fitted with the locking washers on the line unless otherwise stipulated.

b) Don'ts

(i) Cleaning with compressed air is totally prohibited.
(ii) All locking washers/plates used for locking the bolt/nuts in the 'Axle-Cap' and 'Front Cover' should never be used twice and should invariably be replaced at the time of POH/ROH.
(iii) Do not over-charge the grease in the axle boxes.
(iv) Do not recharge the grease in between the two POH.
(v) Do not open the roller bearing axle boxes in sick line /Yard, except for the specified examination/attention at the nominated sick line.
(vi) Do not carry out any welding on the wagons, without earth the bogie frame/wagon body.
(vii) Do not carry out any welding on the axle box during POH, except for provision of manganese liners under special precautions, as stipulated.

605 L. REPAIR AND MAINTENANCE IN SICK LINE

a) The Scroll iron is to be checked for

i. Rivets loose, deficient or broken
ii. Scroll iron cracked or broken
iii. Scroll iron shifted out of alignment
iv. Eye hole worn over size or oval

The repairs should be done as given in para 605 B (a)

b) Shackle pin is checked and to be repaired as given in para 605 B (b)

c) Cotters found to be broken, deficient or wrong size, not split properly and some times jib not in correct position. In the first three cases the cotter should be replaced and in the last two cases, it should be fitted properly or replaced where necessary.

d) Spring to be examined and repaired as given in para 605 B (h)

e) The buckle to be examined and repaired as given in para 605 B (e)

f) Wagons unevenly loaded should not be allowed to run in service. Worn out pins should be replaced. Spring with shifted plates beyond limit should be replaced.

605 M. REPAIR AND MAINTENANCE DURING ROH & POH

The following additional work also to be carried out during maintenance at the time of ROH and POH including the above work mentioned at para 605 L.

i. All spring to be given a scrag test and their camber should be checked..
ii. At least 5% of springs must be subjected to load deflection test.
iii. Important Do's & Don'ts for spring as given in para 605 F to be followed.
iv. It should be ensured that packing plate sits properly on the axle box crown and the spring buckle rests properly over it and there should be no chance for them to come out of the crown. Buffer height to be adjusted as given in para 605 G.
v. The inner portions where axle guards wear, horn cheeks have been provided on the axle guard. Horn cheek should be replaced after reaching condemning limit.
vi. To ensure that the longitudinal and lateral clearances on horn cheeks are within limits 'not go gauge' and 'wear limit gauge' for condemning the horn cheeks should be used
vii. Important Do's & Don'ts for Roller bearing as given in para 605 K to be followed.

605 N. AXLE BOX ASSEMBLY WITH PLAIN BEARING

Axle box keeps the axle in position and provides lubrication to the journal. It encloses bearing and conditions lubrication. The bearing may be a plain brass or SGCI bearing or a roller bearing using oil soaked waste for the former and grease for the latter. There are many types of axle boxes in use on Railways. Plain brass bearing axle boxes in use on Railways of IRS & IRCA type only are being described in this chapter.

1. IRS Axle box (BG) for 8 wheeler wagons journal size 255 x 127 mm to Drg. No. W/AB-555.
2. IRS Axle box (BG) for 8 wheeler wagons journal size 305 x 155 mm to Drg. No. W/AB-1650
3. IRS axle box (BG) for 4 wheeler wagons journal size 255 x 127 mm to Drg. No. W/AB-570
4. IRS Axle box (BG) for 8 wheeler wagons journal size 305 x 152 mm.
5. IRS axle box (MG) for 4 wheeler wagons journal size 230 x 115 mm to Drg. No. W/AB-1401
6. IRS axle box (MG) for 8 wheeler wagons journal size 230 x 115 mm to Drg. W/AB-1404

7. IRCA axle box (for 4 wheeler wagons journal size 254 x 127 mm.
8. IRCA axle box (MG) for 4 wheeler wagons journal size 229 x 114.
9. IRCA axle box (MG) for 4 wheeler wagons journal size 187 x 120 mm.

IRS axle boxes have been provided with key plate. IRCA Non-standard type are without key plate. Four wheeler axle boxes have two channel in which the axle guards slide.

Axle box is made of cast steel class 'A' grade. It is normalized. An IRS BG axle box assembly for journal size 255 x 127 mm meant for four wheeler wagons has been shown in the figure below:-

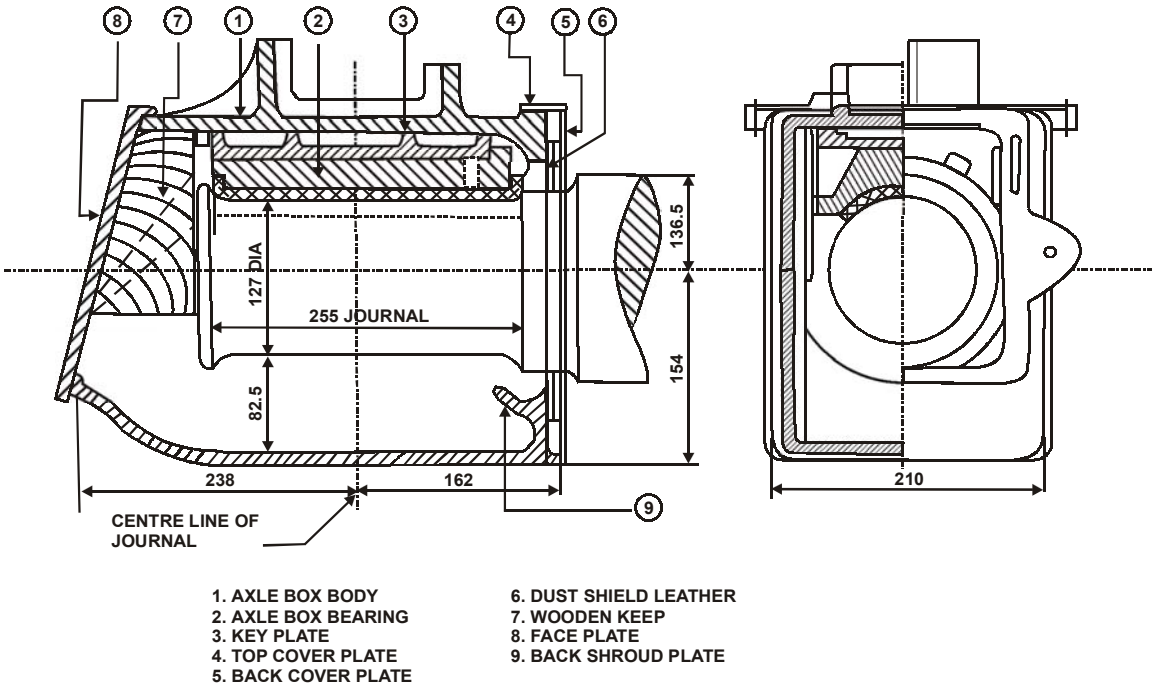


Fig. 6.8 AXLE BOX ASSEMBLY 255X127BG

The axle box is a rectangular hollow box with openings in front and back a crown on the top. Back opening is meant for entry of the journal. Front opening has been provided for insertion/withdrawal of bearing brass, oil soaked cotton waste/FRLP, key plate, etc. Crown has been provided to keep bearing spring in position and preventing its displacement. Crown also enables insertion of packing plate between axle box and spring.

After replacement of the soaked waste/FRLP, wooden key, bearing brass, key plate in position axle box is sealed in the front by riveting a faceplate to its lugs. On the backside the axle box is sealed by providing a dust shield, back cover and top plate. Axle box body is 8 mm thick at bottom and sides and 13 mm thick at the top. On the backside near the bottom, a shroud is provided for keeping soaked packing into position and not to allow the oil to find way out through and back opening.

Axle boxes having key plate have been provided with lugs in the front and back as well as on both the sides. The key plate is kept in position by these lugs. The bearing brass gets suitably locked with the key plate and thus the former is prevented from having undue movement longitudinally and transversally in relation to axle box. It is, therefore, very important that machining of the lugs should be correctly done, otherwise, there will be undue movement of the brass in relation to the axle box. The front, back and side lugs are fine-finish machined. The inner top surface of the axle box, which comes in contact with the top surface of the key plate should be fine machined. The surface on which the faceplate sits should be rough machined. The machining tolerance between the front and back lugs and side lugs is +1.0/ - o.5 mm. In addition to machine tolerance, 1 mm wear is allowed on the lugs. These dimensions should be very strictly followed at the time of manufacture as well as at the time of POH and at the times of re-packing in sick lines.

It has been the experience that the initial machining at the time of manufacture is not always satisfactory and, therefore, 1 to 2% of the new axle boxes should be checked in the workshops to ensure that –

- The crown inner surface has not been machined out of square.
- The lugs are of equal depth and also at an equal distance from the centre line of the axle box and
- The machining of the guides is not on a taper or in other words, guide surfaces must be parallel to each other along the full length.

In service, the inside crown of the axle box wears. It should be checked for wear at the time of POH and re-packing. Concave wear on the inside crown should not be permitted under any circumstances. If worn, the inside crown should be fine machined to ensure proper flatness. The thickness of the crown may be reduced to the extent of 2 mm by machining.

IRCA axle boxes have not been provided with key plates. On such axle boxes instead of front & back lugs, the top inner surface have a downward projection. These axle boxes have side lugs. The bearing brass has upward projections at the 2 ends at a distance corresponding to the downward projected portion of the axle box. The projected portion rests on the top recess of the bearing brass. The raised portions of the brass do not permit its movement along the centre line of axle. The side movement is prevented by the side lugs. It is, therefore, important that the projected portions should be machined accurately. The distance between the edges should be correct. If it is more, it will infringe with the brass and if less, it will give excessive movement of the brass in relation to the axle box.

a) AXLE BOX COVER PLATE (TOP AND BOTTOM)

The back opening of the axle box is covered with cover plates/plate. In IRS boxes the cover plate is used in two half. It is known as ‘Cover plate top’ and ‘cover plate bottom’. In IRCA axle boxes, one complete plate is used. It is secured with axle box by welding.

Top and bottom cover plates are made of 3.15 mm thick plate of steel. It has a rectangular shape with a semicircular portion removed from one of the edges. The radius of the semicircular portion should invariably be more than the dia. of the axle at the shoulder. It has a hole in the centre. The top bent edge is kept substantially long to cover axle box top opening. For IRCA axle boxes, a separate top cover is not required. The cover plate keeps the dust-shield in position. In addition, it also prevents ingress of dust inside the axle box.

b) AXLE BOX TOP COVER

An opening is provided on top of the axle box for inserting the dust shield. After inserting the dust shield, this opening is covered by axle box top cover. Top cover should be fitted without fail otherwise dust will find its way in the axle box through this opening. Top cover is a rectangular piece made of steel plate SI-42-S to Specification No. IS: 226. It has two rivet holes, one at each end (6.5 mm dia. to suit 6 mm rivets).

c) DUST SHIELD

It is made of leather of either 3 ply or 2 ply. It has rectangular shape with a circular hole in the centre. Its four outer-corners have been cut at 45^{o} for a length of 25 mm. It is stitched close to the outer edges and central hole. The outer leather should be pliable and inner ply/plies should be as stiff as possible. The thickness of the dust-shield is 9.5 $\pm$ 1 mm. The manufacturing tolerance for the edge is 1.5 mm and for the hole is + 0 mm/ -1.5 mm the outer ply is bent inwards at right angles leaving sufficient gap from the inner ply. The thickness of the outer leather is 3 mm for 3 ply and 5 mm for 2 ply.

Before using the dust shield it should be soaked in axle oil medium for 48 hours. It should not be allowed to come in contact with water. It should be stocked in dry place. The dust shield should be examined, every time the axle box is repacked in sick lines as well as at the time of POH. If found worn, torn, or if it has lost its stiffness, it should be replaced.

d) AXLE BOX GUARD GROOVE LINER

It is a channel shape piece made of steel to Specification No. IS: 1079. The thickness of the plate is 3.15 mm to BG and 4 mm for MG four wheeler wagon. Its sizes are as under:-

B.G. Stock - 273 long x 60.3 $\pm$ 3.4 wide x 30 mm depth
M.G. Four Wheeler Stock - 232 long x 50.8 $\pm$ 8.4 wide x 22 mm depth

At bend corners, the inner radius is 6 mm for BG., 4 mm for MG four wheeler & 3 mm for MG bogie. The Liner is tack welded vertically to the Axle Box Groove. When the Liners are worn to such an extent that the prescribed permissible lateral and longitudinal clearances exceed, it should be replaced. Provision of Liners prevents wear of Axle Box Groove. The Liners can be replaced at a much lower cost compared to repair/replacement of Axle Box.

e) AXLE BOX FACE PLATE

It is fitted to the front opening of the Box by riveting it to the axle box lugs. It prevents entrance of dust/moisture inside the Box as well as leakage of oil from the Box, pilferage of soaked cotton waste and bearing Brass. While riveting care should be exercised that the face plate fits square on the face of the box and does not gap. Now, it has been prescribed to provide a rubber gasket between the face plate and Axle Box face to ensure proper sealing.

The face plate is made of 6 mm thick steel plate to specification No. IS: 226 by hot-blanking, pressing in die and bending the end at the top. It is almost of a rectangular shape with two projected lugs at mid-height. In these projections, two rivet holes of 13.5 mm dia have been Jig-drilled to suit 12 mm rivets. In the vertical plane, 3 mm, camber provided to ensure proper fitment on sides of the Axle Box. Near the top, a 14 mm dia oil hole has been provided. It is covered by a cover fitted at a distance of 19 mm upwards. The Oil hole cover is secured with the face plate by an 8 mm dia standard rivet head. A 7 mm dia counter sunk hole has been drilled in the face plate for the rivet. The 8 mm dia portion of the rivet goes inside the 10 mm dia hole of the oil hole cover. This clearance of 2 mm. enables the oil hole cover to rotate freely. After putting oil in the axle box, the oil hole cover should be put back to the normal position, thus covering the 14 mm dia oil hole.

The face plate is likely to get dented and damaged near the rivet holes when the rivets are cut by hammering, oxy-cutting or by pneumatic busters at the time of repacking/POH. To avoid it, lead hammers should be used, pneumatic cutting should not be resorted to and oxy-cutting should be done very carefully. The elongated/oval cut holes is a very undesirable feature as it does not allow proper riveting of the face plate leaving gap between the face plate and axle box. Also proper shape heads are not formed. At the time of riveting the face plate, it is also important to check its camber. Only good face plate should be used at the time of re-packing in sick lines or at the time of POH in workshops. For this purpose, sufficient stock of good face plate should be reclaimed to the extent possible by re cambering it and repairing worn holes. Axle box should be repaired by oxy or electric welding.

I. REJECTABLE DEFECTS IN AXLE BOX

The rejectable axle box defects are as under:-

(i) Axle box visibly worn in such a way as to interfere with the lubrication of the bearing.
(ii) More than one loose liner used for taking up wear in a groove of an axle box.
(iii) Axle box loose liner, when fitted to take up wear, not bent over the top and bottom of axle box.
(iv) Axle box cracked below the journal centre or with a crack through both lugs of an axle guard jaw or groove.

(v) Axle box broken.
(vi) Deficient back plate or dust shield.
(vii) Axle box back top cover plate deficient on Broad Gauge wagons.
(viii) Integrally cast back plate broken so as to allow the dust shield to be displaced.
(ix) Axle box fitted with mild steel back plate in one piece or in two halves not with horizontal, joint seam weld and if the thickness of plate is not 3.15 mm
(x) Hot box.
(xi) Axle box overdue oiling.
(xii) Axle box face plate less than 6 mm thick not provided with oil hole with cover lip on top for BG. On Metre Gauge face plate of an axle box less than 1.6 mm if dished or less than 3 mm thick if plain.
(xiii) Overdue re-packing.
(xiv) Oiling or re-packing marks not legibly stenciled with the standard stenciling on at least one PRO plate/sole bar
(xv) Axle box face plate broken, insecurely fastened or gaping more than 1.5 mm
(xvi) Axle box face plate deficient or with rivet broken or deficient.
Note : When an axle box face plate rivet is found broken or deficient, the box must be examined from inside to ensure correct assembly of fittings and contents.
(xvii) Axle box face plate not permanently secured unless exempted under IRCA Part III Rule 2.9.2.2.
(xviii) Faceplate of a Wagon axle box secured with rivets bent over.

Axle boxes should be examined and inspected in Workshops and on open lines for above defects. If these defects are found, it should be rectified.

f) KEY PLATE (SLIPPER PLATE)

Key plates have been provided on IRS Wagons in between axle box top inner surface and the bearing brass. It is an important load distribution medium as well as a device to assist in removal of bearing brass. It is rectangular Plate of 16 mm thickness for BG and 13 mm thickness for MG. Its top and bottom surfaces are flat. Top surface has been provided with recesses. Its top and bottom surfaces are ground and 4 side surfaces finish machined. It has a 10 mm dia hole near front in central portion to facilitate its easy removal. The size of Broad Gauge is 234.5 mm +0/-1.0mm x 155.5 mm maximum and for MG is 209.5 +0.0/-1.0 mm x 138 mm maximum. On BG key plates, the top edges along the length have been rounded off. The back and top has been chamfered by 3 x 11. It is made of one of the following materials :-

- Malleable cast iron grade 'A' to specification No. IS: 2107/IS: 2108
- Steel casting grade 2 to specification no. IS:1030.
- Steel ST 42-S to specification No. IS: 226. For this type, recesses at top need not be provided.

As key plate is an important load distribution medium, it is very important that the key plate must rest squarely on the top surface of the brass and the inside crown surface of the axle box to ensure proper transmission of load.

In service, it has been found that both top and bottom surfaces of key plate wear unevenly. The front and which bears against the axle box front lug and the back and which bears against the bearing brass get battered badly. At the time of POH and repacking, the top and bottom surfaces and the two ends should be checked. The front end should fit securely with axle box front lug and back and with bearing brass. The key plate with badly battered ends should be discarded. The key plate having uneven surfaces should not be used. It should be reused only after proper grinding. Thickness of top and bottom surfaces should not be reduced beyond 1.5 mm each. While fitting key plate, the condition of the top surface of the brass as well as inner crown, surface of the axle box should also be checked for uneven wear. If such defects are found on them, it should be rectified. It should always be ensured that the key plate bears evenly with bearing brass and does not rock. Badly battered and with a worn out axle box front lug may cause the displacement of the key plate disturbing the stability of the wagon. Both top and bottom surfaces should be smeared with oil while fitting it in the axle box.

g) BEARING BRASS

The load from axle box crown as transmitted directly on the bearing brass on non- IRS wagons and through key plate on IRS wagons. The bearing brass rests directly on the axle journal and it, in turn, transmitted the load to the axle. As the journal rotates and the bearing brass remains stationary, frictional forces come into pay and enough heat is generated. It is required to kept to the minimum and suitably dissipated. It is, therefore, necessary that the surface of bearing brass and journal, coming in contact with each other, should be of very high finish and should have adequate and proper lubrication. Absence of any of these two basic requirements will lead to a hot box.

Bearing brass consists of a bronze or S.G.C.I. shell with white metal lining. The latter comes in contact with journal. The shell provides necessary strength and shape to the while metal. The design of bearing brass has received considerable attention in the recent past and many improvements have been incorporated. For IRS stock, the bearing brasses have been standardised in 3 step sizes, to suit decreasing dia. and increasing length of the journals. In service due to wear, the journal dia. decreases, whereas the length increases due to wear on its shoulders and fillets. At the time of POH, the worn out journal surface is turned and ground/burnished in order to get back the required surface finish. Such journals are condemned when they reach condemning dia. or, the wear on fillets and/or on shoulders has gone beyond the permissible limit.

The step sizes of brass cater for all the journals which have dimensions between the new and condemning limit. The 3 step sizes are known as A, B & C. On 'A' size brass, the diameter of the while metal shell is kept 3 mm. more than the new journal as well as on the journals having diameters less upto 3 mm. from the new axle. Similarly, the length of the bearing is kept 3 mm less for MG & 5 mm less for BG than the length of the new journal. These shells can be used for journal length, which are even 2 mm. more than the new. When the length and dia. of the journal crosses these limits 'B' size bearing brass is used. After certain stage, 'C' size bearing is used. Thereafter the journal is condemned. Use of step size brasses is tabulated below:-

S. No.	Particulars		Nominal Size	A	B	C
1.	Journal Dia		mm D	Mm D to (D-3)	Mm Below (D-3) to (D-8) for MG & (L-6) for BG	mm Below (D-8) for MG & (D-6) for BG to condemn-ing size.
2.	Bearing diameter	BG MG	D+2 D+2	D+2 D+2	D-1 D-2	D-4 D-6
3.	Length of Journal	BG MG	L L	L Minimum L Minimum	L+2Minimum L+3Minimum	L+5 Minimum L+6 minimum
4.	Length of Bearing	BG	L-5 L-3	L-5 L-3	L-3 L	L L+3
5.	Shell Height at Crown		H	H	H+2	H+4
6.	Length of Collar (Outer) Depth of Anchor groove (outer)		I L	I D	I +3 D+3	I +6 D+6

The composition of bronze shell and while metal is as under:-

Bronze Shell

Lead	4 to 6%
Tin	4 to 6 %
Zinc	4 to 6%
Antimony	0.3% (Max.)
Phosphorous	0.05% (Max)
Copper	Balance

White Metal

Antimony	14 to 16%
Tin	4.5 to 5.5%
Copper	0.3 to 0.7%
Lead	Balance

STEP SIZES

The various improvements incorporated are as under:-

i. The thickness of the white metal lining has been kept as 6 mm. at centre, gradually reducing to 5 mm. at the ends. This facilitates in ensuring 30^{o} arc of contact of the bearing with the journal. The white metal lining having more clearance on sides does not have a tendency to bind with the journal. The gradually reduced thickness of white metal is obtained by shifting away the centre of radius of bottom surface of white metal lining, from the centre of the radius of the shell.
ii. The white metal lining is not provided up to the edge of the shell, but is finished 3 mm short of it. Thus the unprotected soft white metal at the longitudinal sides of the bearing has been eliminated against damages in rough/hump shifting.
iii. The thickness of the white metal has been reduced from 10 to 6 mm to eliminate its spreading in service.
iv. Step size brasses have been introduced as explained.
v. hole for the bronze shell provided for anchoring & pouring of white metal have been eliminated.

The bronze shell has a flat top surface with 4 recesses. Towards the end, it has a rectangular lug across its width for locking the key plate. A small 5 mm. dia. semicircular groove has been provided just before the lug to ensure proper fitment of key plate. The front and rear ends of the brass have square vertical edges for certain length. The remaining length of the brass has inclined vertical edges. Its bottom surface is circular with flat longitudinal edges. The white metal lining has been provided with suitable recesses at the 2 ends.

The bearing brass is machined all over except on inclined vertical surfaces and top recesses. Accurate machining of shell and white metal lining, as per drawing, is very important and should be ensured without fail. Use of un- machined metal brass is not permissible. The back of the brass forms the datum surface for machining. It should be checked for perfect flatness by using a master key plate. There should be no rocking motion and if found, it should be removed by filing. Even old brasses should also be checked for flatness immediately after de-metalling. Upsetting the centre for machining the white metal lining is also very important and should be ensured.

The bond strength between bronze/SGCI shell and white metal is very important. Bond strength should be more than the strength of the white metal. In case of excessive tensile stress or shear, the failure should take place in the white metal and not in the region of the bond. Correct white metalling procedure has been prescribed. It should be rigidly followed to avoid failure on hot box of the bearing.

The particular step size of bearing should always be fitted on the corresponding step size journal. 'B' size bearing should not be fitted on 'A' size journal. The dia of 'B' size bearings less than it will rest against the journal on its side instead of at centre and will result in hot box. In extreme cases, step size 'A' bearing can be used on 'B' size journal and the 'B' size bearing on 'C' size journals. Care should, however, be exercised that length suits the journal for which lateral play should be checked. In no case, 'C' size bearing should be used on 'B' and 'A' size journals and 'B' size bearing on 'A' size journals.

It is important to identify the step sizes of the bearing and journals. Identification color strips should be painted at one of the recesses on the top of the bearing brass to know its step size with following color scheme :-

Step size 'A' - Green
Step size 'B' - Yellow
Step size 'C' - Red.

Suitable span gauges should be used for measuring the diameter of the journals by which step size of journal can be decided. The length of the journal mostly falls within step size of the journal based on dia. The lateral play of the brass may be checked on a dummy journal or on a journal on which the brass will be used. The gauge to be used for checking the lateral play. Step size brasses, however ensure adequate initial lateral clearances. The prescribed minimum and maximum lateral play of the brasses is tabulated below:-

Lateral play of brass on journal	Trolley		Four Wheeler	
	BG	MG	BG	MG
Minimum	5	3	5	3
Maximum	10	6	10	10

One of the main reasons for the introduction of step size bearing brass is to ensure an initial arc of contact of 30^{o} on the crown. In the course of service, the arc of contact will increase. At the time of re-packing, if the brass is not found to be sound, it should be side relieved with hand scraper so as to provide once again a 30^{o} arc of contact at the crown. The advantages of providing 30^{o} arc of contact are as under :-

i. It will ensure an adequate feed of oil to the fluid oil film.
ii. It will permit the bearing to easily adjust itself to the geometry of the particular axle box
iii. In the event of excessive plastic flow of the white metal, there will be lesser possibility of the oil feed being blocked by the spread white metal.

Adequate number of bearing brasses of different size should be stocked to workshop and in sick lines.

The requirement of bearing brasses of different step size is expected to be in the following proportion:-

Step size - 'A' 80%
Step size - 'B' 15%
Step size - 'C' 5%

However, the proportion to be determined by users after conducting their own survey.

However, the proportion should be determined important aspect. If brasses are not properly handled, it may suffer considerable damage in a number of cases. Throwing of metalled bearings while loading and unloading and careless handling leads to damage to the bond between the white metal and the shell and damage to the white metal surface. The bearing should be loaded one by one on a lister truck or any other type of transport. Similarly, it should be unloaded one by one. In stores, it should be neatly stacked. While sending the bearing from stores to out station depot in Store van, wooden boxes having a carrying capacity of 50 to 100 bearing should invariably in used. These boxes should be fixed in the van and not to be allowed to be handled in loaded condition. Similarly, bearings loaded in wagons should be handled carefully. The bearing should also be handled carefully in sick line. Transportation of bearing from sick line stores to sick line should be done in wooden boxes having a carrying capacity of 4 to 10 bearings.

h) JOURNAL

The portion of the axle on which the bearing brass comes in contact with the axle is known as journal. This journal is an integrated portion of the axle. It differs greatly with the other portion of the axle in respect of surface finish. The journals of wagons are provided outside the wheel. Just after the wheel seat on outer side a small length of the axle is known as shoulder. The journal portion begins just after the shoulder. The diameter of the journal portion is less by about 25 mm to 30 mm as compared to the shoulder. The two surfaces are joined giving a radius of 16 mm for MG and 19 mm for BG. Except at the radius portion, the journal surface is parallel. The journal surface is joined with the collar by a radius of 6 mm. The outer edge of the collar is rounded with a radius of 10 mm.

During service, the journal wears all over. It results in decrease of the dia of the journal and increase in its length. The wear on the journal is not uniform at every place. In workshops at the time of POH, the journal should be turned to a fine-finish, where necessary and should invariably the ground/burnished to a high degree of accuracy. Worn out collar and shoulder should also be restored to correct radius. Even a small mark on the surface of the journal due to mating of two different surfaces being turned or ground/burnished in two different attempts may result in a hot box. Similar care should also be taken on the sides on curved surface. There should be no mark present on it. While checking the surface finish the journal should be hand felt by an experienced man or by a surface finish gauge. Defects if any should be removed by regrinding/burnishing or by hand polishing with emery cloth.

The ovalty and taper on the journal should be within the permissible limit of 0.1 mm. The ovalty and taper of the journal should be checked by measuring the diameter with micrometer at 3 locations both on the vertical and horizontal axis. If required, measurements at more locations should also be taken. If cases of ovalty and taper going beyond the permissible limits, are detected, the grinding and burnishing machine should be checked and its defects should be rectified. Cent percent check for ovality and taper should be carried out. Diameter of all journals coming one of the wheel shop should be measured & a record be maintained. The dia of the journal should be written with chalk on inner surface of the wheel for guidance of the staff in the lifting section. The top surface of the outer collar, where necessary, must be finished by a suitable form tool either on grinding or burnishing machines or on another suitable lathe.

As indicated above, normally the minimum length of the journal for a particular step size diameter is automatically re-ensured. However, there may be exception and the minimum length of the journal should, therefore, be checked by means of a gauge.

Wheels which are required to be send to out stations after repair or which are required to be kept in spare pool, for some days, should be carefully painted with 3 coats of bituminous solution to IS : Specification No. 158. To protect the journal surface of the wheels being sent to out stations against mechanical damage, it should be fitted with tightly bound wood lagging extending outside the collar and up to wheel seat, completely surrounding the journal.

Concentricity of the journal and wheel tread is an important matter for satisfactory performance of the bearings and this should be occasionally checked when wheels are attended to in shop or in sick lines.

The total permissible wear in the length of the different size of BG and MG journals of goods stock for shop purposes, will be as under :-

Size of Journals (mm)	Maximum permissible wear on Length of Journal (mm)	Inner Collar (mm)	Outer Collar (mm)	Maximum thickness of outer collar
BG (i) 255x127 } (ii) 254x127 } (iii) 229x144 } **MG** (iv) 230x115 } (v) 229x114 }	11	6	5	11
(vi) 180x100	10.5	6	4.5	8
(vii) 170x102	11	6	5	8
(vii) 178x89	8	5	3	8

The axle has its lowest diameter at the journal. The dia of the journal, therefore, is the limiting factor for deciding the gross load at rail.

The permissible gross load for standard and non-standard BG & MG axles has been given in IRCA Part III Rule 2.8.10. Upto a certain reduced diameter of the journal compared to the new, the axle cap carry full designed load, thereafter less than the designed load. If full axle load has to borne at the reduced diameter of journal should be condemned and re-axling of the wheels should be done. The axle can, however, be used further by corresponding reduction in gross load and carrying capacity of the wagon. However, this practice is not desirable from commercial point of view. Axle should be changed as soon as its journal dia reaches the condemning limit corresponding to the designed axle load of the wagon.

The distance between the centres of the 2 journals is also very important. The spring shackle assembly axle box and axle guard for a particular type of wagon, have a fixed journal centre. The correct distance between the journals as well as the distance of individual journals from the outer surface of the wheel centre is, therefore, very important and should be ensured. Its absence will cause difficulty in ensuring correct alignment and the bearing brass will have a tendency to ride over collar on one side and shoulder on the other side of the journal.

Many times the axle gets out on the shoulder portion by the back plate of the axle box. Such an axle can be used again after turning the cut provided the cut is only in the part where the dust shield may does not reduce the dia by more than 12 mm, compared to a new shoulder dia and the width of cut is not more than 15 mm. The portion which is turned, shall extend only upto that part of the axle upon which the dust shield may bear. The radius should be provided as shown in IRCA Conference Rule part III and the radius should be merged.

The axle also gets notched in service due to rubbing loose with loose brake rigging parts or any other part. Thus effective diameter reduces and the axle may break in service. Axle should looked for such defects at every stage and any axle found with these defects should be withdrawn and replace.

The journal surface is a highly polished, which has to be handled with care in workshop and other places. Sling chain or hooks, etc., therefore, should never be applied to the journals for handling and lifting the wheels in workshops, sick lines and other places,

Holes provided in the wheel centres may be used for this purpose. While using the wheel it should be checked again for any mechanical damage likely to have taken place during transportation and handling.

During service, many bearings run hot causing considerable damage and scoring of journals. Such scored journal should be used only after proper grinding, burnishing and testing. Wheels with scored journals should be sent to shops or to depots, where facilities to do proper repairs exist. Such journals should not be used on passenger service. Every time the axle runs hot a 5 mm size star mark should be stamped on the face of the affected journal to distinguish it from other journal and to know how many times the journal, in question, has run hot.

The part of axles is not to be built except the outside fillet by electric welding. If the wear on the outer side of the journal is beyond limit, the collar should be built up by electric welding, and be turned to its original size and shape.

The axle should be checked in workshops for flaws. The axle should be tested by ultrasonic equipment for flaws and cracks. All axles being used in workshop for POH stock as well as axles being sent to out-station should be given above tests.

To economize on the consumption of raw material, the BG condemned axles are being used on MG stock and MG condemned axles on NG stock by forging down, cutting to required length, heat-treatment and turning. Such axles should also be subjected to examination and flaw detection. After forging and heat treatment, a test piece of the material out of the same lot, should be sent to CMT for metallurgical test to ensure that the material and properties of converted axle are at part with that of the specified new axles. While converting axle in this manner the journal portions should be discarded.

i) COTTON WASTE PACKING

Lubrication between the journal and the bearing brass is provided by soaked cotton waste roll packing. The packing is now being provided in the form of rolls on standard stock.

A good lubricator should possess following essential qualities:-

- It should have adequate oil holding capacity.
- It should have good wicking action so as to keep packing up the oil from the bottom of the axle box.
- It should have sufficient resilience so as to maintain a continuous contact with the journal even on uneven track.
- The contact pressure between the journal and the lubricator should be such that it only maintains a continuous contact with the journal but is not so tight, as to cause a ‘wiping action’ leading to the suspension of the oil feed to the fluid oil film.
- It should remain, in a specified central position, in the course of normal service, which is seldom free from repeated impacts of varying intensity.
- The structure of the lubricator should be such as will not permit the detachment of any part of it, which might lodge itself between the journal and the bearing and thereby obstruct the oil feed.

The cotton waste should normally consist of 40% unteased cop bottoms mixed with 60% good quality reeling hard waste. The specification had to be relaxed due to non-availability of the required supplies and the permissible mixture should now consist of 90% unteased reeling waste. It must, however, be of good white color, absorbent and elastic. The waste should salso be free from moisture, dust, oily

substances, un-spun yarn, colored threads, rags, etc. The dry cotton waste must always be stored in a suitable clean and dry room free from damp and dust contamination.

Preparation of soaked waste required for the roll packing must be carried out with great care. The soaking of waste is, by and large, at present being carried out in the conventional method though a few railways have switched over to the steam vacuum process which gives a superior product in a such shorter period of time. The required quantity of dry waste should be weighed.

Foreign matter should then be carefully hand picked and the waste placed on an expanded metal table and then beaten with a cane. The weighed quantity of cotton waste should then be placed on an adjustable perforated tray in a suitable size rectangular tank. The tray should be lowered to the bottom position.

A measured or weighed quantity of medium axle oil, about six times the weight of the cotton should then be poured over the waste. It should be ensured that the waste is fully submerged in oil during the period of 36 hours for which it is to be soaked. The waste should be turned over, every four to six hours during the period of soaking.

The perforated tray should be lifted after 36 hours of soaking. Draining should then be permitted for a period of 12 hours in winter and 6 hours in summer. There should be a small black plate or board on each soaking tank for writing with chalk, the timings of commencement and termination of the soaking and the draining operations. The quantity of oil at the bottom of the tank after the draining period, should occasionally be measured with a dip stick to ensure that the drained soaked waste has oil and waste in the proportion of 4.1. The above waste should then, be transferred to a large rectangular but very shallow (250 to 400 mm deep) container. The packing so placed should also be turned over, three to four times in a day, to ensure uniformity of oil and waste proportions.

Dirty, wet and glazed portions of old packing should not be reclaimed, and the back rolls must invariably be discarded. The serviceable portion should then be thoroughly shaken on expanded metal table and also teased by hand. The old waste cleaned in the above manner should then be soaked and drained in a separate tank, which also has a perforated tray. The soaking period for the old waste should be 6 hours only and thereafter, the draining should be for 12 hours in winter and 6 hours during the summer months.

The reclaimed waste so prepared should be transferred a separate shallow container where it should be turned over 3 to 4 times in a day to ensure uniformity of oil and waste proportion. For roll making, the reclaimed and new waste may not be mixed, as far as possible, should be made of re-claimed waste is not available, the mixture of the reclaimed and the new waste in the proportion of 2:1 may be used. It must be remembered that while the maximum amount of old packing must be re-claimed, there should be no compromise in the matter of re-claimation of such old waste as is definitely unfit for further use.

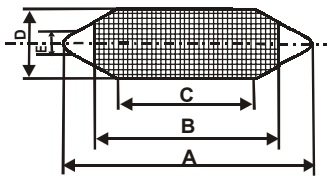
To be able to introduce the procedure mentioned above, 2 soaking tanks with perforated trays would be required, one for soaking new waste and the second for reclaimed waste and the requirement of shallow containers would be three, one for new soaked waste, another for reclaimed waste and the third for the mixed, new and reclaimed waste. This would be the minimum requirement and may be increased depending upon consumption of soaked waste. The steam heated vacuum waste soaking plant is an alternative to the conventional method for preparation of soaked waste, which is also in use on Railways.

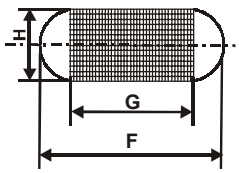
The requisite quantity of cleared waste is placed in the soaking chamber and the temperature maintained at about 200° with 25 cms. of vacuum. After an interval of 10 minutes which period has been found sufficient to remove the moisture from waste, the requisite quantity of oil (the ratio of oil to waste being 4:1) is discharged into the soaking chamber through the oil control valves. The oil flowing over the perforated plate fixed to the inside of the lid, assists proper distribution. The soaking time should be 40 minutes. No draining is necessary. Thoroughly impregnated packing is thereafter ready and this should be transferred to a shallow container.

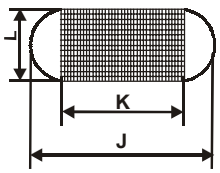
Steam soaking of the reclaimed waste to be carried out by adding 1 Kg. of oil to 5 Kgs. of old waste. Soaking for a period of 10 minutes would be adequate. In the case of old waste which may thereafter be transferred to a separate shallow container for being used along with new steam soaked waste in the proportion already laid down earlier.

A set of roll packing for each axle box consists of one back roll, two centre rolls and one front roll. Their shapes, sizes and weights are indicated in figure 6.9.

The core of each roll may consist of reclaimed ready waste or of mixed ready waste. This should then be covered with new ready waste (on bottoms or reeling waste being pulled open to form long strings). Each roll must have standard density and firmness and should be neither be soft nor too hard. Every roll must be passed through a corresponding gauge to ensure the correct size. Frequent weighment of rolls must be conducted to ensure reasonably correct weight.







FOR AXLE BOX	BACK ROLL						CENTRE ROLL				FRONT ROLL			
	A	B	C	D	E	WEIGHT IN GRAMS	F	G	H	WEIGHT IN GRAMS	J	K	L	WEIGHT IN GRAMS
BG 255 X 127	305	205	100	95	40	1125	255	150	110	1950	205	125	75	900
MG 230 X 115	280	175	90	85	40	900	200	125	90	1130	180	100	85	850
MG 180 X 100	230	160	85	65	30	500	195	120	75	750	150	100	70	500

Fig. 6.9 : DIMENSIONS OF ROLL PACKING

I. IMPORTANT Do's & Don'ts IN PREPARATION OF ROLL PACKING

Do's

i. Ensure that cotton waste, used for preparing axle box packing, is according to the specification laid down.
ii. Ensure before soaking that the cotton waste is free of all foreign matter and that the required quantity of oil is issued. Soaking and draining should be according to periods laid down.
iii. Arrangement adoption of steam soaking as it gives a superior soaked waste in a much shorter period.
iv. Ensure that the soaked waste is transferred to shallow containers and is turned over, three to four times a day, to ensure uniformity of oil and waste proportions.
v. Ensure that only serviceable waste is reclaimed from the old waste and soaked for the specified period.
vi. Ensure that as far as possible, the reclaimed and new waste are used in the proportion of 2:1 for preparation of roll packing
vii. Ensure that the rolls are made according to the sizes laid down and are of suitable density, neither hard nor soft.
viii. Ensure that a sufficiently large size room, maintained at a high level of cleanliness and free from dust is used for soaking and reclaiming of cotton waste and for preparation of roll packing.
ix. Ensure that medium axle oil to IS: Specification No. 1628-71 is used for waste soaking.

Don'ts

i. Do not curtail the soaking period nor increase the draining period as any such deviation would give an unsatisfactory soaked waste.
ii. Do not reclaim back rolls, which are invariably dirty and should be discarded.
iii. Do not store soaked waste in deep containers.
iv. Do not use rolls, which are either smaller in size or less in weight.

j) AXLE BOX PACKING (WOODEN KEEP)

A Wooden keep is placed in axle box between the journal and axle box faceplate. It is provided to keep the roll packing in position. Its top surface bears against, the inner surface of the axle box crown. After placing the front roll into position, the same is pressed downward and wooden keep is inserted making it to bear with the axle box crown and the wooden keep is set in position. The pressed centre roll is then released and thus it remains pressed by the bottom surface of the wooden keep. With front roll being kept into position there is no chance of other rolls getting displaced from their desired position.

Wooden keep is made of hard wood to IRS K-2. It is rectangular in shape. Its one surface is square to the bottom and the other surface inclined. The square surface is kept towards journal end and the inclined surface towards faceplate. In the central portion a cut has been made to facilitate oiling of the cotton waste. The oil is required to inject as near the journal as possible.

For this purpose, 13 mm semi-circular slot has been provided on the inclined surface upto 2/3rd height from the bottom. From the top a V cut or a rectangular cut is made on the inclined surface extending along its thickness upto the back surface. The circular slot joins with this slot. The V slot is also made inclined downwards the inner side. The oil can spout if inserted through the oil hole provided on the faceplate and it extends itself upto the Vee slot and oil is poured. The oil thus finds its way to the cotton waste packing by gravity through Vee and circular cut.

Wooden keep packing should be free from any cracks and other defects and should be of correct dimensions. Its surface finish should be smooth. Before use new wooden keep should be soaked in oil for 48 hours. It should be prevented from coming into contact with water.

605O. PERIODICITY OF REPACKING AND OILING

The axle boxes of Broad Gauge and Metre Gauge stock have either permanently secured face plates or have face plate secured with studs/bolts. Face plates are secured permanently with axle boxes by means of 2 snap headed rivets, of dia. 12 mm or more which ensures reasonable tight joint between them. On MG stock face plates are also permanently secured by means of a bolt and nut with a lock washer which should bite into the threads and can only be removed by hammer and chisel. On many MG non-standard wagons, such as WE, face plates are permanently secured by bent over rivets or bolts riveted flush over the nut because due to design, it is not possible to use snap headed rivets on them.

For BG container flats of C. Rly., the B.G. vegetable oil tank wagons of N. Rly., B.G. wagons, special permission has been given to move them with face plates secured with bolts. The studs/bolts used for securing faceplates should have prescribed security fastenings.

The periodicity and occasion of re-packing will as under :-

(i) Permanently secured face plates -
8 months (+) 7 days for loaded (Maximum)
(-) 7 days for empty (Optional)

(ii) Face plates secured by studs and bolts -
BG - 2 months.
MG -3 months

(iii) In addition to above, all axle boxes should be repacked whenever a wagon is lifted or its wheels are drawn out.

(iv) During Hot Box attention

(v) Re-packing should also be done in Workshops at the time of POH.

(vi) Derailed wagon.

Periodicity of Oiling :-

(i)	Permanently secured BG wagons face plates having oil hole	30 days
(ii)	BG wagons having, face plates not permanently secured	15 days
(iii)	MG wagons with permanently secured face plates having oil holes	3 months.

The quantity of oil to be injected in each BG and MG axle box is 227 ml.

For oiling the axle box, the wagon need not be damage labeled and brought to the sick lines. The oiling of wagons should be done in terminating and originating yards or if they arrive in sick lines for repairs other than re-packing work.

On the left side of the sole bar on both sides of the wagon PRO/PR particulars are to be stenciled. The former is for plain bearings and the latter is for roller bearings. Against P, the date of POH and the name of the Workshop is recorded, against R, the re-packing date and station code of the wagon depot is recorded and against, the oiling date and station code of the wagon depot is recorded. When the wagons are repacked in Workshops at the time of POH, date of re-packing should not be recorded as P includes re-packing also. Similarly, at the time of re-packing date of oiling should not be recorded as re-packing includes oiling also.

605 P. PROCEDURE FOR REPACKING OF AXLE BOXES

While re packing axle boxes in sick lines, the following procedure should be followed:-

i. Accumulated dirt both at the end and at the rear end of the axle box should be removed with a scrubbing brush, scraper or with the help of other material such as condemned dry waste. Both rivets of the face plate should, thereafter, be cut by oxy cutting pneumatic cools or by sledge hammer and chisel.

ii. Remove the faceplate and then extract the wooden keep. It should be examined, and if found to be standard and undamaged, it may be reused after cleaning. The wooden keep should be kept in a bucket or a small drum painted red on the outside.

iii. Remove the front roll and the centre rolls and put these in the same red container. Lastly, remove the back roll which should preferably be put in a separate small red painted container. Clean the axle box from the inside and remove white metal pieces, if any. Place back the face plate so that it can stay in position with the help of its lip. Thereafter lift one or both boxes on the same axle at a time, for removal of the key plate and the bearing brass.

iv. Wipe the journal clean and feel with hand, right-round to ensure that there are no rough marks, on any portion of the journal. Measure the diameter and length of the journal by gauges. Chalk mark the length and diameter of each journal on the body panel just above the axle box.

v. Examine the brass for damage, such as cracks. Tap the brass to check the white metal bond by holding it in a suspension link. If the bond is satisfactory but the white metal has only slightly spread to the sides or ends, it should be dressed up for reuse. It must also be suitably relieved at the sides so as to restore an arc of contract of about 30^{o} on the crown. When put back in position, there should also be a minimum lateral play of 5 mm for B.G. and 3 mm for M.G.

vi. However, the old brass is unfit for reuse, it should be replaced by new brass already side relieved. For this purpose, the lifting staff should carry at the commencement of their duty, a few suitably side relieved step size brasses in a wooden box.

vii. The key plate must then be inspected to check that it is not battered at the front end and that it sits square on the back of the old serviceable brass or the new brass, as the case may be. This to be checked by putting hand-pressure at the diagonal ends to see that there is no rocking motion. When necessary, the key-plate or the back of the brass should be suitably filed. A bad fitting key plate or one with badly battered end must be replaced by a new one.

viii. It is also necessary to inspect the dust shield is missing or very badly worn, in which case it has to be replaced. In such cases the top cover plate, if found deficient must also be made good.

ix. Before re-fitting a bearing, the journal as also the bearing surface of the brass must be smeared with clean medium axle oil. Similarly, the key plate should also be oiled on both sides. After fitting the key plate it should be checked that it is in correct position and its front end is behind the key plate retaining lug.

x. The lifting back should then be lowered taking care that the position of the key plate and the brass is correctly set under load and that the brass does not bind against the journal cap.

xi. New packing should be carried in buckets or small drums fitted with lids, painted green on the outside. Clean and soaked wooden packing should also be carried in the same container.

xii. The back roll should first be inserted in the axle box by placing it across the journal. It should be pressed with a re-packing shovel to the extreme back end. The roll must be placed in the centre and its ends lifted equally. The two centre rolls should then be placed one behind the other and pressed against the back roll. The second centre roll, when in position, should not extend outward, beyond the inside edge of the outer - collar of the journal. It should also be seen that the ends of the centre rolls are at the same height.

xiii. 170 ml oil for BG and 115 ml for MG should now be syringed uniformly over the different rolls before inserting the front roll. If syringe is not done uniformly, most of the oil falls in front portion and there will be a tendency for this oil to spill out. Further, even when it is syringe uniformly, at least 5 minutes time should be allowed for the oil to soak & settle down as otherwise, when the front roll is fixed and pressed, the oil will ooze out. Thereafter place the wooden keep & press it down on the front roll, and push it into position so that when released, it is firmly held in position without any clearance at the top.

xiv. The faceplate should, thereafter, be properly riveted. One end should be held with the bolt and nut and the other end closed with snapped head rivet. The bolt should then be removed and the other end riveted. Where pneumatic riveting is not available hand snaps must be used. Thereafter the PRO/PR plates should be stenciled, as described earlier.

605 Q. AXLE BOX SEALING

i. Any satisfactory axle box design should provide effective sealing at the front and rear ends to prevent leakage of oil and ingress of dirt and moisture into the axle box. It is, therefore necessary to ensure satisfactory sealing at the two ends of axle box. As such, gaping faceplates and loose dust shields should not be permitted on any axle box.

ii. The gaping of faceplate of axle boxes in service is mainly due to unsatisfactory riveting of faceplate and also, in many cases due to warping of faceplates.

iii. Proper attention must, therefore, be paid to the examination and riveting of the face plates both at the time of POH in workshops and also at the time of re-packing in sick-line. The old faceplates must invariably be checked for warping and buckling and even those, which are having slightly defect should be rectified. A pool of good faceplate must, therefore, be maintained at all re-packing centres so that no defective faceplate is to be re-used. Before riveting the faceplate, it is necessary that rubber gasket of a proper size is used to ensure sealing. The rubber gasket should be stuck on the axle box opening by means of an adhesive.

iv. Greater attention is required in the case of rear end. The dust shield must invariably be renewed at the time of POH and a new dust shield must be soaked in oil for 48 hours before use.

v. When wheels have to be changed in sick line, the dust shield of the axle boxes should be thoroughly examined and those found slack or torn should be replaced by properly soaked dust shields. Fitment of top cover plate is also of great importance and must be ensured whenever axle boxes are taken out in workshops or in sick lines.

605 R. IMPORTANT Do's & Don'ts DURING REPACKING

Do's

(i) Ensure that a complete and thorough examination of every axle box and its components is carried out at the time of re-packing.

(ii) Ensure that adequate equipment, staff and spare parts are available at each sick line and nominated lines to carry out the re packing work properly.

(iii) Ensure that the correct re-packing procedure, as laid down, is followed.

(iv) Ensure that axle box and other components, viz. journal, brass, key-plate, baffle block and dust shield to be thoroughly examined and serviceable components are reused only.

(v) Ensure use of journal gauges to measure the length and diameter of the journal and the suspension link for sounding the brass.
(vi) Ensure that an arc of contact of 30° is provided on the bearing brass.
(vii) Ensure that a minimum of 3 mm for MG and 5 mm for BG lateral play is provided between the brass and the journal.
(viii) Ensure that oil is measured on the journal, bearing brass and the two sides of the key plate before assembling the axle.
(ix) Ensure that the key plate is sitting properly in relation to the bearing brass lug and the axle box retaining lug.
(x) Ensure that packing is carried in drums fitted with lids.

Don'ts

(i) Do not re-use a bearing brass with spread white metal on sides without it being redressed and restored to an arc of contact of 30° on the crown.
(ii) Do not use baffle block (wooden keep) of non-standard size.
(iii) Do not pack the axle box in a manner, which may permit the roll packing to come beyond the inner edge of the journal collar.

605 S. WHITE METALLING PROCEDURE

The carriage and wagon bronze bearing shell should be tinned and white metalled with antifriction metal strictly according to the practice laid down in the subsequent paragraphs. As regards SGCI shells, the procedure prescribed in the pamphlet "Prevention of Hot Boxes - A Guide" revision 1, issued by RDSO should be followed.

De-metal the old bearing in a de-metalling bath. The temperature of the de-metalling bath should be kept 400°C and 450°C. The bath should be an oil fired, pot type furnace with temperature controlling and recording devices.

In this operation, the white metal lining is melted and collected in the bath and all the oil is normally burnt. The white metal collected in the demetalling bath should be ingoted and reconditioned.

Remove the shell from the demetalling bath soon after the white metal has been melted and clean it by scrubbing with a stiff wire brush to remove traces of dross and other impurities. The shell should then be allowed to cool in air.

Check the demetalled shell with suitable gauges for important dimensions such as overall length, width at the ends, crown depth, and the height and length of the lug. The maximum wear of 2 mm may be permitted on the length and width of the brass as also on the length and height of the lug. Maximum permissible wear on the crown depth is 6 mm in B.G and 3 mm in M.G. Shells. Any demetalled shell, worn beyond these limits should be rejected and sent to the foundry for being recast.

Demetalled shells, which pass the dimensional check, should then be given the ringing test individually. Shells, which do not give satisfactory sound, should be rejected.

The demetalled shell should also be visually inspected for cracks. Shells having cracks, will not normally give satisfactory sound in the 'ringing test'. But in any case, cracked shells should be rejected.

Shells which are warped and do not permit even a true slipper plate to sit square on the back of the shell, should, if possible, be rectified by machining or otherwise rejected. It is important that the surface to be lined with white metal is prepared very satisfactorily. This must be carried out either by machining or by grinding with a coarse portable grinder until the surface is bright all over. It must be ensured that any serrations found on the surface of the shell are properly ground and where necessary machined.

The under-cuts of anchorage grooves, recesses, awkward corners and pockets should be scrapped so as to remove all dirty spots and sharp edges, thereby eliminating cracking of the white metal lining when the bearings are put into service. The most effective method is by immersion in a hot alkaline cleaning solution (solution of caustic soda 10-15%) followed immediately by washing in cool running water.

A freshly machined new shell or a demetalled shell where surface preparation has been satisfactorily carried out may not require the degreasing operation if it is immediately taken in hand for tinning. There is often some lapse of time between the machining and tinning operations of a shell and it is, therefore, desirable that the degreasing bath is also introduced in the bolt to ensure complete elimination of any oily substance on the shell.

The pre-heating should be carried out in thermostatically controlled electric furnace fitted with pyrometer and preferably with a conveyer. The pre-heating temperature range should be between 200^{o}C and 250^{o}C.

The degreased shell should be given an application of liquid flux on the surface to be tinned and then placed in the pre-heating furnace. Remove the shell from the pre-heating furnace and apply liquid flux by brush uniformly on the surface to be tinned. The flux should be prepared by adding zinc chipping to cold concentrated commercial hydrochloric acid (gravity not less than 1.15) till no more dissolves (about 245 grams of zinc per litre of acid). The solution should be allowed to stand over-night with excess of zinc then decanted. To this solution should be added 60 grams of Ammonium chloride (salt) per litre of the decanted zinc chloride solution.

Tinning bath should be oil fired, pot type furnace, thermostatically controlled and fitted with pyrometer. The tinning bath should be covered with a layer of zinc chloride flux or tallow to prevent drossing. Immerse the fluxed shell with the concave surface down in a molten bath kept at a temperature between 260°C and 280°C and containing alloy of 50% tin and 50% lead. The bearing shell should be kept in the bath till it has reached the temperature of the bath (about two minutes). Remove the bearing shell, wire brush the surface immediately after removal, re-flux it and repeat the above operation.

It is desirable to carry out the above tinning operation, on each shell, three times but in any case the above operation must be repeated at least twice to ensure satisfactory tinning of the shell. Wire brush is not to be used after the last dip in the tinning bath. On the contrary, after the last dip, a soft hair-brush should be used which would help in spreading the tin evenly over the entire surface and also to remove the excess molten tin. A lime wash may be applied on the surface not to be tinned as this will prevent the tinning of such surfaces.

When tinning has been successfully carried out, a continuous layer of alloy covers the base metal (bronze metal) and this is covered with a smooth, bright, uniform layer of tin. Inadequate preparation of the surface before tinning leads to a lack of continuity or uniformity in one or both layers. The white metal when it is poured, amalgamates or alloys with the top layer of the tin. Thus in the final bearing there is a thin, continuous layer of alloy between the shell and the white metal.

Metalling should be carried out with the shell in the vertical position only.

A bearing should never be poured horizontally with the shell upper-most, as in this position both air and oxide are inevitably trapped between the white metal and the shell and a good and continuous bond cannot be guaranteed. When using a vertical chill, pudding should be carried out with a steel wire to ensure escape of air and gases.

A molten layer of tin to be available for amalgamating with the white metal to form a strong bond. It is essential that white metalling be commenced as early as possible and only about one minute time should be allowed to intervene between the withdrawal of the bearing from tinning bath and pouring of white metal on it. It may also be ensured that pouring of white metal is completed within 10 seconds.

The white metal bath should be a pot type, thermostatically controlled, oil fired furnace fitted with pyrometer. The molten baths should be kept covered with dry powdered charcoal to avoid oxidation. The white metal chill or mandrel should be sufficiently hot (150-175°C) to check premature freezing an yet not too hot so as not to give a slight chill to the bearing surface. As far as possible, the running - gate should be 6.5 sq. cm. in section and 33 cubic cm. in volume to avoid shrinkage. Use bottom pour ladle of adequate capacity so that one shell could be completed without interruption. Pour the white metal into the bearing with steady and continuous flow at temperature between 350°C and 380°C so that no turbulence is created and the air and gases escape from the mould. While pouring the metal, care should also be taken to ensure that no dross runs with the metal into the bearing. Temperature of the metal in

the bath must not exceed 45°C under any circumstances because above this temperature, some of the valuable hardening elements like antimony and copper are partly lost by oxidation as dross and hard oxide inclusions cause excessive wear of the journal. Over heating also cause brittleness and excessive contraction. Remove the bearing after the metal is set and allow it to cool in air. However, a minimum time of 5 minutes must be given after pouring of white metal to enable the white metal to solidify properly.

Each metalled bearing should be tested for soundness by giving the 'ringing test' to a bearing suitably suspended. A perfectly metalled bearing with satisfactory bonding would give a ring more or less similar to the ring of the shell prior to its metalling. A dull sound would indicate discontinuity such as porosity, improper adhesion, loose spots and general unsoundness. At least 1 percent of the daily output of metalled brasses should be given a destructive test, preferably the chip test. This involves the removing of a portion of the white metal from the shell with a chisel and hammer. When properly bonded, difficulty will be experienced in doing this and the lining will torn away from the shell leaving a rough surface where some of the white metal will be still adhering to the shell. If on the other hand, bonding is not satisfactorily done, the white metal will come away from the shell quite easily, leaving a dull grey surface.

The temperature ranges, although indicated earlier in these instructions are summarized below and must be adhered to :-

Demetalling bath	**400°C to 450°C**
Caustic Bath	**60°C to 70°C**
Pre-heating prior to tinning	**200°C to 250°C**
Tinning bath	**280°C to 300°C**
Pre-heating of chill	**150°C to 175°C**
White metal bath	**350°C to 400°C**
White metal pouring	**350°C to 380°C**

Frequent checking of the temperatures of various baths is necessary. Pyrometers are likely to go out of commission or give faulty readings a bit too frequently. Portable thermometers must therefore be provide at each white metalling point to check on the accuracy of the pyrometers and also for regular use in the event of pyrometers going out of commission temporarily.

605 T. MAINTENANCE INSTRUCTIONS FOR FRLP

FRLPs may be procured/supplied in :

a) Dry condition
b) Pre-oiled condition

a) Preparation of FRLP Dry Pads

I. Insert FRLPs into a tank filled with axle oil to specification IS:1628 medium grade and ensure that they are fully submerged.
II. Periodically squeeze the pads to ensure proper absorption of oil.
III. Saturate the pads for 12 hours.
IV. On removal from the tank the saturated pads may be immediately applied to axle boxes, or placed on suitable rake/wire netting for draining of excess oil for a period not exceeding one hour prior to application to axle boxes or packaging in leak proof bag.
V. Pads that drain for more than one hour must be return for resaturation.
VI. Minimum amount of oil that must be retained by lubricator after 12 hours saturation and one hour draining should be

(i) MG Pads 1200 grams
(ii) BG Pads 1800 grams

The pads should occasionally be weighted for cross checking.
VII. Oil saturated FRLPs that are to be stored or sent to other fitment points must be packed in individual leak proof polythene bags and contains a minimum of 5% more oil by weight than that specified under para "VI" above.
VIII. Both dry and saturated pads should be kept in dry and clean place to avoid ingress of dust and other foreign material.

b) Preparation of FRLP Pre Lubricated Pads

I. These FRLPs are mechanically saturated with oil at the manufacturers end.
II. Pre oiled pads shall be supplied by the manufacturers packed in individual polythene leak proof bags and securely sealed.
III. These pads shall be packed by the manufacturer in corrugated or other suitable container lined with polythene or plastic material of sufficient thickness to prevent leakages.The container used shall be sufficient strength to avoid damage or permanent distoration of the package pads. Each container shall contain a set of 4 FRLPs. The container shall be suitable sealed to prevent contamination.
IV. These container should be properly stacked/stored in sickline/workshop to avoid any damage.

c) Preparation of Journal Boxes and Associated Parts

I. Before applying the pads to axle box remove journal bearing and wedge
II. Thoroughly clean the axlebox. Lintfree wiping rags must be used for cleaning purposes.
III. Waste or paper should never be used for cleaning purpose.

IV. Axle boxes must be inspected for crack or other defect, which could cause oil leakage. Those axle boxes found to be leaking should be repaired or removed from service.

V. Examine journal, journal bearing & wedge; renew all defective parts

VI. In shop new dust shield and front gasket have to be fitted. In nominated depots condition of dust shield and front gasket should be checked before fitment of FRLP. If found defective they should be replaced.

VII. Check and ensure that the surface of the journal is smooth and thoroughly clean before applying the bearing.

VIII. Ensure that the journal bearing is smooth and clean before application.

IX. Before applying journal bearings and wedges, the top surface of the journal must be thoroughly flushed with axle oil. Axle oil must be applied to the top surface of the bearings and wedges prior to installation.

d) Method of fitment to FRLP in the axle box

I. Jack the box

II. Remove the plain bearing and key plate

III. Jack the box down

IV. Insert the pad. The pad must be pushed to the rear of the box away from the journal collar and cantered from left to right to prevent cutting of the front of FRLP.

V. Jack the box up.

VI. Insert bearing and key plate.

VII. Jack the box down .

VIII. Check to make sure that the pad is centered.

IX. After re-packing the axle box of the wagon, the axle boxes must be added to the box to a depth of 60mm/45mm for BG/MG axle boxes to ensure full re-saturation of the pads.

X. Before releasing the wagon the axle boxes must be inspected to determine if atleast 25mm of free oil if visible in the bottom of the box after the pad has finished absorbing free oil.

XI. The front cover should then be riveted after applying new front gasket and ensuring proper sealing.

XII. While fitting FRLPs care must be taken to avoid damage to the pad through use of improper tools.

XIII. No other type of axle box packing/lubricating device is to be used with FRLPs.

XIV. Alternative method of fitment of FRLP in shops or on loose wheel sets should not be adopted.

XV. Remove axle box from journal and clean it from inside.

XVI. Fit new dust shield.

XVII. Clean the journal.

XVIII. Insert soaked FRLP with strap facing the front. The pad must be pushed to the rear of the box to prevent cutting of the front of the FRLP by the journal.

XIX. Insert the axle box over the journal.

XX. Fit bearing and key plate on the journal.

XXI. Add free oil in the box to the depth of 60mm/45mm for BG/MG axle boxes.

XXII. Fit axle box faceplate with front sealing gasket.

XXIII. While fitting FRLP care must be taken to avoid damage to the pad through use of improper tools.

ATTENTION AT INTERMEDIATE POINTS.

I. All axle boxes fitted with FRLP must be monthly oiled with 227ml of oil for BG wagons and once in 3 months for MG wagons and marking be done as per instructions in "Trial Scheme".

II. In case of hot box the axle box cover should be opened and inspected. Proforma as per the trial scheme should be filled up and sent to Director General (Wagon) RDSO/Lucknow for information.

III. If during BOX feeling any axle box is found to have temperature above normal the same should be opened and inspected. If any irregularity as mentioned below is found it should be rectified as per instructions given below:

IV. If lubricator is out of place, away from the journal rear fillet, rolled up on one side or worked out under journal collar, it should be set up in proper place, using packing iron with blunt ends as shown in Fig-2 or whenever the axle box is opened for inspection.

V. If during service or whenever the axle box is opened, it is found that the pad does not properly contact the journal due to excessive compression set, as shown in Fig-3 may be used as an aid to determine proper contact to pad.

VI. Sufficient axle oil should be added to provide a oil level of not less than 25mm. When no free oil is visible in the box, oil must be poured on the top of the pad along each side and in front of the journal to bring oil level to a depth of 60/45mm for BG/MG axle boxes.

VII. If a box contains any foreign matter which has a detrimental affect on the lubrication of the bearings the box must be repacked with a new pad.

VIII. If axle box cover is broken or does not provide proper sealing, it must be replaced.

IX. Axle boxes should be topped with axle oil whenever the axle box cover is opened for any inspection.

X. Proper sealing should be ensured before rivetting the journal cover.

XI. Pad life

XII. The lubricating pads are expected to have a normal life around of 2 years and have to be changed after a service of about two years. During any inspection in between the pads will be considered as defective and will require renewal for the following reasons:

i) Any non-contact with journal.

ii) Any scorched or burnt areas.

iii) Any glazing of the surface.

iv) Top, front, back or side torn for more than on half it length.

v) Fabric deteriorated or decayed.

vi) Exposed core or metal part contacting journal.

vii) When wagons are dismantled for any reason necessitating removal of the pad.

viii) Axle boxes given attention during POH.

ix) When involved with a hot box requiring renewal of journal bearing.

x) Contaminated by flood, excessive water or debris.

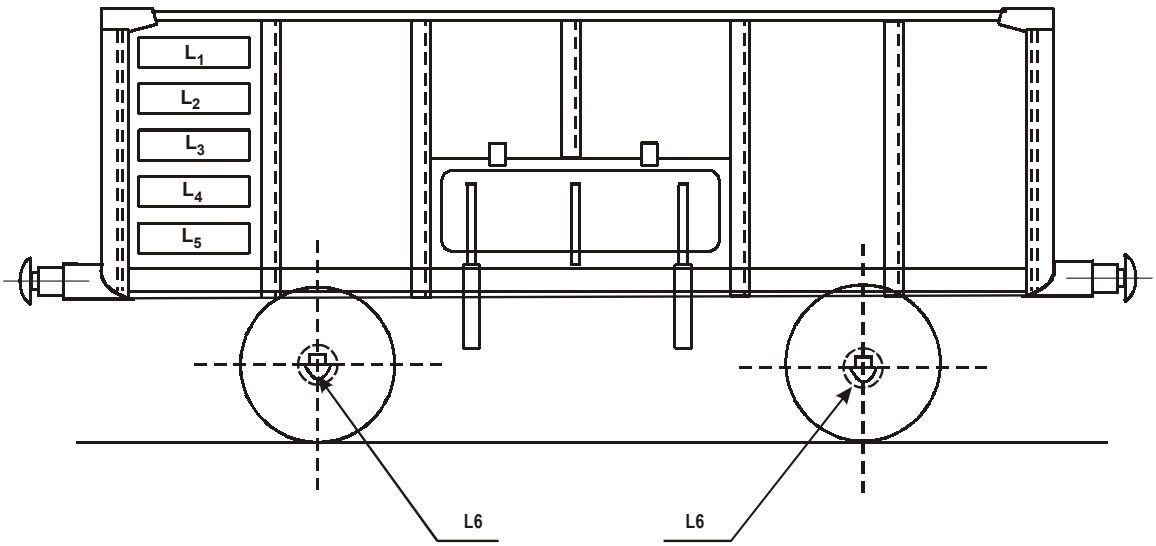
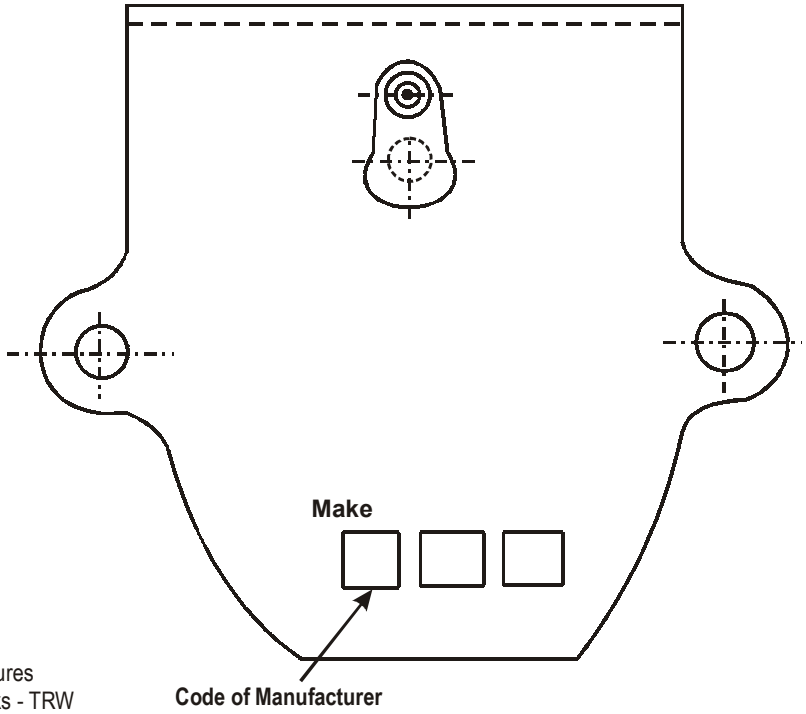


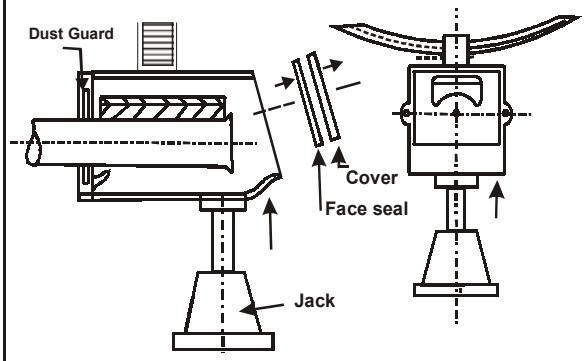
FIG. 6.10 : IDENTIFICATION MARKS FOR WAGONS



Note : Code of manufactures
Trivendrum Rubber Works - TRW
Ransal Rubber industries - RAN
Technical works industries link ltd. - TWL

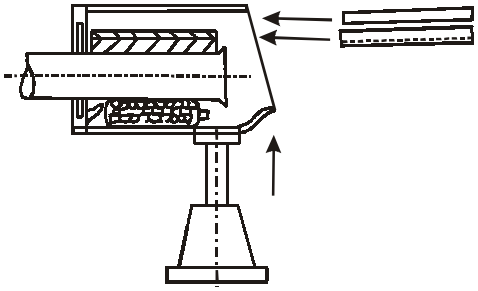
FIG. 6.11 : MARKING OF FACE PLATES

1



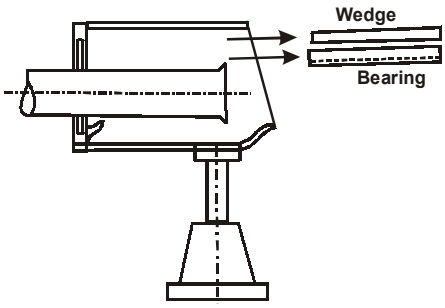
Remove cover with face seal and raise journal box with help of jack or other device

4



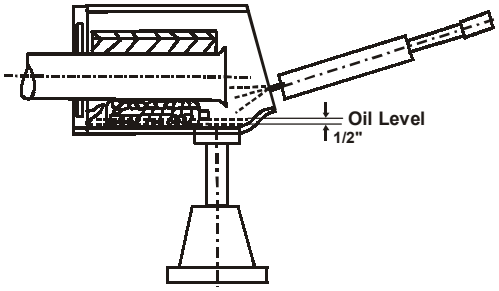
Removal plain bearing & wedge from journal box

2



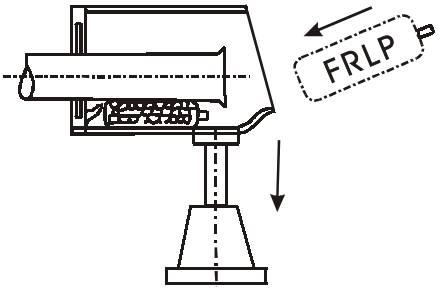
Remove plain bearing and wedge from Journal box.

5



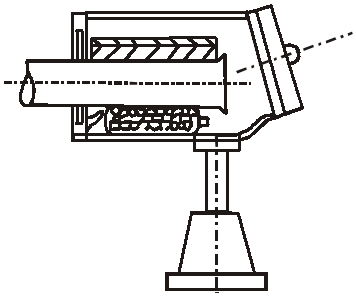
Lower journal box to normal position
fill lubricating oil to 1/2" level in journal box.

3



Lower Journal Box to the maximum possible. Insert pre oiled FRLP into journal box. Ensure it is centred from back to front and left to right keeping strap facing the front Not - Do not use any implements to push in FRLP which may tear FRLP cover

6



Fit back face seal cover

Note :
1. Ensure dust guard and face seal is fitted with every FRLP
2. For detail instructions see over leaf

FIG. 6.12 : Fitment of FRLP

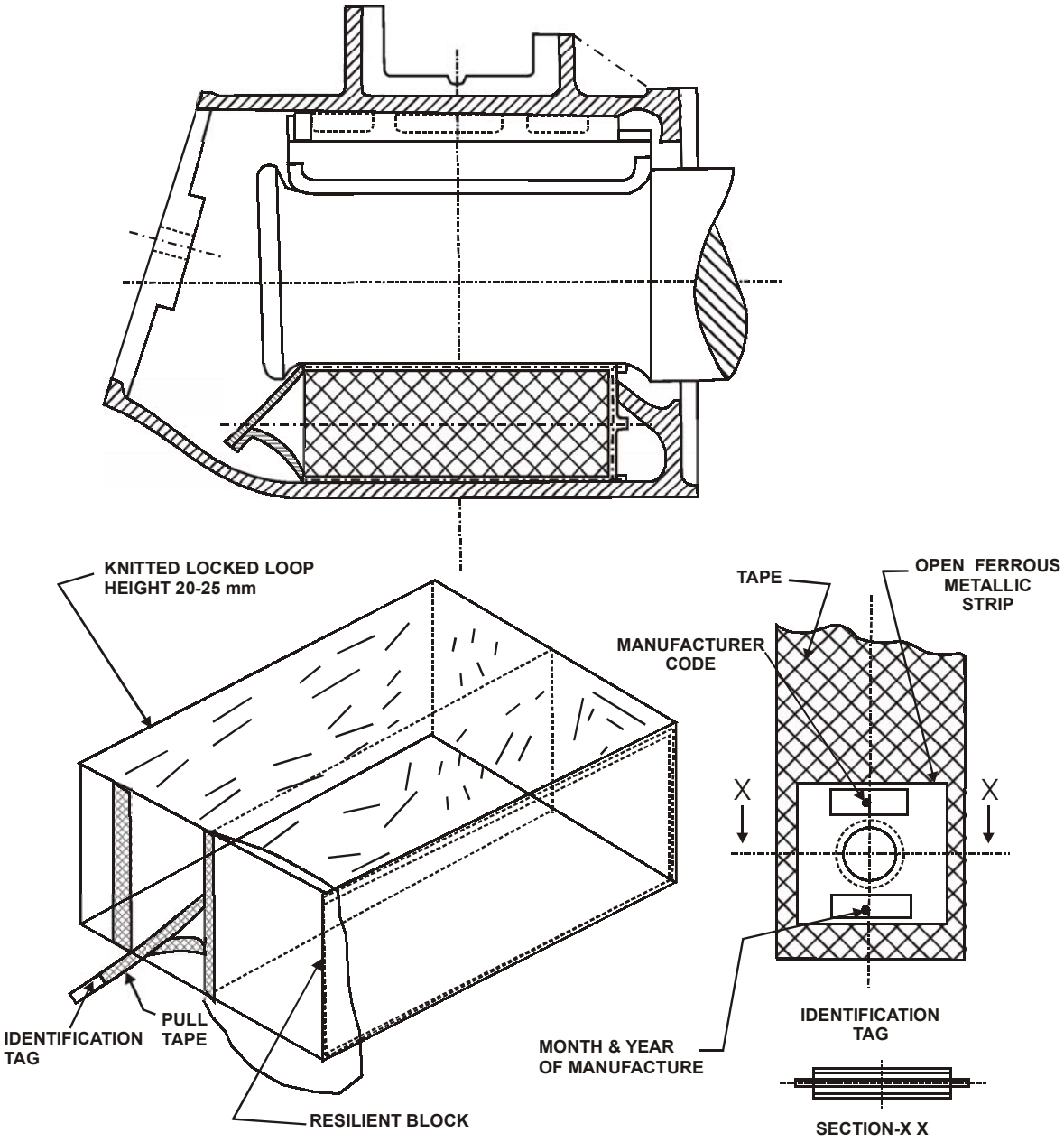
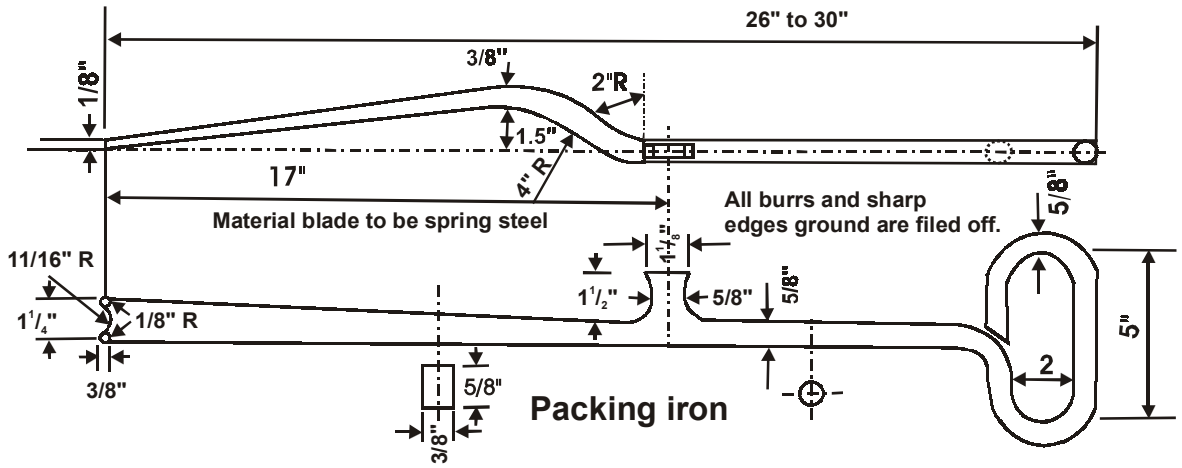
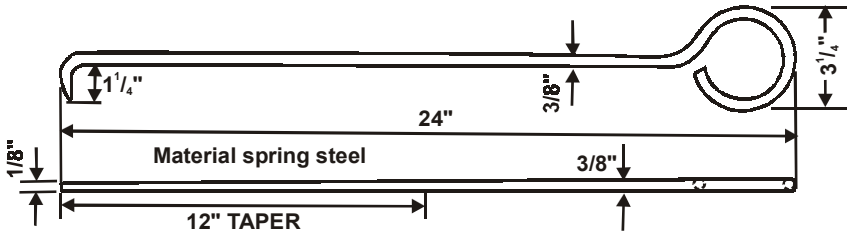
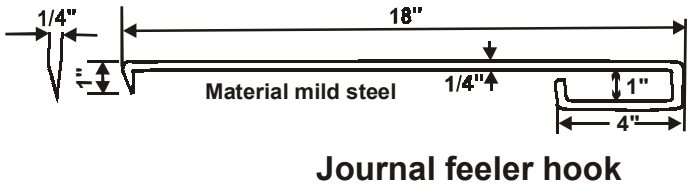

KNITTED LOCKED LOOP
HEIGHT 20-25 mm
IDENTIFICATION
TAG
PULL
TAPE
RESILIENT BLOCK
TAPE
OPEN FERROUS
METALLIC
STRIP
MANUFACTURER
CODE
X
X
MONTH & YEAR
OF MANUFACTURE
IDENTIFICATION
TAG
SECTION-X X

Fig. 6.13 : FRLP







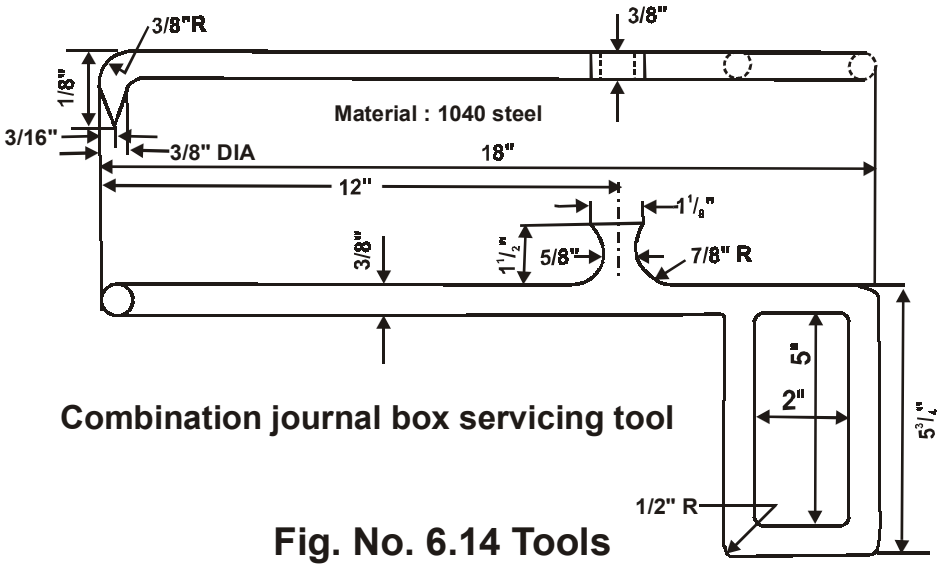


Fig. No. 6.14 Tools

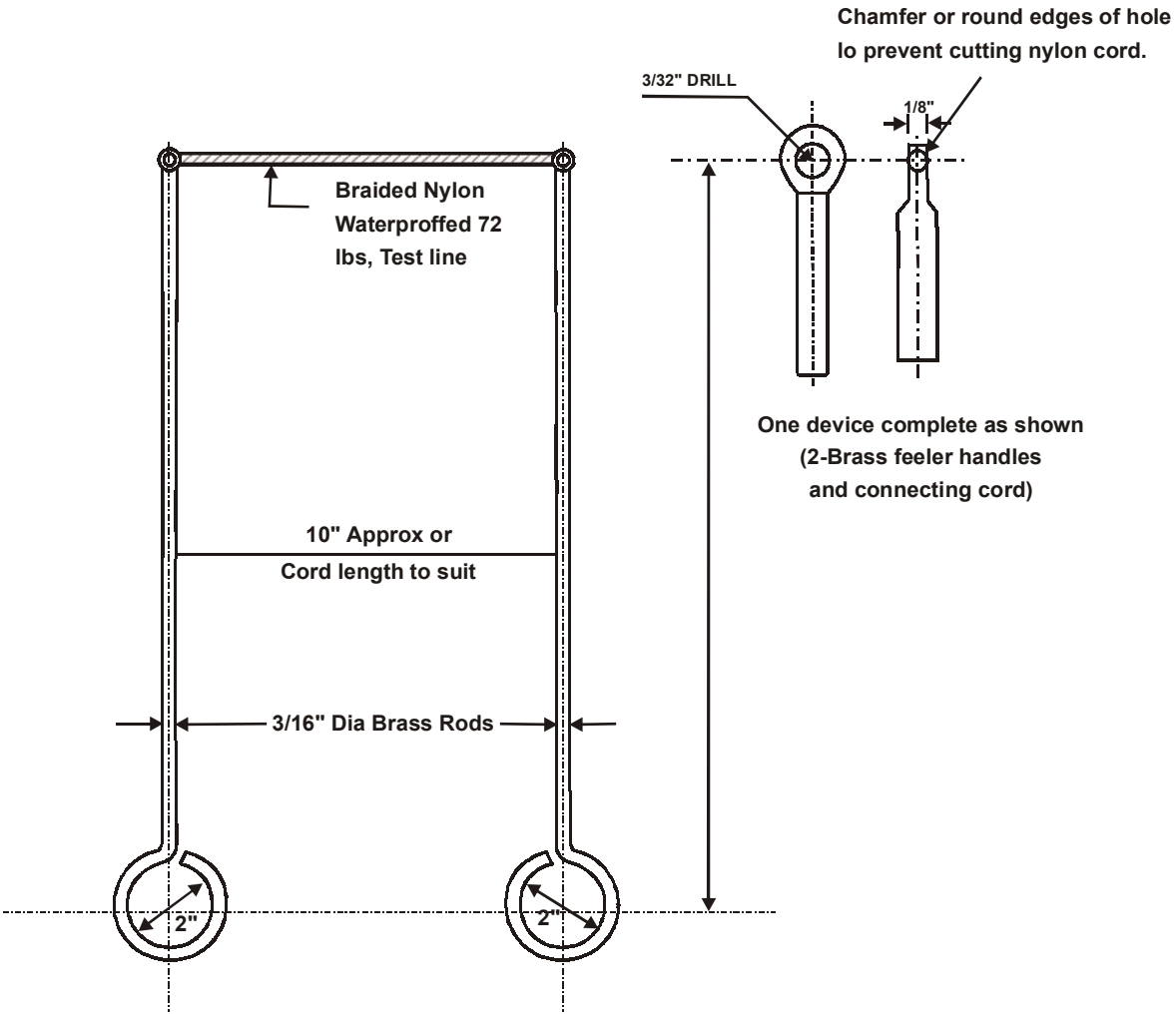


Fig 6.15 : JOURNAL LUBRICATOR CONTACT TEST TOOL

606. WHEEL ASSEMBLY

A. Axle

An axle is a long steel bar to hold a pair of wheels in position. Carriage & Wagon axle is made of steel to specification No. IRS-R-16. Its journal portion is suitably designed to mount a plain or roller bearing. It can be divided into following portions:-

i. Portion between the wheel seats.
ii. Wheel seat on either side.
iii. Shoulders just after the wheel seat on either side.
iv. Journal just after the shoulder on either side.

The portion of axle between the two wheel seats used to be made taper the lowest diameter being the centre of the axle. Now the practice of tapering axles have been discontinued and is made parallel. The portion of the axle on which the wheel centre is pressed is known as wheel seat. The seat is fine finish machined. The shoulder portion is also fine finish machined.

Two small axle centres are drilled on end surfaces on the axle. These holes facilitate turning of the axle on centre lathes, grinding/furnishing of the journals and turning of the tyre on the wheel lathe.

No collar is provided on roller bearing axles. Axle on which roller bearings are mounted should have surface finish and ovality as per drawing. To facilitate the locking of roller bearing in position, three holes are built and tapped on each face of the axle.

B. WHEEL

Wheels are of two types: solid and tyred. The tyred wheel consists of wheel centre, tyre and glut ring to fasten the tyre with the wheel centre. In solid wheels, the wheel centre and the tyre portion is rolled in one piece. Glut ring is therefore not required is case of solid wheels. Only solid wheel shall be procured for fitment.

After solid wheels get worn to condemning size in case of four wheel BG wagon and MG wagons, it is machined to the size of the wheel centre and separate tyre is shrunk fit on it and suitably fastened by glut ring. When the tyre also reaches condemning limit it is removed by machining its lip opposite the glut ring a new tyre is fitted.

List of drgs. for wheels of different wagons is as under;

LIST OF DRGS. FOR WHEELS OF DIFFERENT WAGONS

S. No.	DRAWING NO.	AXLE LOAD(t)	TYPE OF WAGONS
1.	W/WL-4764 SK-68512 WD-97037-S-01 OR WAP/SK/M 153	22.9	BOXN, BCN, BRN, BOBR, BTPN (FITTED WITH CASNUB BOGIES)
2.	SK-69001	22.9	BOY, BOBX MK-II, BOZ
3.	W/WL-4771	22.9	BWT/A, BWL
4.	W/WL-4750 WD-89025/S-5	20.3	BOX, BOX MK-I, BOX MK-II, BOXC, BRH, BRHT, BRS, BOI, BRHC, CRT, CZ, BVZI, BVZC, OZ, BTAL, BTO, BTALN, BTPGL, BOXC, BOXT,
5.	W/WL-527	16.3	TPR, TORX, TORXT, TORXC, TCH, TSA, TCS, THT, TALR, TCL, TCIR, TPGL, TPG&R, TPRC, TPRT, O, BWX, BWX/A, TP, BVG, BVN, BVGT
6.	W/WL-770 WD-83074/S-2	12.2	MG 4 WHEELED & BOGIE WAGON
7.	W/WL-3140	8.1	ALL NG WAGONS

C. DIAMETERS OF WHEELS USED ON BG AND MG STOCK WITH CONDEMNING LIMITS

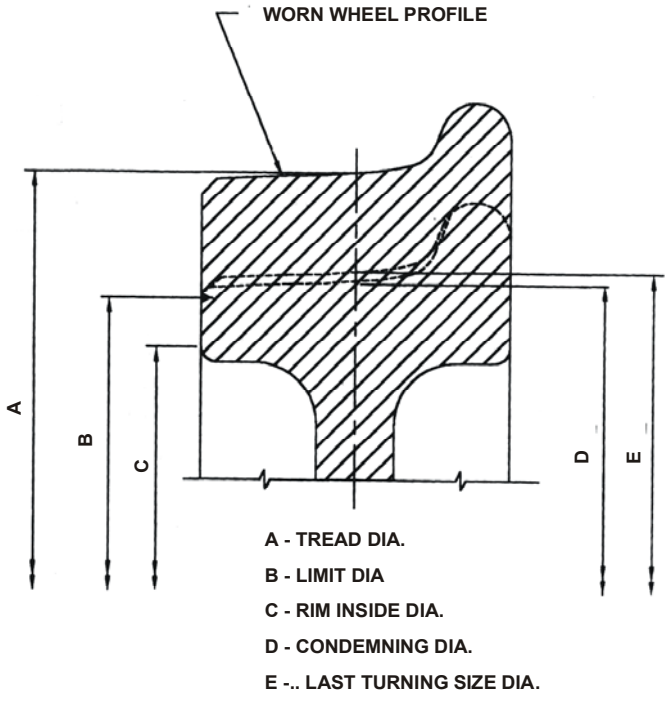


Fig. 6.16 : Wheel profile

The last shop issue size and the condemning dia of different wheels shall be as per RDSO Drg.No.WD-88089/S-1 given below;

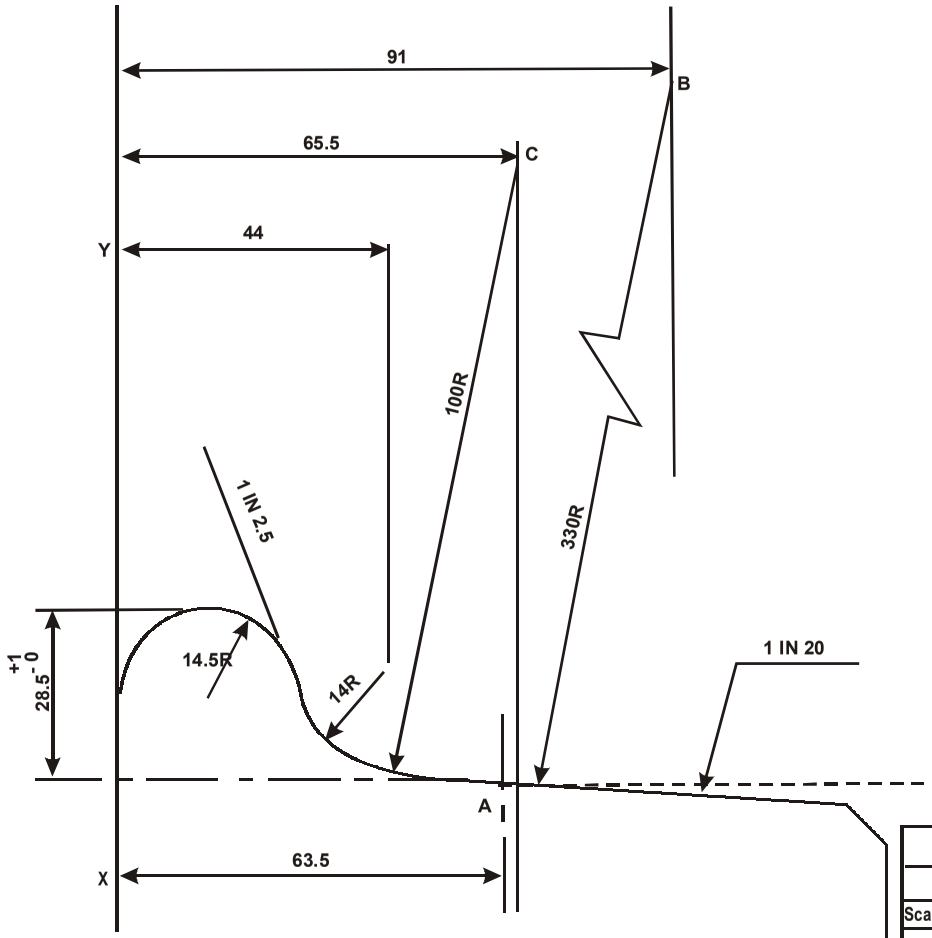
S. No.	Axle (t)	Drg.No.	Nom. Dimensions				
			A	B	C	D	E
1.	22.9	W/WL-4764/Sk-68512	1000	897	850	906	919
2.	22.9	WAP/SK/M/153 or WD-97037-S-01	1000	897	-	906	919
3.	22.9	**SK69601**	1000	897	850	906	919
4.	22.9	W/WL-4771	915	804	761	813	826
5.	20.3	W/WL-4750	1000	851	814	860	873
6.	20.3	WD-89025/S-5	1000	851	814	860	873
7.	16.3	W/WL-527	1090	980	940	990	1003
8.	16.3	WD-89025/S-9	1090	980	940	990	1003
9.	14.0	WD-89061/S-2	725	626	585	635	647
10.	12.2	W/WL-770	725	626	585	635	647
11.	12.2	WD-83074/S-2	725	626	585	635	647
12.	8.1	W/WL-3135	585	496	456	505	518
13.	8.1	W/WL-3140	585	496	456	505	518

D. WHEEL CENTRE

There are two types of wheel centres namely solid, in which the wheel tread is integral with the wheel centre, and tyred, in which a separate tyre is shrunk on to the centre. Tyred wheels are again sub-divided into two types. Disc type, which is currently in use, and spoke type, which is rapidly becoming obsolete.

E. TYRE PROFILE

Presently Indian Railways using the wheels having optimised wheel profile known as Worn Wheel profile as per RDSO Drg. No. WD-88021 (for BG wagons) and Drg No SK-91122 (for MG wagons) . All wheels are being turned as per these drawings. For Intermediate worn wheel profiles RDSO Drg. No. WD-89060/S-2 shall be followed. Worn Wheel profile and Intermediate worn wheel profile are given on next page.



PROCEDURE OF DRAWING :-

1. DRAW A VERTICAL LINE X-Y
2. DRAW SEMI-CIRCLE OF 14.5 R TANGENTIAL TO LINE X-Y.
3. DRAW LINE 1:2.5 TANGENTIALLY TO 14.5 R SEMI-CIRCLE.
4. DRAW A HORIZONTAL LINE AT 28.5 mm FROM THE TOP OF THE FLANGE AND LOCATE Pt. 'A' AT 63.5 mm FROM THE LINE X-Y.
5. FROM Pt.'A' LOCATE CENTRE 'B' OF ARC OF 330 R ON A VERTICAL LINE AT 91 mm FROM X-Y.
6. DRAW ARC OF 330 R FROM CENTRE 'B'.
7. LOCATE CENTRE 'C' ON VERTICAL LINE AT A HORIZONTAL DISTANCE OF 65.5 mm FROM THE LINE X-Y SUCH THAT BC=(330-100) i.e. 230 mm.
8. DRAW ARC OF 100 R WITH CENTRE AS 'C'.
9. DRAW ARC OF RADIUS 14 mm TANGENTIALLY TO 100 R ARC AND LINE 1:2.5.
10. DRAW LINE 1:20 TANGENTIALLY TO 330 R ARC.

SUPERSEDED			BY
SUPERSEDES			Dt.
Scale	Passed		
	Checked		
	Drawn		
	Tarced		
	J.S. No.	WD-98018	4/98

WORN

WHEEL PROFILE (For B.G. Wagons)

ALT.	ITEM	AUTHY	DESCRIPTION	DATE	ASSEMBLY DRG.
4	—	WD-98018	REVISED & REDRAWN	4/98	

B.G.	R.D.S.O. (W)	GROUP	WD-88021

FIG. No. 6.17 WORN WHEEL PROFILE

HINDI

CONTENT

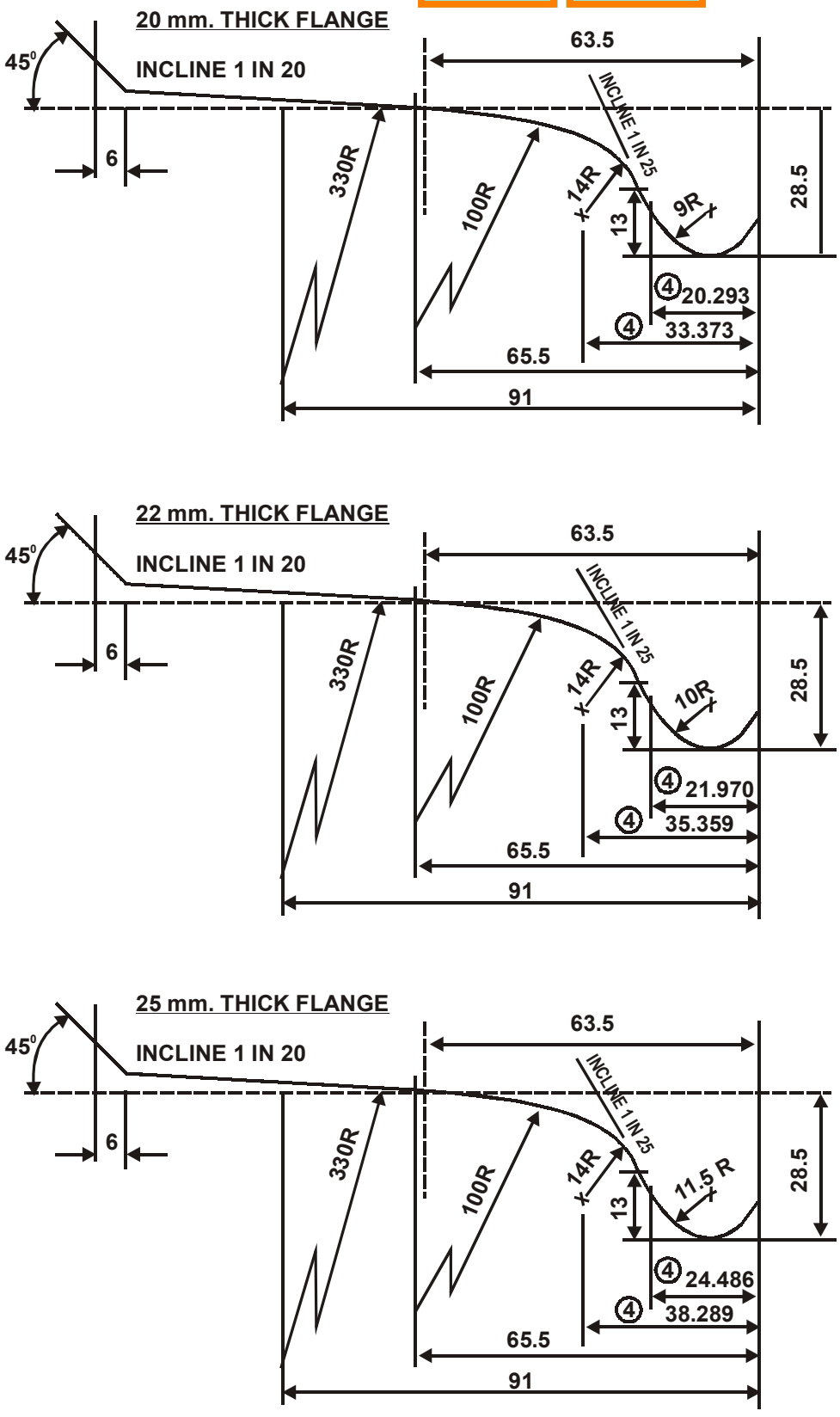


Fig. 6.18 Intermediate Profile (WD-89060/S-2)

F. RE-AXLING

Defective axles, which cannot be repaired, otherwise, required to be replaced. The axles requiring replacement are pressed out of the wheel centre on a Wheel Press machine, specially designed for this purpose. After machining new axles to the required size, wheel centres are pressed on it on the press machine.

After the wheel centre is pressed out with or without tyre, the bore shall be machined to specified finish on a vertical boring machine. The depth of cut should be minimum possible, just enough to remove the irregularity of the surface and to ensure fine finish machined surface. The finish size of the bore should be taken and wheel seat of the axle should be fine finish machined accordingly to a higher diameter giving allowance for the required interference fit. The interference should be kept as 0.001 mm per mm, of the dia of the wheel seat/bore of the wheel centre. For example, for a 180 x 100 mm journal dia of the MG axle, the nominal dia of the wheel seat is 127mm. The required interference fit will be equal to 0.127 mm. The dia of the axle at the wheel seat should, therefore, be kept 0.127 mm more than the dia of the bore of the wheel centre. This interference will normally ensure required pressure of pressing the axle. The prescribed pressure for mounting the wheels and axles shall be as per IRS specification R-19/93 Pt-I.

While pressing the wheel, care should be exercised to see that the pressing is stopped at a pre-marked correct location on the inner side of the wheel seat. Wheels can be mounted on axle with or without tyres. For spoked wheel, if wheel centre and tyres are separate, wheel centre should be pressed in first and thereafter tyre should be shrunk. After re-axling, the tyre should be turned on a wheel lathe to remove minor eccentricity, which is always present. For major eccentricity, which cannot be removed by tyre turning on a wheel lathe, it should be re-axled.

At the time of re-axling, following points to be ensured :-

i. Before mounting the wheels on axles, carefully clean the wheel seat and bore of the wheel to remove rust grit, chips and grease.
ii. Coat wheel seat and bore with mixture of basic carbonate white load and boiled (not raw) linseed oil to avoid scoring of mounting surface.
iii. Keep special care so that wheel-seat and bore and not damaged during mounting operation.
iv. Mounting press must have dial pressure gauge and a pressure recording gauge.
v. Mount the wheels centrally on axle at a proper gauge distance.
vi. Recorder must be maintained and kept properly adjusted all the time.
vii. Check wheel mounting and check gauge frequently so that excessive wear does not allow improper mounting of wheels.
viii. Stamp at the end of the axle box code pressing on pressure and date of mounting to facilitate tracing of history of the paid of wheels.
ix. After mounting of wheels on axle apply rail gauge at three or more equi-distant points around the circumference to see that wheels are within gauge limits.

G. Retyring

Retyring may have to be done on a solid wheel which has reached condemning limit in case of four wheeled MG wagon or over a composite wheel. Solid wheels are turned to the size and the shape of wheel centre on a wheel lathe. Retyring of solid or composite wheels becomes necessary when it reaches the condemning dia. at tread or the tyre and/or wheel centre have become slack or loose or has cracked. Other defects on the tyre profile can be removed by tyre turning.

For composite wheels requiring re-tyring, the old tyre is to be removed first. For composite wheels secured by Glut rings the inner side surface of the tyre opposite the Glut ring has to be removed by machining on a wheel lathe. Thereafter the old tyre is removed either by oxy-cutting it at one location on the circumference or by heating it on furnace. The former method is more economical. Where the tyre is oxy cut, the tyre has to be removed by knocking it down. The wheel centre is now available for fitting a new tyre. The wheel centre should be checked for its squareness on top rim surface of the wheel centre is parallel to the axle and is not tapered. Tapered rim will not grip the tyre properly. The distance between the two wheel centres and its diameter should also be checked to ensure that they are within the prescribed limits. The rough machine tyres should then be finish machined to suite the individual dia of the wheel centre. The diameter of the tyre is kept less than the dia of the wheel centre to ensure proper grip after shrunk fit. The prescribed allowance is 0.001 mm per mm of the dia of the wheel centre. If the dia of the wheel centre is 611 mm the internal dia of the tyre will be 610.389 mm (611 mm)..

After fine finish machining the tyre should be heated on an electric induction furnace or on a cool/oil fired furnace, designed for the purpose. The shrinkage on the tyre should be done at low heat. The temperature of the tyre should be enough so that by expansion if exceeds the dia of the wheel centre and is able to easily go over the wheel centre. After the tyre is heated to the required temperature, it should be kept at a suitable flat location and the wheel centre along with the axle should be inserted in it vertically. Thereafter the Glut ring should be inserted. If any small gap is left on the circumference, a small make up piece of the Glut ring section should be inserted. It is important that while shrinking the tyre on the wheel centre, water should not be used to cool the tyre. After the tyre has cooled, it should be removed to a wheel rolling press. On the press the lip of tyre on the inner surface opposite the Glut ring is pressed in till no gap is left between the Glut ring and the tyre. Now the wheel is ready for tyre turning.

H. TYRE TURNING OR REPROFILING

To remove irregular surface on the profile caused due to wear in service re-profiling is to be done. In service some of the wheel develop defects beyond the permissible limit for the safe turning. Such wheels are to be withdrawn and should be sent to workshop for removing the defects. The wheel requiring re-profiling shall be turned to worn wheel profile or to intermediate profile to RDSO Drg. No. WD-88021 or WD –89060/S-2 respectively.

On receipt of wheels in wheel shop, the diameter of both the tyres at wheel tread should be measured. Some times wheel with unequal dia. on the same axle are received. The tyre should be tapped and if sounding dull, re-profiling should be done. Many times skidded wheels are received due to which tyre surface at some spots got hard. Such spots can not be machined on wheel lathes available in many workshops. Such wheels should be sent to re-profiling section for softening the hard spots on suitable designed furnaces. After softening, the wheels should be sent to tyre turning section. Wheels requiring re-axling and re-tyring should be sent to these sections first and only after completing the re-axling and tyre turning should be resorted to.

Tyre turning is done on a specially designed wheel lathe. The root radius, vertical inclined surface, radius on the top of the flange are difficult portions to be machined.

To machine these portions, specially designed gadgets are provided on the Tool ports. On some old type of lathes form tools are used. Use of form tool is not desirable. Apart from not getting the desired profile it involves frequent grinding of the form tool. Also excessive wear is caused on the tool post and the productivity is very low. When the specially designed gadgets go out of order, form tools should be used in lieu for very short duration. Very attempt should be made to put the gadgets in working order as early as possible.

While tyre-turning, the following should be kept in mind :-

i. The wheel gauge, i.e. the distance between the flanges of the 2 wheels of the same axle should be within the laid down limit. The aspect has to be particularly ensured when new tyres have been fitted. On old tyres normally the distance is correct. But in some cases where the machining has not been done accurately in the past, the distance may be beyond the permissible limit. If the distance is less it can be corrected by machining the side surface of the wheel. In case the distance is more, the wheel shall required re-axling. It is very important that the turner of the wheel lathe checks this distance at the time of turning in addition to the check done by incoming Inspection staff. The laid down distance is 1600 +2/-1 mm for BG and 930 +2/-1 mm for MG.

ii. The variation in tread diameter of wheel tyres on the same axle should not exceed 0.5 mm. The turner normally machines the wheels to equal diameters. However, small variation may occur if the cut has not been taken carefully. After finishing the operators should assure dia of both wheels. If the difference is more than 0.5 mm he should take another cut on the tyre having the large diameter.

I. PAIRING OF WHEELS

Different wheels fitted on a wagon are to be paired. Normally it is done in the Lifting section of the wagon shop. Where large number of wheels of the same tyre are turned on each day, no difficulty is experienced for such pairing. However, when

the supply of wheels to Lifting section is from hand to mouth such pairing for the day's requirement has to be done in the tyre, turning section of the Wheel shop itself. Pairing in Wheel shop also becomes necessary for special tyre of wheels received in small numbers. When pairing is done in the Wheel shop, it becomes necessary to turn such wheels even to lesser diameters than is required from the point of view of wear. For such cases specific instructions should be given to turner of the Wheel lathe.

The variation in tread diameter should be as per Clause2.8.14.2 of IRCA Part III(2000).

J. WHEEL DEFECTS

The wheels are required to be withdrawn from service for the following major defects:-

i) Reached condemning limits
ii) Flat places/skidded
iii) Flanges sharp/deep/thin
iv) Too insufficient radius at the root of flange
v) Gauge slack/tight
vi) Slack Tyre
vii) Cracked or broken

Defects i) to iv) mentioned above are detected with the help of tyre Defect Gauge. Defect as in item (v) is checked by Wheel Gauge. Defect as in item (vi) is checked by ringing test and defect as in item (vii) is determined by visual examination.

Permissible maximum flat surfaces on tread are as under:

Wagon Type	**Permissible Flat Surface**
BG Wagons	60 mm
MG Wagons	51 mm

a) THIN AND SHARP FLANGE

(i) For proper method of using Tyre Defect Gauge, please refer IRCA Part III .
(ii) Wheel may be passed provided the minimum thickness of flange is 16 mm.
(iii) Wheel must not be allowed to run if flanges are worn to knife edge but may be passed if the radius is not less than 5 mm.
(iv) Wheels with too small radius at the root of flange should not be allowed to remain in service.

K. REPAIR AND MAINTENANCE IN SICK LINE

i. Inside Crown of the Axle Box should be checked for wear at the time of re-packing. Concave wear on the inside Crown should not be permitted under any circumstances.

ii. The dust shield should be examined during re-packing of axle boxes in sick lines. If found worn, torn, or if it has lost its stiffness, it should be replaced.

iii. Axle boxes with rejectable defects to be attended as given in para 605 I(b).

iv. Bearing brass to be examined and repaired as given in para 605 N(g).

v. Periodicity of re-packing and oiling to be followed as given in para 605 -O.

vi. Procedure of re-packing of axle boxes to be done as given in para 605 P.

vii. Important do's & don'ts in re-packing of axle boxes to be followed as given in para 605 R.

viii. Examination and maintenance of Axle, wheels and tyres should be done as per IRCA Part III (2000) Rule 2.8.

L. REPAIR AND MAINTENANCE DURING ROH & POH

The following additional work is also to be carried out during maintenance at the time of ROH and POH including the work mentioned in para J.

i. The dust shield should be examined, every time the axle box is repacked during POH. If found worn, torn, or if it has lost its stiffness, it should be replaced.

ii. Axle boxes should be examined and inspected on open lines for defects. Rejectable defects of axle box to be attended as given in para 605 I(b).

iii. The elongated/oval cut holes on face plate should not allowed. Proper riveting of the face plate to be done with axle box.

iv. Bearing brass to be examined and repaired as given in para 605 N(g).

v. Repair of the journal to be done as per IRCA Part III (2000).

vi. Periodicity of repacking and oiling to be followed as given in para 605-O.

vii. Procedure of re-packing of axle boxes to be done as given in para 605 P.

viii. Proper attention must be paid to the examination and riveting of the face plate at the time of POH in workshop. Important do's & don'ts in re-packing of axle boxes to be followed as given in para 605 R.

ix. Procedure for white metalling to be done as given in para 605 S.

x. Examination and maintenance of Axle, wheels and tyres should be done as per IRCA Part III (2000).

607. IMPORTANT DIMENSIONS RELATED TO SUSPENSION

(Unless otherwise indicated, the dimensions are in mm)

Sr. No.	Description	MG	BG
1.	■ Scroll iron eye hole dia max. ■ Shackle pin-dia ■ Max. Clearance between Shackle pin and scroll iron when new ■ Max. clearance between shackle pin and spring eye when new ■ Shackle plate thickness ■ Shackle plate eye hole dia ■ Washer	23.65 mm 21.6 mm 1.05 mm 1.15 mm 20 mm 23.65 mm 6 mm	29.65 mm 27.6 mm 1.05 mm 1.15 mm. 25 mm 28.65 mm 4 mm
2.	■ plated IRS type spring for 4 wheeler wagons (MG) ■ plated non standard sp- 76 mm ring for 4 wheeler wagons ■ plated non standard for 4 & 6 wheeler wagons ■ plated IRCA type ■ plated BG spring for 4 wheelers ■ plated BOX spring for UIC bogies	Free camber 50.8(+5/-0)mm 76 mm 86 mm 51 mm	 75.5(+6/-0) mm 47(+6/-0) mm
3.	■ Spring buckle packing pieces step sizes ■ Pressed steel axle guard plate thickness	Buffer Height adjustment. 9, 19, 26 & 35 mm 8 mm	11,26, 37 mm 10 mm
4.	■ Horn cheek thickness ■ Leg size ■ Height ■ Rivet hole dia ■ Distance of centre line of holes from bent corner	12 mm 82x36 317 mm 21.5 mm 47 mm	19 mm 96x48(for 16 t) 95 x 64 (for 22t) 419 (for 16t), 432 (for 22t) 21.5 mm 57 mm
5.	■ Tie bar thickness ■ Rivet hole dia ■ Axle Guard packing plate ■ Edge radius	12 mm 17.5 mm 387x55x12 (thick) 6 mm	20 (for 22t ISA 50 x 50 x 6 (16.3t) 17.5 mm 536x75x10 (thick) 10 mm

Sr. No.	Description	MG	BG
	■ No. of rivet holes ■ Dia of rivet hole	5 Nos. (27 mm from edge 21.5 mm New	5 Nos. (28 mm from edge) 21.5 mm Max.
6.	■ Axle guard lateral clearance ■ Box Bogie ■ Longitudinal clearance ■ BOX Bogie	MG - 6.8; BG - 6 20 mm MG – 3; BG - 3 12 mm	25 mm Max. 18 mm Max.
7.	■ No. of holes to secure spring plank by rivets ■ No. of holes in bracket in tie bar ■ Axle box bolt hole dia max. wear ■ Diamond frame bogie spring plank rivet holes (number) ■ Cast steel bogie spring plant rivet holes ■ Brake beam support plate rivet holes ■ Push rod safety loop rivets holes ■ Spring plant Inspection hole ■ Bogie brake fulcrum bracket bolster	6 3 2 mm 12 8 mm(vertical) 6 mm 4 mm 127 mm dia 4 holes	6 mm 3 mm 2 mm 4 8 mm (vertical) nil nil 152x76x2 holes nil
8.	■ Rivet dia clearance ■ Top surface radius of bottom pivot ■ Side surface of bottom pivot ■ Diametrical clearance between pivot bin portions ■ Diametrical clearance between outer edges ■ Diametrical clearance between top pivot and pin	2 710 115 Min.4 Max.8 8 10	2 495 255 3 16 10
9.	■ Side bearer clearance ■ Axle box bolt size ■ Radius of column at bottom outer side ■ Centre of radius of tie bar ■ Column bolt size ■ Tie Bar ■ Tie bar camber ■ Distance between centre of two radius ■ Strengthening bar	Max. 6 Min. 3 M-30x390 12 70 M-30 x 50 150x82 thick 286 578 125x10 thick	BOX Bogie:- Max.-7, Min.- 4 M-30x386 12 40 M-45x590 150x50 thick 390 508 Nil

Sr. No.	Description	MG	BG
	■ Length of tie bar ■ Square piece welded ■ Top arch bar ■ Top arch bar camber ■ Radius at bends ■ Bottom arch bar ■ Bottom arch camber ■ Bottom arch bar radius at bends	830 32x126 32x150 30 70 150x16 32 70	217 Nil 40x150 45.5 152 150x20 85 152
10.	■ Axle box top cover rivet holes ■ Axle box guard groove liner plate thickness ■ Axle box guard groove liner sizes 4 wheeler ■ Axle box guard groove liner inner radius at bends ■ Key plate thickness	2(6.5 dia) 4 (for 4 wheelers) 232x50.8 M x22 4 mm (for 4-wheeler) 13 x 209.5x 138	2(6.5 dia) 3.15 (for 4 wheelers) 273 x 60.3x30 deep 6 mm (for 4-wheeler) 16x 234.5x155.5
11.	Radius provided on top of flange: ■ Profile A ■ Profile B (1st intermediate) ■ Profile C (2nd intermediate)	 12 10.75 9.5	 14.5 R 12 (NR practice) 10 (NR practice)

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