

1. INTRODUCTION OF CARRIAGE & WAGON

1.1 Role of C&W in Railways

A. Related with Open Line working:-

- To ensure and co-operate in safer running of rolling stock.
- To attend required schedule maintenance & running repairs of rolling Stock till the stock are again due for P.O.H.
- To assist in time running of trains to maintain the punctuality.

B. Related with Work -Shop working:-

- To attend Periodical Overhauling of Rolling Stocks.
- To adopt required modifications.
- To maintain proper records of all the rolling stock running in Indian Railways.

1.2 Classification of Rolling Stock

- **Rolling Stock:** - It is a term for the stocks of coaching, freight (Goods) & Locomotive.
- **Coaching Stock:** - All coaching vehicles including self-propelled units such as rail cars, electrical multiple units (luggage & brake van) fit to run with coaching stock are known as coaching stock.

- **Goods Stock:** - All goods stock other than coaching stock whether attached to passenger or goods train is known as goods stock.
- **Coaching Stock (Vehicle):** - It is a term used only for coaching stock. There are two types of Coaching Stock
 - i. Passenger coaching vehicles (PCV): - A vehicle in which whole or partial portion is being utilized for carrying passengers.
 - ii. Other coaching vehicles (OCV): - It comprises salons, inspection cars, medical cars, tourist cars, parcels & horse van, composite luggage Power Cars, Pantry Cars & brake van.

1.3 Types of Coaches

- I. **ICF:** - Integral Coach Factory. (Perambur, Chennai) & Rail Coach Factory, Kapurthala (Punjab)
- II. **LHB COACHES:** LHB body with FIAT bogie (Linke Holfmann Busch – German):-Maximum Permissible Speed 160 kmph
- III. **Hybrid Coach:** LHB Body on Modified ICF Bogie – Running in same of the Duranto Rake.

2. ICF COACHES

Introduction

An attempt for standardization of manufacturing of passenger coaches led to development of IRS design of steel body coaches. In 1954 Steel body coach design was taken from M/S Schlieren Switzerland for manufacturing of ICF Coaches at Perambur.

Initially original speed of ICF coach was 96 kmph since secondary suspension was laminated spring. The design was modified to all coil bogies with longer suspension hanger and weight transfer through side bearers, thereby enabling speed potential to 105 kmph on mainline coaches and gradually enhanced to 140 kmph for Shatabdi, Rajadhani and Janshatabdi coaches as per RDSO report No CWI Vol 1.

Initial coaches manufactured were with Vacuum brake and later modified into twin pipe graduated release air brake system - under frame mounted. Due to frequent failure of SAB and heavy vibrations of pull rod this was further modified into Bogie Mounted Brake System. Brake rigging pins were reduced from 104 Nos to 82 Nos.

Drawbar capacity is enhanced from 36t to 75t.

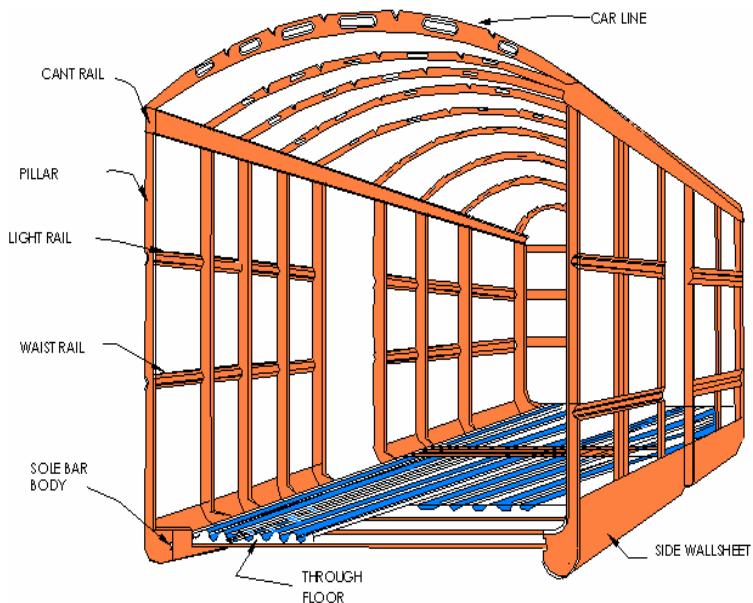
The codal life of ICF coaches of normal utilisation coaches is 25 years and light utilisation coaches are 40 years.

Dimensions of Coach

Description	Dimension
Length Over Buffer	22296 mm
Length Over Head Stock	21336 mm
Width	3245 mm
Height From Rail Level	3886 mm (old), 4025 mm (new)
Codal Life	25 Years

2.1 ICF COACH SHELL / BODY

Construction of coach body which forms big tubular hollow construction which is light in weight.



2.1.1 Salient Features of ICF Coach Shell / Body

- **All Metal:** - ICF coach shell is made up of steel channel frames of thin sections except the seats & luggage racks which are made up of wooden members.
- **Light Weight:-**The weight of coach shell is reduced due to minimal use of wooden members, use of anti-corrosive Corten Steel (IRSM 41) of thickness 1.6 mm for roof and 2 mm thickness for corrugated floor, side panel and end panels during fabrication of coach body. The use of gusset plate, knee & rivets are also avoided in under frame. Hence weight of ICF shell is reduced by 26% to 32% compared to IRS coach shell which was used in the past.
- **Integral Construction:-**The shell of ICF coach is formed by welding together body side pillars, roof carlines, waist rail, light rail, cant rail & sole bar. Corrugated flooring, side panels, end panels & roof are welded together by means of homogenous welding. End pillars, stanchions and side pillars are also connected with panelling work. This type of structure gives the integral
- **Anti-telescopic construction:-**The shell of ICF Coach is designed to bear 45 tons of vertical load and 200 tons of longitudinal impact on side buffers. The coach body is so designed that it is stronger at end portion as well as in passenger seating portion and less at the doorway and toilet. Due to which maximum kinetic energy during accident is absorbed by the end portion and get damaged and balance kinetic energy is also shared by the corrugated flooring and other members of body shell, resulting in keeping the passenger accommodation area of middle portion of shell safe with minimum damage. As a result of these properties,

telescoping of one coach into adjacent coach is avoided during accident. Hence the above type of shell construction is known as anti-telescopic construction.

- **Stressed Skin Construction:** - During the construction the side panel is welded to side pillars, waist rail, light rail and cant rail by means of CO₂ welding which results in accumulation of stress in the panel. The stress is relieved by spot welding on the panels at different location after completion of the construction. 70 % of total developed stresses are absorbed by corrugated trough flooring. Thus this multi-point welding property of the end & side panel is enough to minimize developed stresses of panels.
- **Aerodynamic shell:** - The shell is constructed with the curved roof at the corners and curved turn under to minimize the air resistance during the run of the coach at high speeds.
- **Anti-corrosive:-** To achieve anti-corrosive property to the shell, Corten steel IRSM - 41 (max at turn under and lavatory portions) is being utilized for panelling purpose. During manufacturing the process of sand blasting, grit blasting is also given on panel sheet which is helpful to prepare rough surface for painting resulting in less chances of corrosion. Three coats of bituminous anti-corrosive paints are given at welded portion and for other portion red- oxides paint is applied for anti-corrosive treatment. The Trough floor is provided with holes for proper drainage of water. 200 x 135 mm size elliptical holes are given in turn under portion for proper drainage of seeped water coming from window shell. The flooring inside is made of 19 mm thick ply or 12 mm thick COMPREG sheet and 2 mm PVC flooring is layed over it avoiding the seepage of water from the floor below to the

corrugated sheets. The above precautions and provision of facilities minimizes the incidence of corrosion.

- **Heat resistance:** - To improve thermal insulation property in coach shell following precaution or facilities has been provided:-

Silver / Aluminium paint coat is provided on roof outside which reflects the sun rays.

Further the ceiling is provided with layers of insulating materials like Asbestos / Glass wool which is bad conductor of heat resulting in minimum transmission of heat to interior of the coach. The carlines are designed with elliptical holes for proper air circulation from one compartment to another. Sufficient no of ventilators are also provided on top of roof for exhausting the stale and hot air from the coach and to circulate fresh air. Limpet sheet is used for inside ceiling (2mm thick) which is bad conductor of heat.

2.2 BOGIE

Main Components of ICF Bogie

UNDERFRAME:-

- i) Sole bar
- ii) Head stock
- iii) Transom
- iv) Longitudinal bar

PRIMARY SUSPENSION:-

- i) Dash pot
- ii) Dash pot spring
- iii) Dash pot protection tube
- iv) Air vent screw
- v) Axle box safety bolt
- vi) Axle box wing & lug
- vii) Safety strap & safety loop
- viii) Axle box & axle box plate

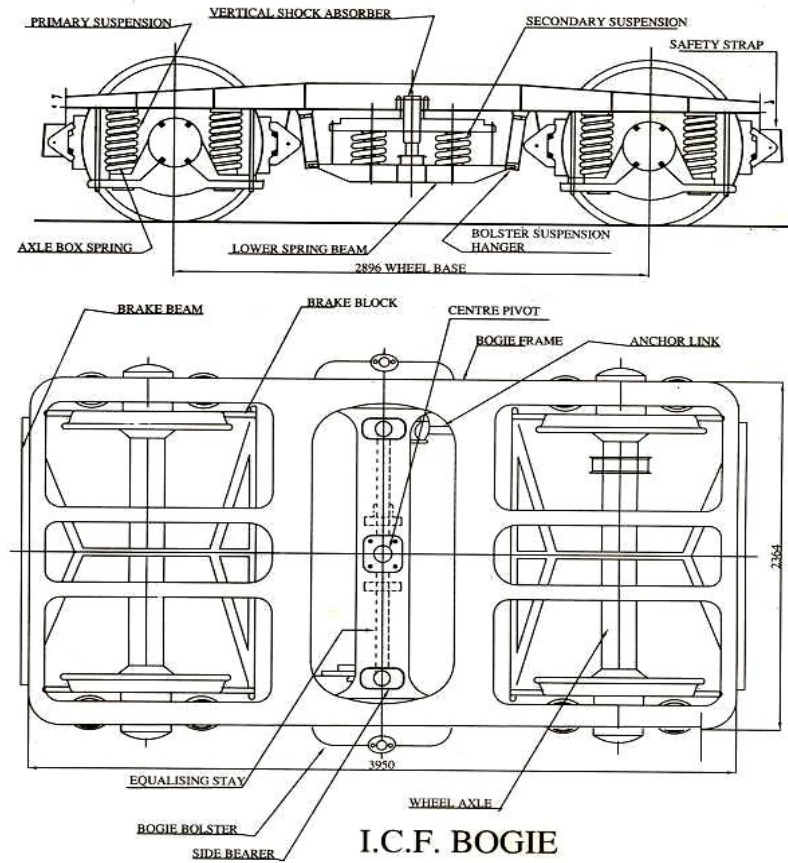
SECONDARY SUSPENSION:-

- i) Bogie bolster upper plank
- ii) Bogie bolster lower plank
- iii) Suspension link, link pin & stone
- iv) Bolster spring
- v) Vertical shock absorber
- vi) Safety strap & safety loop
- vii) Equalizing stay rod
- viii) Anchor link
- ix) Centre pivot cotter, split pin & cup
- x) Silent block
- xi) Side bearer housing
- xii) Side bearer metal plate
- xiii) Side bearer bronze wearing piece

BRAKE GEAR:-

- i) Brake beam
- ii) Brake beam hanger & safety bracket
- iii) Brake safety wire rope
- iv) Brake shoe & key
- v) Floating lever
- vi) Curved pull rod
- vii) Equalizing truss bar
- viii) Palm end

2.2.1 Features of ICF All Coil Bogie:-



- 1) Bogie is designed to run on Indian Broad Gauge Track (1676 mm).
- 2) Provision of coil spring at primary & secondary suspension so that bogie is known as All Coil Bogie.

- 3) Bogie Head Stock is provided with pressed T- section and sole bar is with pressed I-section, but at the location of link brackets it is in box section.
- 4) Transom – Previously it was in C-section but now a day it is in Box section to be more robust.
- 5) Wheel Base of bogie is 2896 mm.
- 6) Weight Transmission - By 2 side bearer located at distance of 1600 mm.
- 7) Guidance of bogie Lateral and Longitudinal both with the use of Centre Pivot pin located at the centre of bolster.
- 8) Wheel Guidance lateral and longitudinal both with the use of 2 nos. of Dash Pot guide per Axle Box Wings welded at sole bar.
- 9) Axle Capacity - 13 T – For Non A/C coach 16 T – for A/C coach and WLRRM coach
- 10) Roller Bearing – Double Roll Self Aligned Spherical Roller Bearing.
- 11) Axle – Solid and Straight
- 12) Wheel Diameter – New – 915 mm
Condemn – 825 mm (workshop release size - 833 mm).

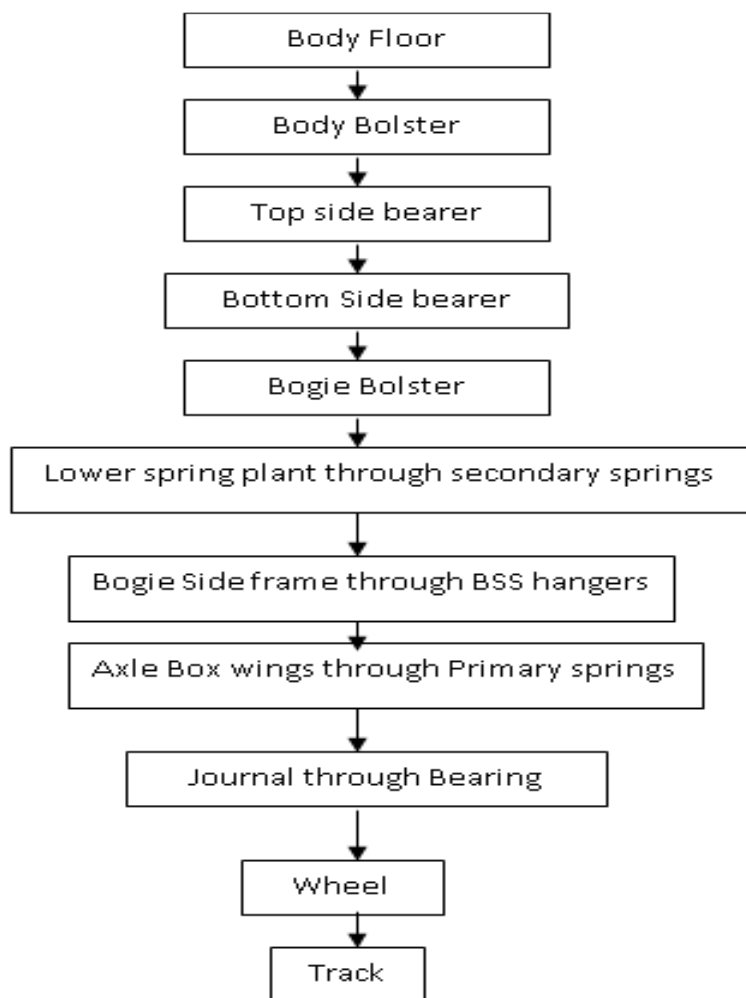
Ref: Rly. Board's Letter No. G2/ M(c)/151/2 vol. - V dated 25/01/2011

- 13) Shock Absorber – Provided on Secondary suspension between Bolster and lower plank (2 nos. of each Bogie).2 nos. of lateral shock absorber are being provided in ICF Bogie to be utilized for Hybrid Coach.
- 14) Vertical Hydraulic Dampers – 2 nos. per Axle Box Vertical telescopic hydraulic Dashpots are provided.

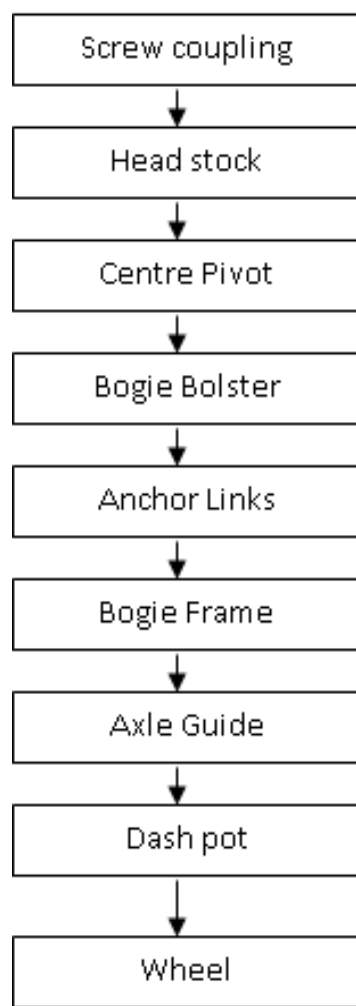
- 15) Fitment of brake block - Clasp type brake block arrangement is provided with the use of brake shoe head and brake beam.
- 16) 2 nos. equalizing stay rods per bogie are utilized to maintain the distance between both the lower planks and to maintain lateral thrust occurring during run.
- 17) Provision of Anchor link – 2 nos. per bogie with the provision of silent bushes are provided diagonally between bogie transom and bolster to work as a media to transmit the draw and braking force from trolley to body and body to trolley vice versa.
- 18) Piston Stroke – In conventional type Air Brake system 90 ± 10 mm and in BMBC within 32mm should be maintained.
- 19) Provision of Running Clearance:-
 - a) 'A' Clearance: - For 13 T – $43 +0/-3$ mm, For 16 T – $27 +0/-3$ mm

It is a clearance to be provided between axle box crown & safety bolt.
 - b) 'B' Clearance: - It is a clearance to be provided between bolster top & bottom of sole bar that should be $40 +/- 5$ mm to all type of bogie.
- 20) Riding index: - ICF bogie – 3.25 to 3.50
- 21) Truss bar Hanger: - Strength with double eye hole.
New length - 235 mm. Old length – 205 mm
- 22) Journal Size: - Dia. – 120x113.5 mm (sleeve mounted), 120x130.5 mm (direct mounted)
- 23) Journal Centre: - 2159.5 mm
- 24) Speed: - Fit to run up to 110 kmph. (Trial has been conducted up to 140 kmph.

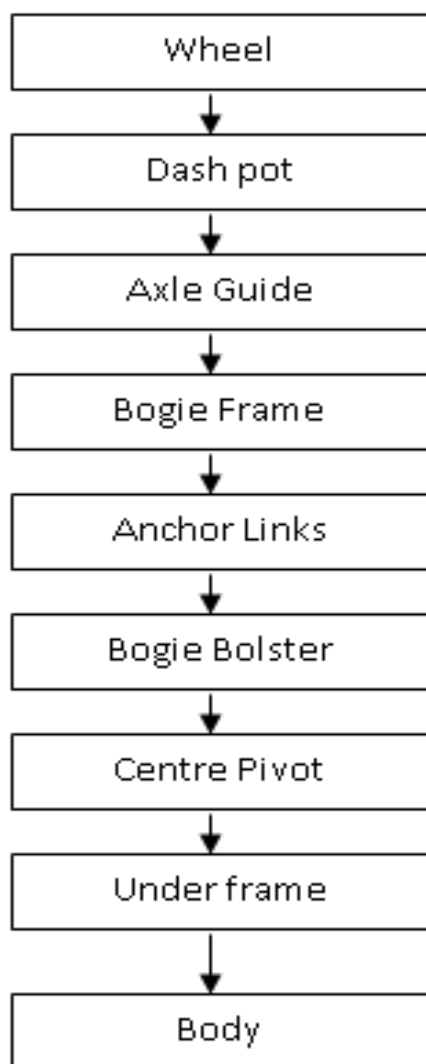
Weight Transmission of ICF Coach:



Draft Force Transmission of ICF Coach



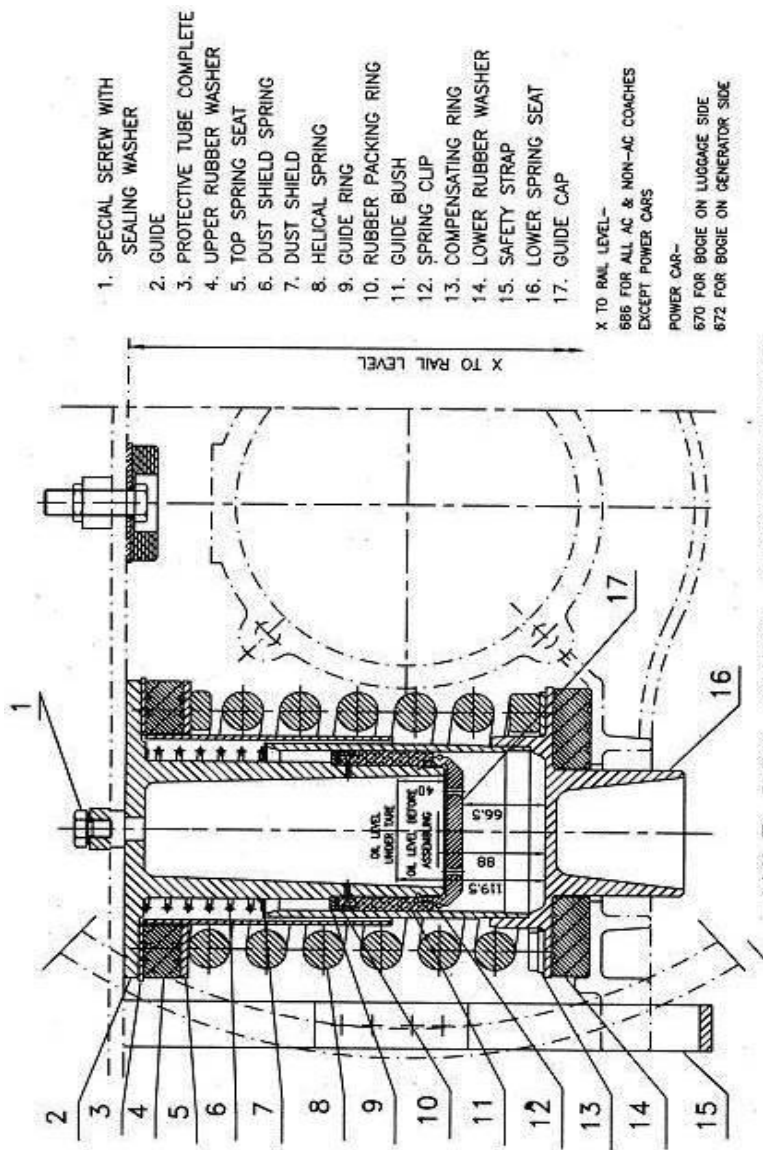
Braking Force Transmission of ICF Bogie to Body

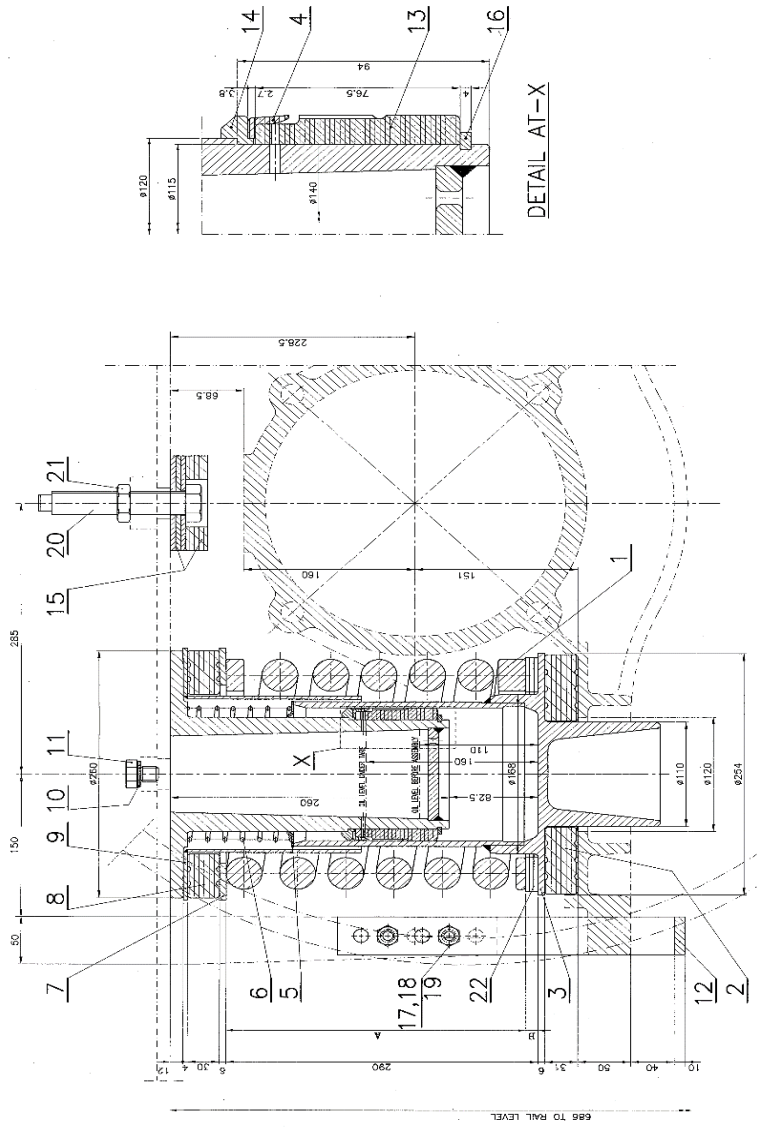


2.2.2 Axle Box Guide with Dashpot Arrangement

Axle box guides are of cylindrical type welded to the bottom flanges of the bogie side frame with close dimensional accuracy. These guides together with lower spring seats located over the axle box wings house the axle box springs and also serve as shock absorbers. These guides are fitted with guide caps having nine holes of diameter 5 mm equidistant through which oil in the lower spring seat passes under pressure during dynamic oscillation of coach and provide necessary damping to primary suspension to enhance riding quality of coach.

This type of rigid axle box guide arrangement eliminates any longitudinal or transverse relative movement between the axles and the bogie frame. The quantity of oil required for maintaining 40 mm oil level above the guide cap in modified arrangement is approximately 1.6 litres and in unmodified arrangement is approximately 1.4 litres. As it is not possible in open line to distinguish between modified and unmodified arrangements, 40 mm oil level is standardized for both.





Sl. No.	Description & dimension	No. per Coach	Ref. Drg
1	Helical Spring	16	F-0-1-006
2	Lower rubber washer	16	T-0-1-601
3	Lower spring seat	16	DL-0-1-103
4	Rubber packing ring	16	T-0-1-632
5	Dust shield	16	T-0-1-619
6	Dust shield spring	16	T-0-1-607
7	Top spring seat	16	T-0-1-608
8	Upper rubber washer	16	T-0-1-609
9	Protective tube complete	16	T-0-1-610
10	Sealing washer	16	T-0-1-629
11	Special screw	16	T-0-1-616
12	Safety strap	16	T-0-1-631
13	Guide bush	16	T-0-1-634
14	Guide ring	16	T-0-1-640
15	Rubber stopper arrangement	2	ICF/SK 0-1-193
16	Circlip 115 X 4N	16	IS: 3075-86 Part 1
17	Spring washer	32	IS: 3063-94 Tab 1A, Type B
18	Hex Head Bolt M12 x 65	32	IS: 1364 (P-1) – 92 4.6 tab 1 & 2
19	Hex Nut M12	32	IS: 1364 (P-1) – 92 4 tab 1
20	Hex Head Screw	8	ICF/SK 0-0-196
21	Hex Thin Nut M24 RH (Chamfered)	8	IS: 1364 (P-4) – 92 4.6 tab 1 & 2
22	Compensating Ring		ICF/SK 0-0-042

Common Defects Found in Axle Guide Assembly, Causes and their Remedial Action

Sr. No	Defect	Reasons	Remedies
1.	Perished Rubber packing ring.	Poor quality of rubber packing ring	Replace rubber packing ring at every examination involving lifting of coach. Use only rubber packing rings conforming to IRS specifications.
2.	Axle guide found worn on one side	Initial difference in wheel diameters on same axle more than 0.5 mm. Coach is not leveled.	Maintain difference in wheel diameters on same axle within 0.5 mm, during wheel turning. Use wheel diameter gauge with minimum 0.2 mm accuracy. Level the coach. The squareness and alignment of axle box guides should be checked with alignment gauges and corrected. Vent holes should be sealed with gaskets & screws tightened well after topping.
3.	Axle box upper spring seat (protective tube) worn-out/broken	-do-	-do-
4.	Guide bush worn.	-do-	-do-
5.	Lower spring seat	-do-	-do-

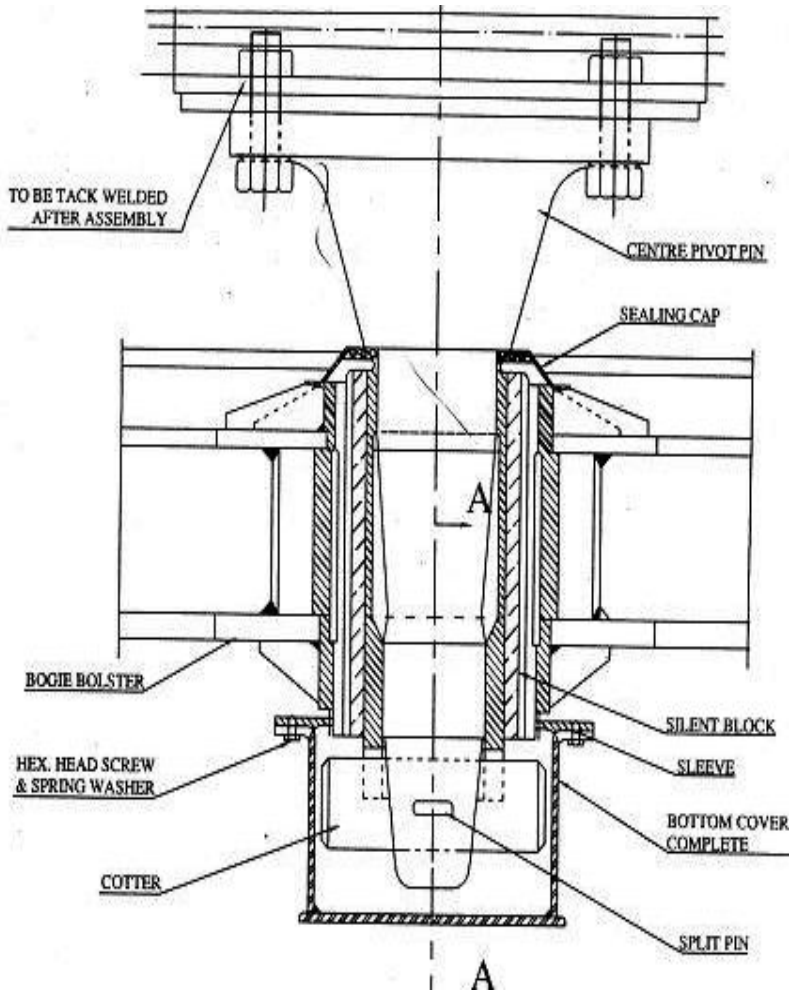
	surface worn.		
6.	Guide bush/ring broken	Axle guide is hitting lower spring seat.	Guide securing bolt should not project out of guide cap for non-modified Axle guide. Use good quality upper and lower hytrel washers and ensure correct number of compensating rings in the axle box guide assembly. Adjust ABC clearance on leveled track.
7.	Broken/distorted cir-clip of guide bush.	-do-	-do-
8.	Lower spring seat scored/dent mark on guide cap.	-do-	-do-
9.	Dust shield spring broken/distorted.	-do-	-do-
10.	Dust shield twisted or damaged.	-do-	-do-
11.	Leakage from Lower spring seat	-do-	-do-

Air Vent Screws: On the bogie side frames, directly above the dash-pots, tapped holes are provided for replenishing oil in the dash pots. Special screws with copper asbestos washers are screwed on the tapped hole to make it air tight.

Bogie Bolster Suspension: The bolster rests on the bolster coil springs - two at each end, located on the lower spring beam which is suspended from the bogie side frame by means of bolster-spring-suspension (BSS) hangers on either side.

Springs: In ICF bogie, helical springs are used in both primary and secondary suspension. The springs are manufactured from peeled and centre less ground bar of chrome vanadium/chrome molybdenum steel.

Centre pivot arrangement: The centre pivot pin joins the body with the bogie and transmits the tractive and braking forces. It does not transmit any vertical load. It is equipped with rubber silent block bushes which tend to centralize the bogies with respect to the body and, to some extent control and damp the angular oscillations of the bogies.



Centre Pivot Arrangement

Side Bearers: The side bearer arrangement consists of a machined steel wearing plate immersed in an oil bath and a floating bronze-wearing piece with a spherical top surface, kept on both sides of

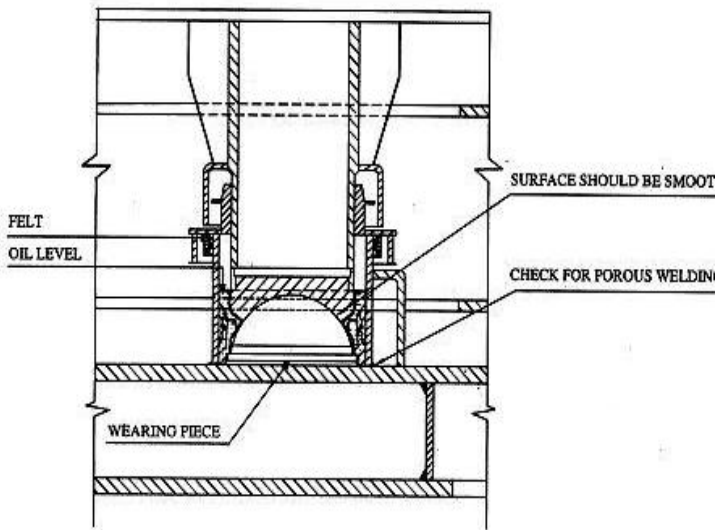
the bogie bolster. The coach body rests on the top spherical surface of these bronze-wearing pieces through the top side bearer at the bottom of the body-bolster. The whole arrangement is provided with a cover to prevent entry of dust in the oil sump.

Wear limit for wearing plate:

New size: 10 mm Condemning size : 8.5 mm

Wear limit for wearing piece:

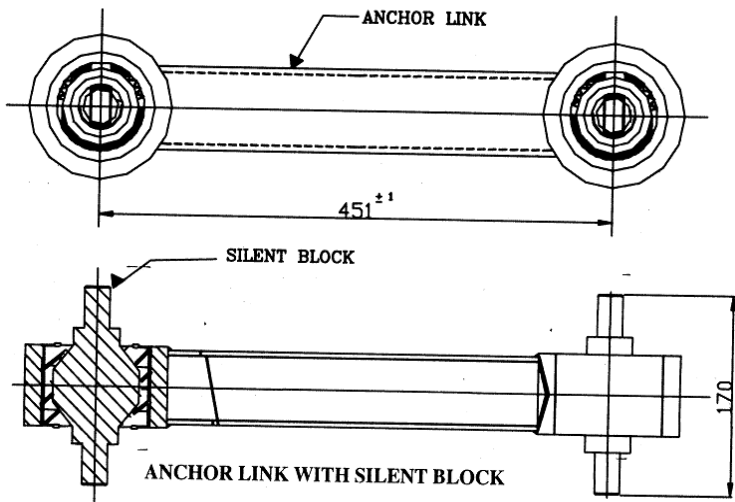
New size: 45 mm Condemning size : 42 mm



SIDE BEARER ARRANGEMENT

Anchor Links: The floating bogie bolster which supports the coach body is held in position longitudinally by the anchor links which are pinned to the bolster sides and the bogie Transoms.

One anchor link is provided on each side of the bolster diagonally. The links can accommodate vertical movement to permit the bolster to rise and fall. The links prevent any relative longitudinal movement between the bogie frame and coach body. They are designed to take the tractive and braking forces. The anchor links are fitted with silent block bushes.

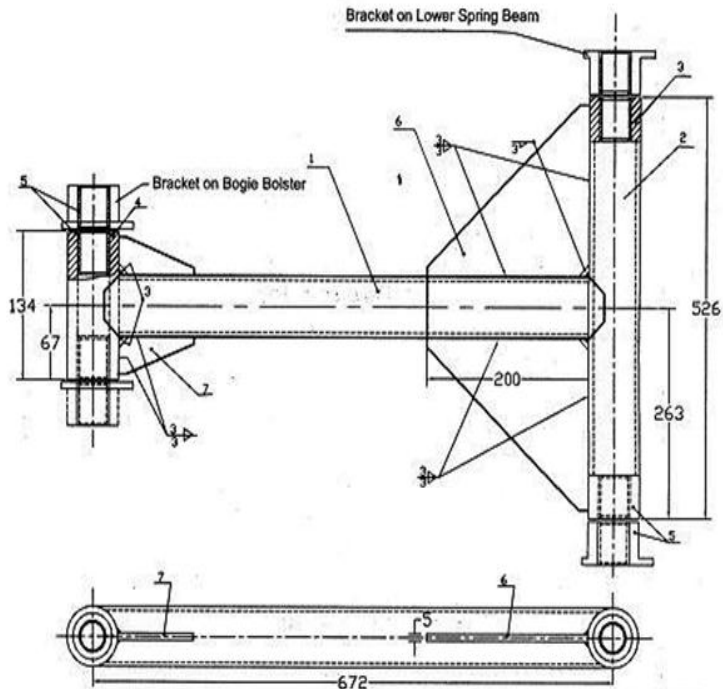


Silent Block: This is a synthetic rubber bush fitted in anchor link and centre pivot of ICF bogies to transmit force without shock and reduce noise.

Bolster Spring Suspension (BSS) Hangers: In the secondary suspension, the bolster is supported on helical coil springs which are placed on the lower spring plank. The lower spring plank is suspended from the bogie side frame through BSS hangers on hanger blocks.

Shock Absorbers: Hydraulic shock absorbers with capacity of 600 kg at a speed of 10 cm/sec. are fitted on 13 ton bogie & 900 kg at a speed of 10 cm/sec. are fitted on 16 ton bogie work in parallel with the bolster springs to provide damping for vertical oscillations.

Equalizing Stays: This device has been provided on bogies between the lower spring plank and the bolster to prevent lateral thrust on the bolster springs as these springs are not designed to take the lateral forces. These links have pin connections at both ends and, therefore, can move vertically.



EQUALISING STAY FOR LOWER SPRING BEAM
(16.25 t Axle Load Bogie) (RDSO Sketch 88105)

2.2.3 Direct Mounted Roller Bearing Arrangement

Double Row Self Aligned Spherical Roller Bearing

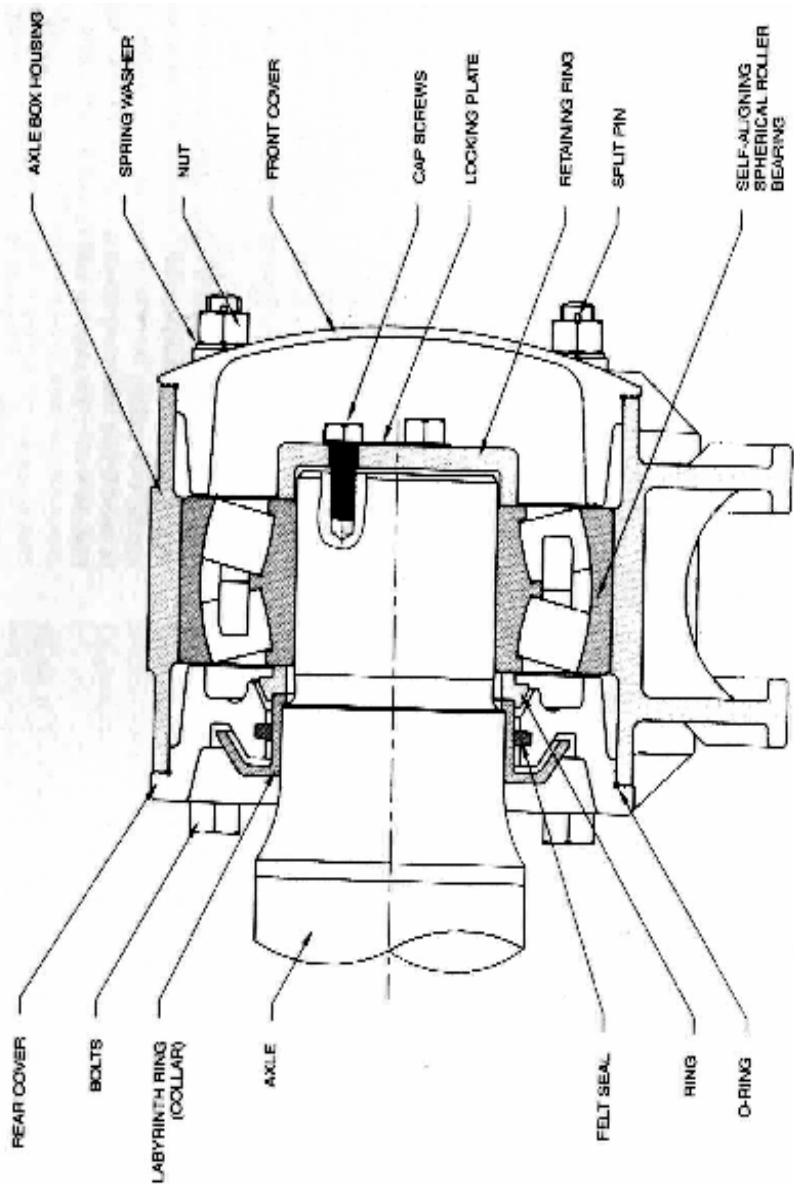
Bearing make	Radial clearance in mm
SKF	0.105 to 0.296 mm
FAG/NORMA	0.080 to 0.185 mm
NEI/NBC	0.080 to 0.190 mm

2.2.3.1 Roller bearing defects

Flaked, pitted, Burnt, Dented, Excessively worn and seized rollers. Smearing, Cage broken, Corrosion, Locking stud loose or broken, Over greasing, Less grease & Contaminated grease, Felt ring damaged/perished, Retainer ring broken, Excessive lateral play.

Inspection of other components related to Roller Bearing

The following components other than roller bearing should be inspected during roller bearing maintenance in the workshop. Axle end holes, End locking plates, End locking bolts, Retaining Ring, Collar, Felt ring, Rear and Front Cover, Axle box housing



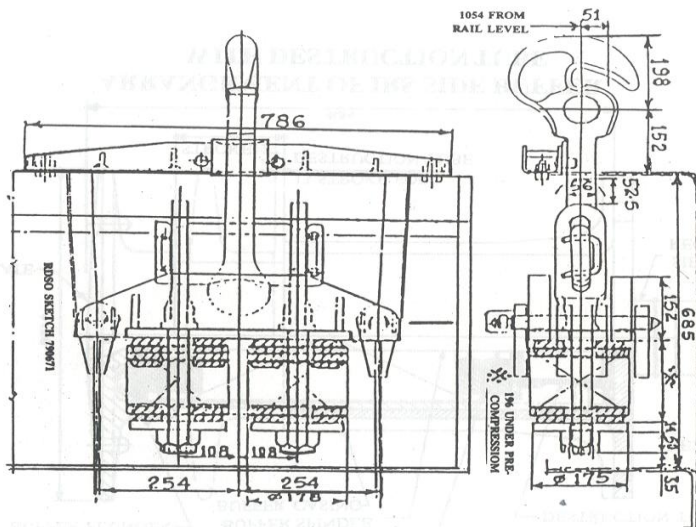
2.3 Draw & Buffing Gear:

2.3.1 Draw Gear:

It is a vital component of rolling stock, which is utilized to connect one rolling stock to the adjacent rolling stock to form a train & also to transmit draft forces from engine to last vehicle. It is provided in the centre of the body in the under frame head stock at both the ends. Mainly two types of draft gear are being utilized in Indian Railways.

Conventional Draft Gear and Centre Buffer Coupler

2.3.1.1 Main components of conventional draw gear:



IRS DRAW GEAR WITH RUBBER PAD SPRING

Draft Hook

Draft Links

Draft Key

Draft Spring/ Draft Pad.

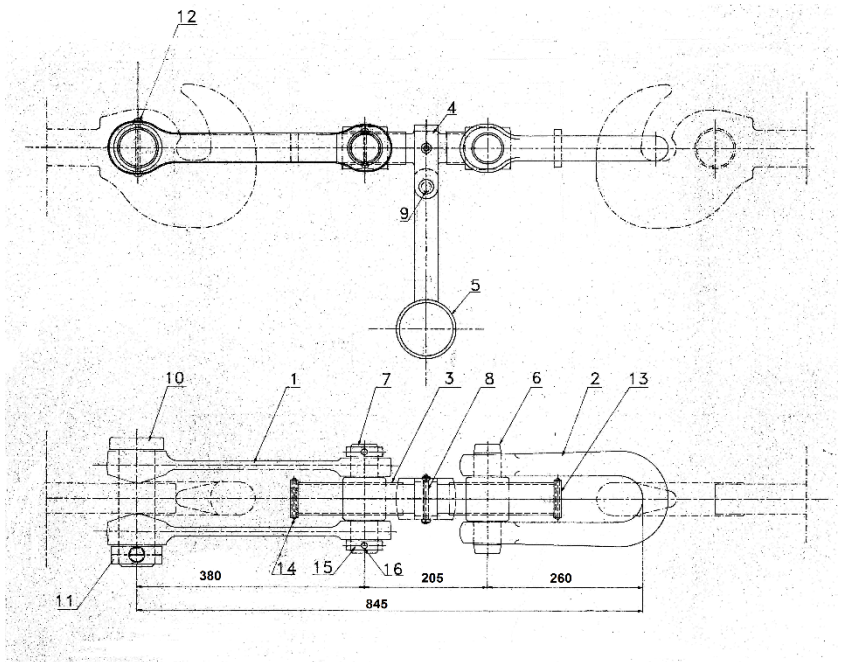
Cotter

Washer

Bent Pin (U-Pin)

Hexagonal Nut

Screw Coupling



2.3.1.2 Parts of Screw Coupling.

1. Link
2. Bent coupling link
3. Screw
4. Bent coupling

5. Lever
6. Trunnion
7. Trunnion
8. Snap head rivet dia 8 x 85
9. Pin 60 x 218
10. Collar
11. Snap head rivet 12 x 95
12. Collar
13. Snap head rivet 6 x 70

In 1984 use of Enhanced Screw Coupling was started, which was again modified in 1998. To identify this coupling a Dumble mark is stenciled at both the side of coach end body.

Length of coupling when fully opened – 997 mm

Length of coupling when fully Tight – 751 mm

Modifications:

S. N.	Description	Non Modified	Modified
1	Working Capacity	36 Tonnes	36 Tonnes
2	Proof Load Capacity	60 Tonnes	70 Tonnes *
3	Breakage Capacity	Draw Bar – 108T S/Coupling – 112T	130T for both
4	Stamping Mark	C – 60.61	IS – 5517

Note: *Proof Load Capacity of Enhanced Screw Coupling is increased from 70T to 75T. This must be used in all coaches including 24 coach trains.

2.3.2 BUFFING GEAR:

Two nos. of buffers are provided on body head stock on both ends to absorb the longitudinal impacts during run, these are fitted at a distance of 1956 mm. The buffers also transmit buffing forces during pushing to its trailing end stock

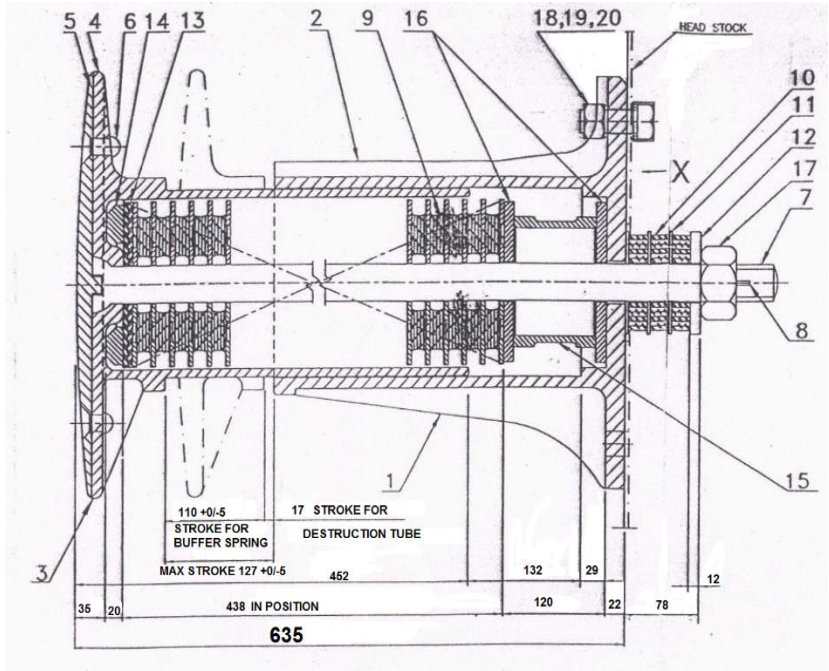
The main components of Buffering Gear are as under:-

1. Buffer Plunger
2. Buffer Socket with securing bolt
3. Buffer Spindle & Plug
4. Buffering Pad 5. Destruction Tube
6. Recoil rubber Washer
7. Washer
8. Nut & Cotter

Mainly Buffers are of two types:-

Long Case Buffer – Length from head stock – 635 mm

Short Case Buffer – Length from head stock – 458 mm (4 wheeler)



1. Side buffer Casing (casting)	2. Side buffer casing (Forging)
3. Buffer Plunger (Casting)	4. Buffer Plunger (Forging)
5. Face plate for buffer plunger	6. Flat CSK HD Rivet (Forged)
7. Buffer spindle	8. Bulb cotter
9. Rubber buffer spring	10. Side buffer recoil spring
11. Recoil spring parting plate	12. Recoil spring washer
13. Buffing spring parting plate	14. washer
15. Destruction tube	16. End plate M 12 X 170 dia
17. Hexagonal nut M 39 x 3	18. Hexagonal bolt M 24 x 90
19. Nylock nut M 24	20. Spring washer

Other data:

Max. Height in Empty condition – 1105 mm

Min. Height in Loaded condition – 1030 mm

Minimum buffer height of coaching stock should not be less than 1090 mm at the time of releasing of coach from POH Workshop.

Allowed variation in height at same end – 64 mm

Allowed variation with adjacent vehicle – 75 mm Max.

Plunger Travel – 127 mm

Min. Plunger Travel – 51 mm

No. Of Buffing Pads per Buffer – 14 to 16 Nos.

Capacity of Buffing Pads – 1030 kgm

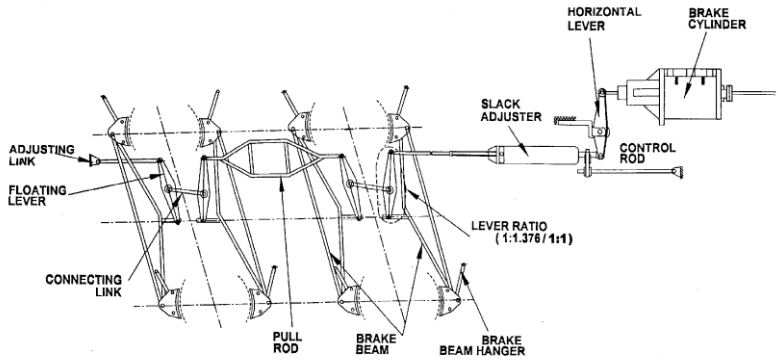
2.4 Brake Rigging

Brake rigging is provided for transferring the braking force from the brake cylinder to the wheel tread. Brake rigging is different for Bogie mounted brake system and under frame mounted brake system.

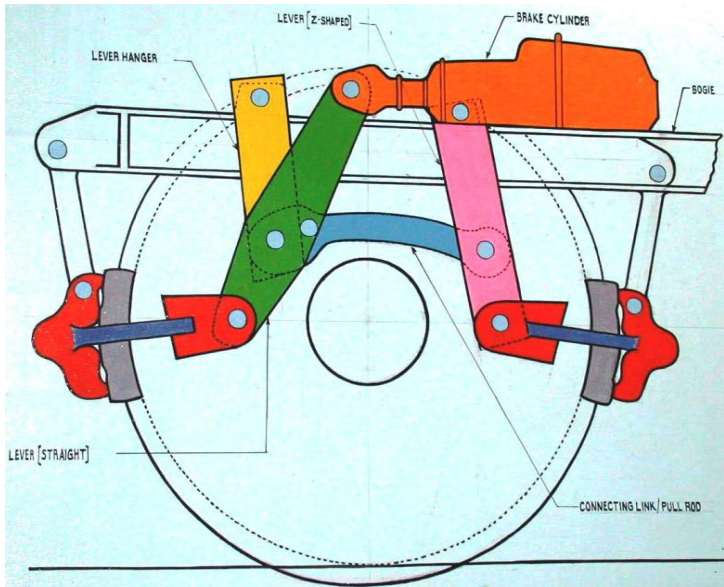
Coach under Frame Mounted Brake Rigging:

In 16.25 t axle load bogie the four levers used in bogie brake rigging are each with lever ratio of 1:1.376 hence the total Mechanical advantage in a bogie is 5.504.

In 13 t axle load bogie the four levers used in bogie brake rigging are each with lever ratio of 1:1 hence the total Mechanical advantage in a bogie is 4.



Bogie Mounted Brake Rigging:



The following parts are used in the Brake Rigging.

Lever- Straight, Lever- Z shaped, Lever Hanger, Connecting Link.

Bogie brake rigging has been modified to incorporate a total mechanical advantage of 7.644 per bogie for Non-AC coaches and 8.40 per bogie for AC coaches

Brake rigging of BMBS is discussed in detail in the BMBS chapter

2.5 Maintenance

Coaching Maintenance Depots.

According to number of based coaches (holding Capacity), depot is classified into three categories.

<u>Sr. No</u>	<u>Depot</u>	<u>Number of based coaches</u>
1	Minor	50 to 100
2	Medium	100 to 250
3	Major	Above 250

Standard Facilities:

1. Pit line for examination and repairs of coaches
2. Sick line with covered accommodation
3. Office & store facilities
4. Machinery & plants
5. Covered Accommodation:

Length of track under covered accommodation for any type of sick line must be at least 4% of the holdings of the depot (based coaches). The working space required for each coach is 35 m. Track length should not be less than 140m for any type of sick line.

It is essential to provide 50% track length under a covered area with pit examination facilities with proper light arrangement inside the pit. The pit also is ensured that it is provided with drainage facilities with 1% inclination & required number of man holes. Electric hoist of capacity 3 to 5 tonnes should be made available to cover the sick line across the track.

The width of the covered accommodation should be normally 15 meters covering two tracks under it. The distance between two centre lines of tracks should not be less than 7.5 meters. It should be ensured that proper space is provided beside the track for free and easy movement of transport vehicles like fork lift, lustre truck, trolleys, truck, etc.

Entire covered accommodation must have adequate lighting arrangement for workers to work without eye strain.

Machinery and Plant:

To avoid heavy manual labour, wastage of manpower and to provide efficient working environment in depot, suitable adequate machinery and plant is required as under:

Synchronised whiting jacks, Coach shunter, Welding plant 200 amp capacity, Gas cutting & welding equipment, Vacuum exhauster, Air compressor (350cfm), 2 tones tram beam hoist, Sewing machine, Light Commercial Vehicle, Wood cutting saw

machine, Forklifts, Hand shearing machine, Portable furnace, Centre lathe, Wheel lathe, Manipulator/fixture for bogie, Ultrasonic testing apparatus, Tool post grinder.

TOOLS:

- a) Pneumatic hand tools
 - i) Grinder,
 - ii) Drill,
 - iii) Chipper/buster,
 - iv) Riveter

- b) Electric power tools.
 - i) Pop riveting tool gun,
 - ii) Drill,
 - iii) Bolt tighter/torque wrench.

Hand tools including torque wrenches as required.

- c) Test benches and miscellaneous items.
 - i) Single Car test rig
 - ii) DV Test bench
 - iii) Air Brake cylinder overhauling test bench
 - iv) Water tank test rig.

Primary Depot and Secondary Depot

Sl. No	Primary Depot	Secondary Depot
1.	Complete maintenance of based coaches is attended including the schedules at primary depot.	All maintenance activities on the coaches are to be carried out during pit examination except the schedules at the secondary depot.
2.	Preparation of DRS card is done by primary depot.	Only cross checking of items as per DRS card. Shortage/missing if found shall be provided by secondary depot.
3.	Primary maintenance depot is responsible to prepare history card of coach.	Intimation to primary depot with regard to any major repair/maintenance is attended.
4.	It is duty of primary depot to ensure proper supply of brake van equipment for all originating trains.	Secondary maintenance depot is responsible to ensure only if there is any shortfall.
5.	Primary maintenance depot is responsible for all types of schedules of coaches.	Secondary maintenance does not have responsibility other than trip schedule.
6.	It is the responsibility of primary maintenance depot to send the coaches for POH or NPOH as per the arising/requirement.	Even though it is not the responsibility of secondary depot, it assists in sending the coaches for POH or NPOH through primary depot.

➤ **Maintenance Schedules to be followed in Coaching Depots**

Schedule is a work which is to be carried out at a prescribed interval of time. Schedule attention is required to keep the rolling stock in good serviceable condition without any failures during its life cycle for effective utilisation.

The different schedules that are carried on the primarily maintained coaching stock are:

a)	Trip Schedule	:	After every trip
b)	‘A’ Schedule	:	1 month \pm 3 days
c)	‘B’ Schedule	:	3 months \pm 7 days
d)	Intermediate overhaul (IOH)	:	9 months + 30 days
e)	Periodical overhaul (POH)	:	Once in 18 months (After 24 months for newly built)
f)	Special Schedule	:	As prescribed by each railway

Primary maintenance schedules are required to be carried out by the base depots to which coaches are allotted. In emergency, due to any reason if the coaches cannot reach their base depots and schedules become due, A & B schedules should be undertaken by the Coaching depot where the coaches are available.

2.5.1 Trip Schedule:

Trip schedule attention is given after completion of every trip. It has to be attended both by primary and secondary depots. The coach need not be detached from the rake during trip schedule attention.

Following items are given attention during the trip schedule:

Thorough examination of all under gear parts, lubrication of all moving parts, and complete examination of buffing & draw gear is done for its proper functioning. Ensure easy operation of coupling, proper examination of primary and secondary suspension arrangement, Ensuring there is no leakage in dash pot and maintaining prescribed oil level. Ensure intactness of safety strap and safety loop. Examine the condition of springs and shock absorber. Properly examine suspension link bracket, BSS hangers, pin & hanger blocks. Examine the equalizing stay for its proper securing. Examine the proper securing of bolts & cotters & silent bushes of centre pivot. Ensure the required level of oil in side bearer. Changing of worn out brake blocks & pins and adjust the brake rigging to ensure prescribed piston stroke. Conduct Rake test as per the procedure, and ensure 100 % brake power, testing of alarm chain apparatus.

Wheel profile and thickness should be visually examined and gauged in case they appear to be near condemning limits. Ensure thorough cleaning of coach from inside & outside and disinfection of toilets after cleaning. Examination of all pipe joints & other fittings for leakages & ensure filling of water tank after attention of leakages. Examine for proper opening & closing of vestibule doors and proper fitment of fall plates. Ensure intactness

of all amenity & safety items. Prepare DRS card & brake power certificate.

2.5.2 Schedule – A:

Schedule `A' attention is required to be given every month with a tolerance of 3 days at the nominated primary maintenance depot within the normal primary maintenance time on a washing/pit line. A coach need not to be detached from the rake for Schedule `A' examination unless it requires such repairs which cannot be attended to on the washing line or within the prescribed maintenance time on the washing line. Following items are given attention during 'A' schedule:

All items of trip schedule

Thorough inspection of brake pipe, feed pipe and branch pipes connecting brake cylinder, distributor valve, Auxiliary reservoir and also hose coupling for leakage and give required attention. Carry out manual brake release test on every coach to ensure proper functioning of release lever of distributor valve. Micro switch of ACP should be tested by electrical staff for proper functioning. Clean Dirt collector filter with kerosene and refit. Test the working of slack adjuster in under frame mounted air brake system. Repair/Replace the defective slack adjuster. Examine loops/ brackets and their securing devices and rectify. Examine for wear of brake hanger pins, brake blocks and brake heads and replace if required. Thorough check and repairs of SLR doors for easy and smooth operation and correct alignment of all wearing parts, loose screws etc. Intensively clean the coaches. Ensure intensive cleaning of lavatory pans and commode with specified cleaning agent and thorough flushing of water tanks. Checking of

water pipes, flush pipe, flushing cocks, push cocks, etc., for ease of operation and free flow of water. Thorough dis-infection of all compartments. Thorough inspection and repairs of draw gear and buffers. Oil in hydraulic dash pots should be checked to detect oil leakage from them through defective seals or through vent screws. Add/replenish with specified grade of oil if oil level is below 40 mm in tare condition to ensure better riding comfort. Similarly oil in side bearer baths should be checked, if the oil is below the plug, replenish with specified grade of oil so that wear plate is fully covered by oil. Inspection and repairs of commode chute. Thoroughly check sliding doors and vestibule doors for easy and smooth operation and correct alignment, lubricate all moving parts. Thorough cleaning of chimneys of dining cars, buffet cars, tourist cars and inspection carriages by wire brushes.

2.5.3 Schedule – B:

Schedule `B' is required to be given once in three months with tolerance of 7 days at the nominated primary maintenance depot within the normal time allowed for primary maintenance on a washing line in rake. Coach need not be detached from the rake for purpose of this examination unless it requires such repairs which cannot be attended to on the washing line or within the prescribed maintenance time on the washing line.

The following items of work should be attended.

All items of A schedule

Painting of lavatories from inside. Thorough inspection and repairs of brake gear components. Examination overhauling and testing of alarm chain apparatus. Thorough checking of trough

floor, turn under, etc. from underneath for corrosion. Touching up of painted portion, if faded or soiled. Testing of guard van valve.

New Policy (Recommendations) for enhancements of POH/IOH schedules of Coaching Stock.

The revised POH periodicity from 12 to 18 months is applicable to all Mail/Express coaches also. A marking on the coach below return date shall be specified to distinguish 18 months periodicity. The general sequence of Schedule will remain as per existing coaching maintenance manual.

The items of trip schedules; 'A' and 'B' schedules will remain same. The coach will be given 2 quarterly schedules (B Schedule) before IOH.

The work specified for IOH schedule to mechanical & electrical work in appendix C & D respectively as specified by CAMTECH Pamphlet No CAMTECH 2008 coach POH/1.0 in jan-2008 shall be followed.

Technical circulars/pamphlets issued by RDSO with regard to schedules on time to time shall be followed for necessary modification and replacements.

The requirement of bogies for unit exchange shall be planned as per the arising of IOH keeping two bogies spare considering the transportation time from the workshop.

The periodicity of overhauling of DV is changed from 24 months to 18 months (during every POH)

Work shop to switch over to PU painting during POH in workshop as advised by RDSO.

2.5.4 Intermediate Overhauling (IOH):

IOH is required to be given every nine months + 30 days at the nominated primary depot. Coaches have to be detached from the rake and taken to Sick line for IOH attention. Coach that is detached for IOH is taken over to the washing line for cleaning, lubrication and minor maintenance.

The following items of work should be attended for newly built/passenger coaches at the depot during IOH;

All items of Schedule `B'

Thorough repairs of running gear duly running out of bogies. After lifting and running out of bogies, the bogies/under frame members and body including trough floors of integral type coaches should be thoroughly examined and all parts of running gears are repaired/ replaced as necessary.

The bogie frames should be particularly checked to detect damage, cracks or deformation and necessary repairs carried out. Where it is not possible for the maintenance depot to give attention to such heavy repairs or are prohibited to be done in the maintenance depots, the bogies should be sent to the shops for carrying out these repairs. The detailed table of maintenance activities to be carried out during IOH schedule is enclosed as appendix-G. Touching up damaged paint on coaches both outside as well as inside. Thorough cleaning and removal of dust, rust, dirt, etc., accumulated at the pillars through the turn under holes, with coir brush and compressed air. Thorough examination and repairs of upholstery, cushions, curtains, etc. Thorough examination and attention of all Doors and window shutters, for safety catches, safety latches, staples and hasps for ease of operation. Thorough

checking and repairs of UIC vestibules, their rubber flanges metal frames, doors, fall plate, locking gear, etc., for ease of operation and safety. Thorough checking and attention to all cracks and worn out portions of flooring in the compartments. Engineer (C&W) of Primary Coaching Maintenance Depots should be fully familiar with the vulnerable areas of ICF coaches for corrosion, viz., sole bar at doorways, lavatories and its adjoining areas, corridor portion etc., special concentration shall be given to SLRs which are more prone for corrosion as it is used in transportation of Fish, Salt, etc. For facilitating inspection of sole bars even spaced elongated holes of (215x127 mm) are already provided in the turn under.

Special attention should be given for the following:

Pocket between sole bars and turn under should be thoroughly cleaned through the inspection opening of the sole bars and inspected with the help of torch light or inspection lamps. Drain holes provided in the trough floors should be kept clean and unclogged. During the cleaning of these drain holes any accumulation of water is noticed, the affected area should be very carefully inspected for possible corrosion.

Air brake system maintenance:

Check brake cylinder for loose rocker arm plate on Bogie mounted Brake Cylinder and change if found defective. Brake cylinder should be checked for smooth functioning and prescribed stroke. Defective brake cylinders shall be sent for repairs. Guard's van valve should be tested for operation. Test BP & FP air pressure gauges with master gauge and replace if found defective (all the gauges to be calibrated once in 6 months). A set of two master gauges should be kept for this purpose at every Primary

Maintenance Depot and each master gauge should be sent one after the other to the workshops for testing, repairs and calibration. Thoroughly clean filter of Dirt collector in kerosene or replace on condition basis. Check working of PEASD & PEAV by hearing the hissing sound of exhaust air. After resetting with the help of key the exhaust of air should stop. Replace the defective PEASD/PEAV. Conduct Single car test of the coach with Single car test rig and record the parameters in the prescribed pro-forma. The date of intermediate lifting should then be stencilled at the appropriate place in schedule chart on the end panel

Note: Intermediate Overhauling of Shatabdi / Rajdhani Exp. Coaches are to be attended in nominated workshops only.

Intermediate overhauling of newly built coaches are to be attended after 12 months in the depot duly replacing the wheels with repaired/UT tested wheels from work shop

Lifting of the Body from the bogie:

The coach body shall be lifted by using;

- a) 4 no. of Mechanical Jacks (capacity of 25 T each) OR
- b) 4 no. of Hydraulic jacks (capacity of 20 Ton each) OR
- c) 2 no. of Electrical Operated Travelling Crane (capacity of 20 T/25 T each) OR
- d) 4 no. of Whiting jacks (capacity of 20/25 T each)

Other Tools required:-

Trestles, Complete set of Spanners, Complete set of Gas cutting & welding equipment, Different types of hammers, Wooden Wedges & Packing and Tool kit

Items to be disconnected before lifting of the body:

- Remove of centre pivot cotter [If lifting is being done by E.O.T cranes or whiting jacks]. Unscrew and remove centre pivot studs [If lifting is being done by mechanical/hydraulic jacks], unscrew air vent screw of dash pot. Disconnect Dynamo belt, S.A.B pull rod, lateral shock absorber if connected, axle box safety loops etc.
- Remove commode chute and dummy carrier if it is infringing, foot board if required.
- Insert required thickness of wooden packing between upper portion of bolster & Bogie frame.

Following are the causes of low buffer height in ICF coaches;

- Wear of wheel. Loss in stiffness of coil springs provided in primary and secondary suspension. Wear in Bronze wearing piece and wear plate of side bearer. Wear on link brackets, stone & pin provided on secondary suspension arrangement.
- Procedure for buffer height adjustment in ICF coaches:
- To achieve required buffer height standard size of wooden packing pieces are used which are provided below the coil springs of primary suspension as given under.

New Wheel dia :- 915 mm

Condemning: - Solid Wheel: 825 mm.

RPC-4 Revision-Jan 2007 (No. 95/M/C/141/1)

Sub: - Revised maintenance pattern of coaching train- running up to 3500 km in round trip with terminal attention at the other ends.

Sl. No	Category of train	Preventive maintenance at pit line	Under gear/ Brake System maintenance at pit	Internal cleaning , passenger amenity fittings and watering	External cleaning nominated line with proper facilities	En route/terminating	Brake system check prior to start at platform/ at other end
1	Mail/Exp. One way run > 3500 km	At primary end	At both the ends	At both the ends	At both the ends	En route after every 250-350 km location to be decided by Rly for each train. Termini	Complete air brake testing with fresh BPC

						nating exami nation at termin ating station .	
2	Mail Exp one way run <3500 km but round trip run >3500 km	---do---	---do---	---do---	At both the ends	---do-- --	--- do--- -
3 a	Mail Exp round trip run up to 3500 km	---do---	Only at primary end	---do---	---do---	---do-- --	Only conti nuity chec k if stabl ed at platf orm for 2 hrs, other wise

							brake power check with endorsement on BPC engine
3b	Inter connected Mail Exp round trip run up to 3500 km	---do----	To be done after 3500 km or 96 hrs after issue of original BPC whichever is earlier at primary end	At primary end & each terminal	---do----	---do-- --	---do--- -
4	Passenger trains with toilet including	---do----	---do----	At primary end	---do----	---do-- --	---do--- -

	interconnected passenger shuttles						
5	Passenger trains without toilet	---do---	To be done after 3500 km or 7 days, after issue of original BPC whichever is earlier only at primary end	---do---	---do---	Once a day at primary end or at nominated terminal	---do---

Note: - Internal cleaning, passenger amenity attention and watering may be done at platform line or nominated stabling line provided stipulated facilities are available at such line, in case the rake is stabled in yard for more than 6 hrs, positive safety arrangements should be made for the rake and in case the security is considered inadequate, the rake should be taken to pit line for attention to under gear as given under column (4) above.

Difference between IOH, POH & NPOH

S N	IOH	POH	NPOH
1.	Intermediate Overhauling.	Periodic Overhauling.	Non Periodic Overhauling.
2.	Once in 9 months (for new built coaches after 12 months)	Once in 18 months (24 months for newly built coaches)	Time Period is not fixed for any vehicle for NPOH
3.	IOH of coach can be carried out in sick line where facility to lift the coach is available.	POH is carried out only in workshops.	NPOH is carried out in workshop.
4.	During IOH all the parts of under gear are thoroughly examined and replaced if necessary. For Mail/Exp coaches, Bogie is replaced as unit and the old is sent to workshop for repair and return.	At the time of POH all parts of under gear are dismantled and should be replaced if there is any wear and tear.	At the time of NPOH all parts of under gear are dismantled and should be replaced if there is any wear and tear.
5.	At the time of IOH painting of complete coach is not necessary, only required places are touched up.	Painting of whole coach is necessary.	Generally painting of coach is done completely

FACILITIES REQUIRED FOR MAINTENANCE OF 24 COACH TRAINS

(Railway Bd.'s letter no. 98/M(C)/137/19 Pt. I dt. 28.7.99 & dt. 05.05.2000)

Infra structural Requirements:

24 coach length fully equipped pit line. High pressure jet cleaning pipeline with plant for cleaning in pit line at primary depot. Mechanized external cleaning is preferable. Water hydrants for 24 coach length at en-route watering stations with 20 minutes stoppage at nominated stations. Availability of the prescribed air brake maintenance and testing equipment.

Coach Design related Requirements:

Air brake with twin pipe graduated release system

Only enhanced capacity draw gear and screw coupling to RDSO sketch No. 79061 and 79067 are to be provided on the rake.

Maintenance Practices and system related requirements:

The integrity of the rakes to be maintained. Primary maintenance of the rake should be done in one hook without splitting. Minimum 6 hours' time to be given in the pit for primary maintenance. Leakage rate in air brake system to be maintained within prescribed limits by using rake test rig. Provision of proportionate brake system on the locomotive in good working order. Provision of audio visual alarm system on the locomotive.

In case of double-headed diesel locos maximum traction motor current will be restricted to 650 Amperes and in case of double headed WAP1/WAP3 electric locos, the traction motor

current limit will be 750 Amperes as prescribed in RDSO 's instructions for operation of main line air brake trains - C-9408.

Operational requirements:

Communication between driver and guard should be provided through suitable means. Ensure no gap between coach buffers after tightening the coupler. No additional coach attachment beyond 24 coaches will be permissible.

Note: As per Railway Board Instruction now one occupied saloon & one parcel van can be attached with 24 coaches rake.

2.6 EXAMINATION OF TRAINS

Ref: IRCA Rule Book Part – IV (Ch. 3)

➤ Rolling In Examination:

There are certain types of defects in rolling stock which can only be detected during the motion of train. To detect such type of defects, rolling in examination is adopted. This examination is carried out on all pass through trains and terminating trains. To carry out Rolling in examination, C & W staff and supervisor will take position on both sides of platform / line in which train is being received.

During examination following defects are detected:

- Unusual sound due to flat faces on tyre of wheel in any vehicle of train.
- Whistling sound from bearing, if unattended that can lead to hot box.

- Hanging part or loose fitting on the vehicle.
- Any Spring broken. Brake binding on any vehicle. Any component of spring suspension like bracket loose/broken etc.
- Any abnormal behaviour of vehicle during run.
- Any other defects which can affect the safety of the train.

➤ **Rolling Out Examination:**

The procedure of conducting Rolling out examination is similar to rolling in examination. Supervisor and staff will take position for conducting examination ahead of engine and ensure that the brakes of all vehicles are in released condition and any other defect that can be noticed like in Rolling in examination and could have leftover during the previous examination and can hamper the safety of the train.

Sr.DME/ DME in charge shall nominate the location for carrying out Rolling in/Rolling out examination after personal inspection of site.

While nominating the site following should be kept in view:

- Site shall provide unobstructed view of under gear from both sides.
- Speed of the train shall not be more than 30 Kmph. The track should not have any rail joints at the location, It should cover the entire length of train.
- Should have adequate space for arrangement of shelter for staff.
- It should be ensure that proper lighting arrangement is provided on both the sides of the track at nominated spots

for examination of under gear parts during night. Focusing of lights shall be done by keeping a coach on the line and adjusting the angle of light to illuminate under gear and bogie.

➤ **Examination of originating trains:**

All trains must be examined by the mechanical train examining staff before dispatch to ensure that all coaches in the train are fit to run, without rejectable defects (for rejectable defects, please refer to IRCA Conference Rules, Part IV). Station Master (SM) shall handover part B & C of check memo (T431) to Senior Section Engineer (C&W) after placement of the formation in pit line for Examination, cleaning and watering. After carrying out all necessary examination and work, SSE (C&W) shall communicate fitness of the train to Station Master by giving part C of T431 duly getting acknowledgement in part B. The Station Master shall not dispatch the train unless the fitness certificate is received from SSE (C&W).

The level of the air pressure/vacuum on the train engine and the brake van gauges as well as the percentage of operative cylinders should be recorded on Brake Power Certificate and signed by Junior Engineer/C&W, Driver and the Guard of the train. Trains which have been attended on pit line should have 100% brake power and no train shall be allowed with an inoperative/defective Brake cylinder on any coach after pit attention. Trains which are attended on platform or where secondary examination has been dispensed with or en-route should have minimum 90% brake power.

➤ **En route/Terminating Examination of Passenger Trains:**

Rolling in examination of the train has to be conducted for the terminating trains. After train comes to halt, it should be ensured that the train is protected from both the sides (with the stop board/red flag during day time and red lamp during night time) before commencing the examination of the train. It should be ensured that a suitable indication board is placed at conspicuous location visible to the driver indicating that C&W staff is at work. Temperature of the axle boxes should be checked & recorded preferably with the help of the Non contact infrared thermometer. Brakes of the coaches to be released manually and ensure complete release by physically moving the brake beam. Other under gear parts should be examined visually to ensure that the train is safe to run further. Repairs if required should be carried out on pass through trains by taking shortest required time to avoid detention to train to the extent possible. Lavatories of the coaches should be properly cleaned using High pressure water jet machine provided at nominated stations during halt of the train. Any complaint from passengers should be attended promptly to the satisfaction of the passenger. After attending to any required repairs only stop board/red flag should be removed. C&W control should be informed about any out of course work done. C&W control shall repeat the out of course work done to the Primary Maintenance (PM) depot after corrective action. At the train examination stations where locomotives are changed on through trains, the level of air pressure/vacuum created on the locomotive and brake van gauges should be recorded on the BPC. The inoperative/blanked cylinders, if any, should also be written in the certificate for their information. This certification should be an endorsement on the

original brake power certificate; no fresh brake power certificate needs to be issued.

➤ **Pit Examination of Passenger Trains:**

- **Related to safety:**

Protect the Examination line. Thorough examination and repair of under frame, Bogie, Brake gear, Draw & buffing gear. Test and repair of Vacuum / Air brake system for Brake power including test/repair of Passenger alarm system. Lubricate all moving and rubbing parts. Give preventive maintenance schedule attention for the coaches except IOH.

- **Related to amenities:**

Dry sweeping, Cleaning, Swabbing, Watering, Pipe fitting work, Trimming work, Carpentry work, Padlocking, Painting.

2.7 WASHING AND CLEANING OF COACHES:

Wherever washable aprons are available on the platforms, the time available before the terminating trains are pulled out from platform and backed to the pit line/yard, should be utilized for inside sweeping and toilet cleaning.

➤ **External Cleaning / Washing**

- Place the rake/coaches on the washing pit provided with equipments required for washing and cleaning. It should be ensured that the rake/coach is protected with proper board/signal for safety of the staff working and to prevent

movement/disturbance in the activity. Scotch blocks with locking arrangement should be used to protect lines and keys should be kept with SSE(C&W) till the time rake is under maintenance.

- Before starting washing and cleaning of side wall, ensure that the glass shutters and louver shutters of that side are lowered. Remove dirt/dust accumulated on shutters by compressed air or duster.
- Remove old reservation charts/labels on the body panels. Splash water on old charts so that they are wet and can be easily removed. Care should be taken to avoid any damage to the paint.
- The cleaning solution should be spread/rubbed with nylon brush or sponge brushes and then rubbed thoroughly to clean the panels. Extra attention should be given to oily and badly stained surfaces. Use recommended solutions for cleaning as per RDSO specification No. M&C/PCN/101/2001 or use cleaning agents approved by CME of the Railway.
- Destination boards may be removed and cleaned with brush/duster.
- Clean the external surface by high pressure jet where facilities are available.
- All exterior panels including end panels should be hosed with water and brushed with diluted soft soap (detergent solution). The strength of the solution may be increased or decreased according to RDSO specification M&C/PCN/101/ 2001.

➤ **Cleaning of Toilet:**

- Before starting cleaning of toilets ensure that all repairs in the toilets have been carried out and after cleaning no employee should enter in the toilet.
- Doors and walls should be cleaned with water sprayed by high pressure jet up to waist level. Apply specified solution and rub thoroughly with sponge brush/ nylon bristle brush.
- Indian style lavatory pans have to be cleaned by thorough rubbing with concentrated solution of recommended cleaning agent. Western style commode shall be cleaned similarly, however due care should be taken that the cleaning solution does not fall on commode lid which may damage/spoil it.
- The flooring should be rubbed with nylon bristles/sponge brush and cleaned with recommended cleaning agent. The drain holes should be cleaned thoroughly for easy discharge of water.
- The mirrors in toilet should be cleaned with light wet cloth. Recommended solution should be used for cleaning the dirty portion of glasses.
- After all the washing and cleaning in the toilets mentioned above, the toilets should be thoroughly cleaned with water jet and water should be flushed out. All fittings and floor should be wiped dry with a cloth. After cleaning, spray deodorant in the toilet to remove the bad odour.

➤ **Internal cleaning of upper class AC and sleeper coaches:**

- Empty the magazine bag and waste from dust bin. Sweep the whole coach with broom in sleeper coaches. Clean the floor of AC coaches with vacuum cleaner.
- Remove dust from floor, berths/seat, and magazine nylon wire mesh bag fitted on panels and fan guards with duster. Use of vacuum cleaner is recommended in such areas.
- Also remove dust/dirt from under the berths, window sill, and sliding door, railing corner and all corner & crevices of coach interior with vacuum cleaner if provided. Ceiling panels, wall panels, cushion berths, fittings, table top, etc. should be cleaned with duster and stain marks on these should be removed by use of recommended soft detergent.
- Aluminium frames, strips, and other metal fittings, etc. should be cleaned with recommended cleaning agent. FRP window frames, louvers, etc. should be cleaned with recommended solution and rubbed out by nylon brush or sponge /duster to remove stain marks. Alarm chain handle and its holding bracket should be washed and cleaned. The PVC flooring should be rubbed with nylon bristles/sponge brush and cleaned with recommended cleaning agent.
- In AC coaches, the amenity fittings and toilet fittings such as coat hanger, stools, arm rest, foot rest, towel hanger, etc. should be cleaned with duster. Stains on these items should be removed with recommended detergent solution.

- The compartment carpet should be cleaned with vacuum cleaner. Every month, the carpet should be cleaned thoroughly by taking it out from compartment and if necessary they should be dry cleaned in every three to four months. Before re-laying the carpet, the compartment floor should be thoroughly cleaned. Spray recommended air freshener in the coach. No employee should be allowed to enter the coach for any purpose/work after complete cleaning
- Curtains in the AC Coaches and Tourist Cars should be removed for periodical washing and cleaning. Faded and damaged curtains should be replaced on condition basis. Precaution should be taken to prevent nuisance of cockroaches in AC coaches and pantry cars by periodical disinfestations.
- No repair works on Electrical train light/fan/AC) or Mechanical account should be left to be carried out after washing and cleaning of the coach.

➤ **Internal Cleaning of GS, SLR:**

- Cleaning of GS, guard and passenger compartments of SLR should be done as mentioned above in sleeper coaches.
- Interior surfaces of parcel and luggage vans should be cleaned thoroughly with recommended detergent and water, and the water should be completely flushed out and make the compartment dry without any moisture.

➤ **Cleaning of buffers and screw couplings:**

- Buffer plungers should be scrubbed with a scraper to remove dirt and muck. Thereafter, they should be wiped clean and lubricated with oil.
- Screw coupling threads should be cleaned with wire brush to remove all dirt and dust. Thereafter, it should be cleaned and given a light coat of oil.

2.8 EXAMINATION OF BOGIES:

Depot maintenance staff should ensure the following things in respect of proper functioning and safety of Bogie & Bogie components.

➤ **Bogie Frame:**

- During every trip, and Schedule A & B, Examine visually condition of bogie side frame, transom, longitudinal etc especially at all welded locations. Examine rubber stopper and crown bolt of axle box, Axle box & Bolster safety strap for damage/ missing/ loose. Examine Brake hanger brackets for damages. Examine the brackets for safety wire rope of brake beam. Examine visually BSS hanger brackets, Anchor link brackets. Visually examine centre pivot mounting bolts, centre pivot cover and attend if needed. Side bearer oil to be replenished in A & B schedules, if needed.
- During IOH at depot, further to attending all the above items, Examine condition of wearing piece and wearing plate, oil level in side bearer oil baths and replenish if oil

level has gone down below the level of last thread of oil filling cup.

➤ **Primary Suspension:**

- Every trip visually examines axle box springs for breakage, dash pot oil filling special screw for deficiency. Check oil leakage in dash pot through defective seals/vent screws. Visually examine axle box clearance
- During Schedule A & B, examine all items as above. Add specified grade of oil in dash pot. Visually examine and adjust axle box clearance.
- During IOH at depot, further to attending to all the above items, examine the axle guide assembly by lifting the coach and give any attention if necessary. Check axle box clearance with gauge and adjust.

➤ **Secondary Suspension:**

- During every trip, and Schedule A & B, visually examine bolster springs for breakages or any other defects. Visually examine Bolster lower spring beam, BSS hangers, hanger blocks, BSS pins. Check bolster clearance between top of bolster and bottom of bogie frame. Visually examine equalising stay rods and pins (small and big) and brackets. Check and attend safety loops of Equalising stay rod. Visually check anchor links, and its securing bolts and attend if needed. Examine safety loops of bolster, vertical shock absorbers for damages and attend if required.

- During IOH at depot, dismantle Secondary suspension and measure the dimensions of spring, BSS hangers, Hanger pins, Hanger blocks and the hole in the bracket. Remove the equalising stay, measure the pins/bushes for any wear and re-grease the pins. After assembling maintain the Bogie 'B' dimension as prescribed.

➤ **Brake Rigging:**

- Every trip, check brake gear and adjust so that the piston stroke is within the limit. Examine brake beams for breakages/damages. Check and attend brake beam safety wire ropes/safety straps. Check and attend brake shoe head and key & replace if necessary.
- Check and replace worn brake blocks. Visually inspect and replace brake hangers, brake gear pins and cotters/split pins if necessary. Visually inspect and replace damaged/missing brake gear bushes.
- During Schedule A & B, further to examination of the above, check and attend brake block adjuster. Examine and attend brake levers, floating lever suspension brackets
- During IOH at depot, examine all items as above. Examine and replace all brake gear components found deficient and worn out

➤ **Draw Gear:**

- Every trip, Schedule A & B, check and replace damage/missing split pins/cotters/rivets. Examine draw

hook, draw bars and rubber pads for damages. Check condition of the screw coupling and its components and replace if required. Check condition of draw beam and locating pins on it. Examine visually draft key locking pins.

- During IOH at depot, examine all items as above, Ensure that wear on screw coupling shackle pins, trunnion pins, shackle/link holes and draw hook holes should not exceed 3 mm. Ensure that wear at any section on draw hook should not exceed 10 mm.

➤ **Buffing gear:**

- Every trip, Schedule A & B, visually examine Buffer plunger for drooping, crack/wear and stroke length. Examine Buffer casing for crack and its securing arrangement.
- During IOH at depot, dismantle the buffer assembly, and check for perished pads, destruction tube, worn out Buffer face/spindle etc and attend/replace where ever necessary. Buffer alignment with head-stock should be true. Buffer projection should not be less than 600 mm and not more than 635 mm.

➤ **Wheel and axle:**

- Every trip, Schedule A & B, examine visually axle box for grease oozing and warm box and any damages/loose covers. Visually examine the profile of the tyre and check

with tyre defect gauge if appears nearing condemning limit.

- During IOH at depot, check the wheel distant gauge for loose/tight wheel. Examine axle pulleys on the wheels
- In addition to normal checks, wheels to be checked for defects as per CMI – K 003.

➤ **Roller Bearing & Axle Boxes:**

- A coach should invariably be detached from service for the following defects
- Hot axle box, damaged axle box, damaged front or rear cover, Seized roller bearing, Coach involved in accident, derailment, fire, flood etc.
- Care should be taken not to keep a coach fitted with roller bearing stationary for a long time. Coaches stabled for a long time should be shunted up and down at regular intervals.
- Coaches fitted with roller bearing should be ensured that:
- No wash basin drain hole / discharge pipe is directly above the axle box. The front and rear covers of the axle boxes are not damaged, cracked or loose. Clearance between axle box and wheel is such that the axle box does not rub against the wheel. Brake gear is properly adjusted to avoid possibility of brake binding.

2.9 SAFETY & AMENITY FITTINGS

The fittings which are fitted in the coach for safety of passengers & their luggage are called as “Safety Fittings“. The fittings which are provided inside the coach for comfort, Luxury and also for non-strenuous journey of the passengers are called as “Amenity Fittings“.

- Following are some of the Safety fittings provided in the coaches:

Alarm pull chain, Internal latches on top & bottom on body side doors, Provision of pad locking arrangement from outside of body side door, Internal latch and tower bolt for compartment doors in first class, Vestibule doors/shutters with locking arrangement, Latches for window shutters, Fire extinguishers, Safety bars on all window openings, Window shutters both glass and louver, Sealed window glass for AC coaches, Frosted glass shutters for toilets.

- Following are some of the Amenity fittings provided in the coaches:

Lights and fans inside the coach, Reading light with switches for upper class coaches, Charging socket out let in upper class coaches & sleeper coaches, Cushioned berths and seats & back rest, Luggage racks, Folding or fixed tables, Roof ventilators, Tumbler holder, Dust bin, Footsteps in sleeper coaches and foot rest for chair cars, Notices, Mirror with shelf, Coat hook, Magazine pouch, Bottle holder, Wash basin, Wardrobe with fixed hangers for 1st AC, Rings below berths for securing luggage, Shower bath, towel rail, flushing commode & pan, coat hook, liquid soap container, push cocks, hand rail, mirror with shelf, soap dish etc. in

lavatories, Destination boards, Reservation display plates, Coach indication boards.

Compartment:-

Amenity Fittings Class	AC Sleeper Coach Coach	1st Class Coach Coach	2nd
Folding or Fixed Table	Y N	Y Y	
Tumbler Holder	Y N	Y N	
Waste Paper Basket	Y N	N N	
Mirror with Shelf below	Y N	Y Y	
Coat Hook	Y Y	Y Y	
Foot rest for	Y N	Y Y	
Upper Birth riding			
Fans	Y Y	Y Y	
Upper Birth	Y N	Y Y	

Luggage Racks	Y	Y
	Y	Y
Light in Compartment	Y	Y
	Y	Y

Furnishing Fittings:-

Shower Bath	Y	Y
	N	N
Wash Basin	Y	Y
	Y	Y
Towel Rail	Y	Y
	N	N
Push Cock & Lota Shelf	Y	Y
	Y	Y
Commode Rail	Y	Y
	Y	Y
Mirror & Shelf	Y	Y
	Y	Y
Bottle Opener	Y	N
	N	N
Liquid Soap Container	Y	N
	N	N

Safety Fittings: - Class	AC Sleeper Coach Coach	1st Class Coach Coach	2nd
Luggage locking wire	Y Y	Y N	
Alarm Chain	Y Y	Y Y	
Upper Birth Safety Rail	Y N	Y N	
Doors latch & catch	Y Y	Y Y	
Doors	Y Y	Y Y	
Window Shutters	Y Y	Y Y	
Fire Extinguisher	Y N	N N	
Commode Rail	Y Y	Y Y	
Vestibule Safety brackets	Y Y	Y N	
Window Safety Bars	N Y	Y Y	

2.10 NMG COACHES

The coaches with age of 20 – 21 years or later are being converted during POH for the purpose to carry Automobile (Express). These coaches are known as NMG coaches and the rakes formed with these coaches are called NMG rakes.

Following are the features:

- Load carrying capacity is 12 ton maximum.
- Speed 75 kmph & 100 kmph Max.
- The life of such converted coach is 30 years from the date of original manufacture.
- Wider end opening of 2800 mm × 2200 mm.
- Improved adjustable internal locking and lashing arrangement to avoid damage to the vehicle during transit.
- The periodicity of POH is 24 months.

Maintenance Pattern for NMG rakes

(As per Rly. Bd's Letter No. 91/M (C)/650/1 dated 29.5.2000)

In order to optimize utilization of NMG rakes it has been decided to introduce the following maintenance pattern:

NMG rakes may be run on goods pattern with intensive examination at both the ends, following other conditions for en-route detention in case at stabling at road side stations. In case of close circuit runs up to 3500 km, the rake may be run on round trip basis. Close circuit rake must be clearly identified and should have a nominated base depot where adequate trained staff and spares should be available. Each NMG coach should be marked with the nominated POH workshop and return date. The maintenance

schedules of the NMG coaches will continue to be on the coaching pattern to be carried out by the base depot. Using these coaches as parcel vans for running on piecemeal basis on passenger carrying trains is strictly prohibited. Each coach should be stencilled at a suitable place on its end panel, the code of the base depot and a schedule chart. The date and station code of the depot where a particular schedule is carried out should be stencilled at the appropriate place in the schedule chart immediately when the schedule is completed.

IOH/POH periodicity of ICF coaches:

(Rly Bd letter No.2007/M(C)/141/1 Dated: 26.09.2008 & 06.08.2009)

D.O.No.2007/M/(C)/141/1 dated: 12.02.2009 by MM to all CMEs

Coach category	Periodicity (months)		
	IOH (in depot)	IOH (in workshop)	POH
New coach turned out by PU or a coach turned out after MLR	12#	-	24
Rajadhani/Shatabdi	-	9	18
Mail/Express, Garibrath, Janshabdi and OCVs forming part of standard rake composition of Mail/Express trains	9^	-	18
Passenger	9@	-	18
Other OCVs	12@	-	24

Note: The concept of C schedule in the depots, hitherto being followed on the Railway, maybe done away with and replaced by an IOH as under.

The bogies must be rolled out and IOH schedule carried out on the bogies in the coaching depot itself with mandatory replacement of overhauled wheel sets supplied by the workshops. The attended bogies must then be provided in the same coach. The IOH schedule is applicable to all new ICF design coaches irrespective of the train category being serviced by them.

Unit exchange of overhauled bogies supplied by the workshops must be ensured.

The Bogies must be rolled out and the IOH schedule carried out on the bogies in the depot itself retaining the wheel sets, unless specific attention or change is warranted on the wheel sets. The attended bogies must then be provided in the same coach.

MAXIMUM ALLOWABLE INEFFECTIVE PERCENTAGE

Authority: Railway Board Letter No: 86-M/(N)/951/7 of 26.6.87

Sl. No	Description	Non-AC (Ineffective %)	AC (Ineffective %)
1	In Workshop for POH	6.0	9.0
2	In workshop for nominated repairs	0.5	-
3	Stabled in yards awaiting workshop repairs	1.0	-
4	C&W depots for repairs to Mechanical & Electrical equipment	2.5	3.0
	Total:	10	12

Average life of coaches

Sl. No	Types of Coaches	Average life in years
1	Steel bodied coaches	25
2	IRS coaches	30
3	Light utilization categories of coaches (Except restaurant/pantry car for which life is 25 years)	40

Following are the few items that Workshop shall ensure during POH:

- The lowest permissible wheel diameter for a coach turned out after POH shall not be less than 837 mm.
- If the buffer height requires adjustment, the load on the axle box springs should be released and the packing rings in halves shall be inserted below the axle box springs. The total height of primary springs and compensating rings should not exceed 295 mm. There should be a minimum clearance of 40 mm between the axle box wing lugs and their safety straps.
- The clearance between the axle box crown and the bogie frame should thereafter be adjusted as per the table given below:

Type of coach	Crown clearance in mm
SCN, VPH, WCB, WFC	45 +0/-3
WFAC, WSCZAC, WCBAC, WLRRM, WFCZAC, WACCW	36 +0/-3
SLR, GS	48 +/- 3
WACCN	34 +/- 3
WGSCZAC, WGFAC, WGACCW, WGFACCW, WGACCN	26 +/- 3

The Bogies shall be trammelled for squareness as per the following;

Suggested BSS bracket and axle guide alignment gauges	13t bogies	16.25t bogies
Longitudinal gauge for BSS brackets	1400±1.0 mm (700±0.5 mm from longitudinal center-line)	1500±1.0 mm (750±0.5 mm from longitudinal center-line)
Transverse gauge for BSS brackets	2159 ±1.0 mm	2159 ± 1.0 mm
Diagonal gauge for BSS brackets	2573 ±1.0 mm	2629 ± 1.0 mm
Longitudinal gauge for axle guide	570±1.0 mm (equidistant from center-line of axle)	570 ± 1.0 mm (equidistant from center-line of axle)
Transverse gauge for axle guide	2159±1.0 mm	2159±1.0 mm

Diagonal gauge for axle guide	3612±1.0 mm	3612±1.0 mm
Distance between BSS bracket and adjacent axle guide	463±1.0 mm	413±1.0 mm
Longitudinal gauge for suspension strap	870±1.0 mm (equidistant from center-line of axle)	870±1.0mm (equidistant from center-line of the axle)

Tolerances for Bogie components

Part name	Wear location
Brake hanger bracket bush	32 H7 Hole +0.025/-0.00
Brake hanger bracket	35 gap
Brake hanger bracket	C.D.1752 +1.0
Axle guide	115g6 -0.034/+0.00 diameter
Axle guide	120 diameter
BSS bracket bush	38 dia. Hole
Pin for BSS	37 diameter
Bracket for anchor link	25+0.021/-0.0 slot
Brake lever hanger bracket	32 dia hole
Anchor link silent block pin	25 mm -0.012/-0.052, thick ends
Anchor link silent block	Outer dia. 90.5 +0.05/+0.025
Anchor link housing	Hole dia 90.5 +0.015/ -0.03
BSS hanger	distance between horizontal wearing arms 384

BSS hanger	thickness of vertical arm 25.5
BSS hanger	horizontal wearing surface 42
Hanger block	Thickness - 9.5
Hanger block	slot 29 ($^{+0.4}/_{-0.2}$)
BSS pin thickness across flat	29 ($^{+0}/_{-0.1}$)
Lower spring seat	Inner dia 140 H7 (+0.04/-0.0)
Guide bush	Outer dia. 140 A9 (-0.3/-0.6)
Guide bush	Inner dia 115 (+0.15/-0)
Guide Ring	Inner dia 115 H7 (+0.04/-0)

There shall not be any leakage of oil from the side bearer. Hard ground plate in side bearer, should not be worn more than 1.0mm in thickness or ridges formed on the plate. Bronze wearing piece for side bearer, should not have worn more than 1.5 mm in thickness. Sharp edges on wearing piece should be rounded off before re-use. Dust seal cover shall sit effectively all around without any gap on the oil-bath and the sleeves slide freely on the guide to ward off dust and moisture coming in contact with the oil. The oil filling plugs should be well secured by chain to prevent it from dropping.

Equalising stay pins should not be worn more than 1 mm in dia (31 mm standard), all the bushes and washers to be replaced. Maximum dimensional clearance between the pins and bushes of brake gear should be within 1.5 mm. springs shall be subjected to load test and grouped as per the following tables.

Drawing code of springs for ICF BG coaches

Type of spring	Type of Bogies	ICF Drg No.	Code
Axle Box	All Non AC	F-0-1-006	A 01
	All AC	WTAC -0-1-202	A 03
	Power car	WLRRM 2-0-1-202	A 04
	Double Decker	DD-0-1-001	A 06
	High capacity power car	WLRRM 8-0-1-802	A 09
	High capacity parcel van	RDSO/SK-98017	A 10
Bolster	All Non AC	F-0-5-002	B 01
	All AC	WTAC -0-5-202	B 03
	Power car	WLRRM 2-0-5-202	B 04
	Double Decker	DD 0-5-003	B 06
	High capacity power car	WLRRM 8-0-5-802	B11
			B 13
	High capacity parcel van	RDSO/SK-98018	B15
B 16			

Code	Wire dia	Free height	Test Load	Acceptable height under test load	Groups as per loaded spring height		
					A	B	C
					Yellow	Oxford Blue*	Green

A01	33.5	360	2000	279-295	279-284	285-289	290-295
A03	33.5	375	2800	264-282	264-269	270-275	276-282
A04	35	372	3000	265-282	265-270	271-276	277-282
A06	36	337	2400	269-284	269-273	274-279	280-284
A09	37	360	3000	277-293	277-282	283-288	289-293
A10	39	315	1800	276-289	276-279	280-284	285-289
B01	42	385	3300	301-317	301-305	306-311	312-317
B03	42	400	4800	291-308	291-296	297-303	304-308
B04	47	400	6100	286-304	286-291	292-297	298-304
B06	36	416	4200	280-299	280-286	287-292	293-299
B11	47	*386	6700	306-322	306-311	312-317	318-322
B13	34						
B15	40	393**	6000	256-272	256-261	262-267	268-272
B16	32.5	286**					

* Combined load deflection test is done

** As per RDSO letter No. MC/MV dtd: 21.11.2001

The maximum diametrical clearance between the lower spring seat and guide bush should not exceed 1.6 mm. The bogie should sit evenly on the four axle boxes. The assembled bogie should be tested for normal working load and the bogie frame height should be 686 ± 5 mm. Safety straps of the axle box wing lugs and bogie bolster should be adjusted so as to ensure a minimum clearance of 40 mm between the lugs and bottom of safety straps.

After placing the wearing plate and wearing piece in side bearer oil-bath, each side bearer oil-bath should be filled with 2 litres of any of the following approved brands of oils.

Servoline – 100 of IOC

Yantrol – 100 of HPC

Bharat univol – 100 of BPC

Apply graphite grease on Centre pivot pin

Shock absorbers should be given a schedule overhaul, when their capacities vary beyond $\pm 20\%$ of their specified values, or after 4 lakh kilometers or alternate POH, whichever is earlier. The shock absorber is tested on the special purpose machine which can measure its capacity in both tension and compression by developing the resisting force at a velocity of 10 cm/sec.

Variation in diameter of wheel should be within tolerance as given below;

- On the same axle 0.5 mm
- On the same bogie 5 mm
- On the same coach 13 mm

Draw hooks and screw coupling (Stc. 60-61) should be tested at 60t and those of IS:5517 Gr. 35Mn6Mo3 should be tested at 75 t respectively. There should be no permanent set after release of load. The draw bar should not have dimensional distortions and damaged threads. The draft key should not be bent or worn out. All the draw bar and hook should have been tested by magna-flux for surface cracks. Draw bar (Stc. 60.61) should have been load tested at 39.5 t and those of (IS 5517 Gr. 35Mn6Mo3) at 60t. There should not be any permanent deformation. The draft pads which are bulged, perished or having set to a length below 186 mm should be changed during POH (New Rubber draft pad pack to STR No.C- 9501 (Rev.2) free height along with parting plates is 208 mm and 196 mm pre compressed length is achieved after tightening the castle nut).The pads should be changed invariably as a set every alternate POH, and all the in a draw bar assembly should be from a single supplier. Draft Yoke should be free from welding cracks distortions.

The wear on the following locations shall be within the limits given below;

Location of wear	Wear limit	Suggested no go gauge
Draw Hook		
Root of hook near point of contact with bent link	13 mm	Profile gauge with 15 mm adjustable projection
62 mm dia pin hole	3 mm	65 mm flat
Bottom side of shank 56 mm height	15 mm	41 mm snap
Draft key slot(159 mm) in hook	13 mm	173 mm flat
38 mm width of key slot in hook	2 mm	40 mm flat
Hook opening 48 mm	5 mm	46 mm go 53 mm no go plug
Draw Bar		
155mm draft key slot in draw bar	9 mm	164 mm snap
39 mm shank body	3 mm	36 mm snap
Slot width 38 mm	2 mm	40 mm flat
Threads M39x3	1 mm	Thread profile
Draft Key		
Draw bar seating 139 mm	4 mm	Profile gauge with 5 mm adjustable projection
Draw hook seating 139 mm	4 mm	Profile gauge with 5 mm adjustable projection
Thickness 36 mm	4 mm	32 mm snap

Cotter hole 14 mm dia	2 mm	16 mm plug
Draft Yoke Assembly		
Draft yoke hole (45mm)	3 mm	
Draw gear pin dia (31 mm)	1 mm	
Bush (32 mm)	1 mm	
Draw hook beam wear plate	6 mm	snap gauge 12 mm thick
Locating pins 25 mm dia	6 mm	19 mm snap
Screw coupling		
Straight link 61 mm dia hole	2 mm	63 mm flat
Straight link 47 mm dia hole	2 mm	49 mm flat
Bent link 42 mm dia stem	3mm	39 mm snap
Bent link 47 mm dia hole	2 mm	49 mm flat
Bent link 78 mm 'U' gap	3 mm on each arm	77 mm to go 85 mm no go gauge
Pin on draw hook 60 mm dia	2mm	58 mm flat
Screw 55 x 6.35 mm k/thread	1 mm	K thread profile gauge
Trunnion LH/RH Knuckle Thread 55.635x6.35 K/thread	1 mm	K thread profile gauge
Trunnion LH/RH 76 mm thickness	4 mm	72 mm snap
Trunnion LH/RH 46 mm dia pin	2 mm	44 mm snap

The projection of the shoulder on the draw hook from the head stock after assembly should be within 92 mm – 120 mm.

The buffers should not be cracked or damaged/deformed. The location of 4 securing holes of buffer casing are 85 ± 0.2 mm from centre of casing along width & 174.5 ± 0.2 mm along length in buffer casing to SK 94043/94044. Rubber buffer pads should be changed if perished, or permanently set to a length below 424 mm. The pads has to be replaced as a set every alternate POH. The set should not be formed from different supplies. (Free height of rubber buffer pad pack consisting of 16 pads to STR No.9501-Ref 2 by adding required parting plate should be 484 ± 2 mm. After assembling and tightening of the M39 nuts on the buffer spindle to achieve buffer projection of 635 ± 2 , the pre-compression of rubber pads along with parting plate will be 439 ± 2 mm).

The wear limits are given in table

Wear location	Wear limit	Suggested gauge
Buffer casing body wall thickness 11.5 mm	5.5 mm in wall thickness	Inside micrometer
Fixing hole in the base 26 mm dia	2 mm on dia	28mm flat
Buffer plunger tube wall thickness 9 mm	4mm	Micrometer
Plunger face/face plate 19 mm	11mm	1905 mm curvature gauge with depth measurement.
Buffer spindle body 40 mm dia	5 mm	35 mm snap
Threads M 39	0.5 mm	thread profile gauge

2.11 INDO – GERMAN MODIFICATIONS

RDSO has approved 13 modifications (7 are on brake gear, 4 on bogie and 2 on buffers) to be carried out as per Indo-German project to increase the POH periodicity and life of the components.

The reasons behind the modifications and intended benefits are given below.

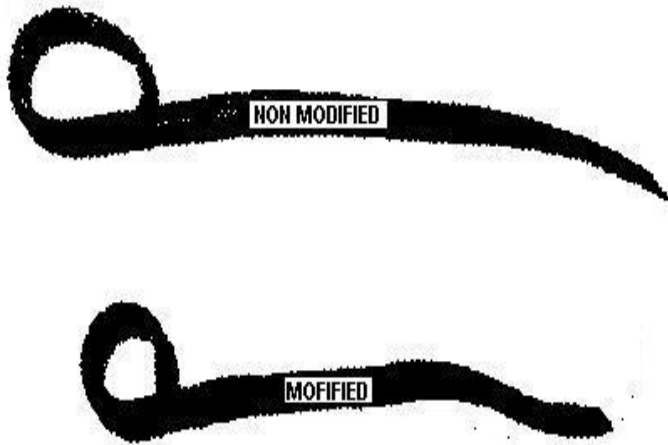
Modification done on Brake gear pins and Bushes:

- In earlier design Acetal bushes were used in the brake rigging. Since these bushes were cracking and wearing at faster rate, results in frequent replacement of Acetal bushes during maintenance and POH.
- Hence to prevent frequent replacement of bushes, the brake gear bushes are replaced with Nylon 66 material. To increase the life of the bushes further, the brake gear pins are finished with N-5 ground finish and coated with Chromium to the thickness of 25 microns. The purpose of coating the pins with Chromium is that it is very good wear resistant material.
- After the above modifications on the bushes and pins, the pins practically show no wear during POH and therefore can be reused.

Modification on brake shoe and shoe key:

- It is seen that the uneven wear of the brake blocks is due to the faulty design of the brake shoe key and brake head. The brake shoe key is functioning well as long as it is inserted from the top.

- For design reasons, the key cannot be inserted from the top in the ICF bogies, as there is insufficient space. If the key is inserted from below, then on application of brakes it will slide downwards and loosen the binding (The slack between the key and shoe increases.)
- The present brake shoe head permits the brake blocks to move up and down along the force of friction on the wheel tread due to the large clearance present between end stoppers on brake block and brake head ribs. Due to the free movement the brake block crushes the base plates and ends of ribs during brake application.
- So to overcome the above problems on Key and the brake head, they have been suitably modified to have a snug fitting between the brake head and the brake block. The modified design arrests the movements of brake blocks to the minimum. It ensures square striking of brake block surface on wheel tread during brake application.



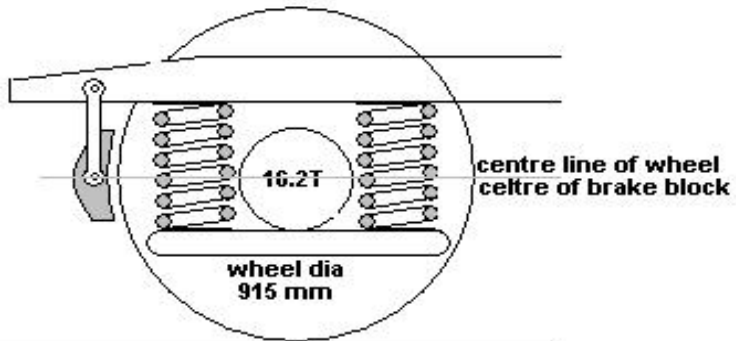
Modification on brake beam safety bracket:

- Brake beam safety straps provided previously ensures only marginal security. It often breaks while supporting the brake beam in case the hanger pin breaks. Hence to prevent dropping of brake beam on run in case if the brake gear pin fails, a new design of Safety wire rope is introduced in place of the safety strap.



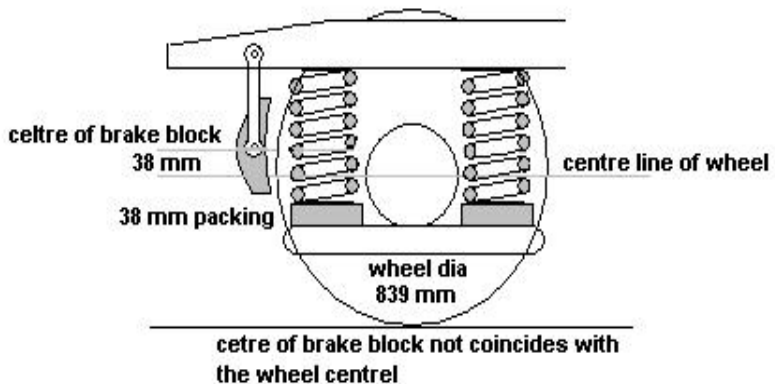
Modification on brake hanger:

- When the wheel diameter is maximum, the centre line of brake block coincides with the centreline of wheel. In this condition, the brake block gives lateral and radial force along the centre line of wheel during brake application.



Centre lines of brake block and wheel coincides

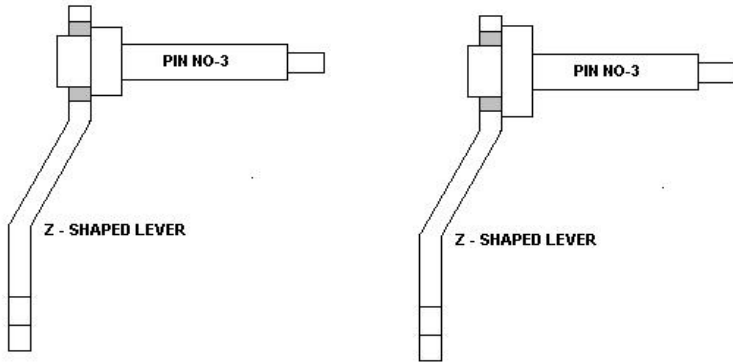
- But when the wheel diameter reduces, the buffer height also reduces. To bring back the buffer height to normal a packing piece is given between the Dashpot and the Axle box.
- Generally whenever the wheel diameter reduces to 839 mm, a 38 mm packing is given between the dash pot and the Axle box, thereby raising the brake block by 38 mm from the centre of the wheel. In this condition, the brake block force is not along the centre line of the wheel but on the upper half of the wheel during brake application and there is a tendency for the brake block to mount over the wheel due to the dragging of brake block by the wheel in the direction of wheel movement.



- To prevent the mounting of brake blocks over the wheels whenever lesser diameter wheels are used, the length of the brake hanger is increased from 205 mm to 235 mm in order to make the centre of brake block to coincide with wheel centre.

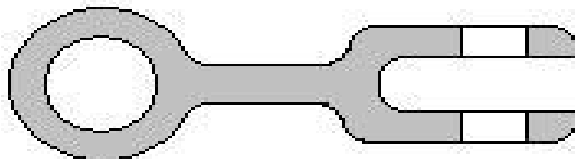
Modifications done on the Z-lever hanger pin:

- The flat size of the hexagonal portion of the lever hanger pin was 46 mm, which is smaller than that of the bush used for the Z shaped lever. This resulted in the bushes getting damaged due to the rubbing action against of the hexagonal portion of the lever pin No.3.
- To prevent the damages to the lever bushes and also working out of bushes, the flat to flat of the hexagonal portion is increased from 46 mm to 55 mm.



Modification done for articulation arrangement:

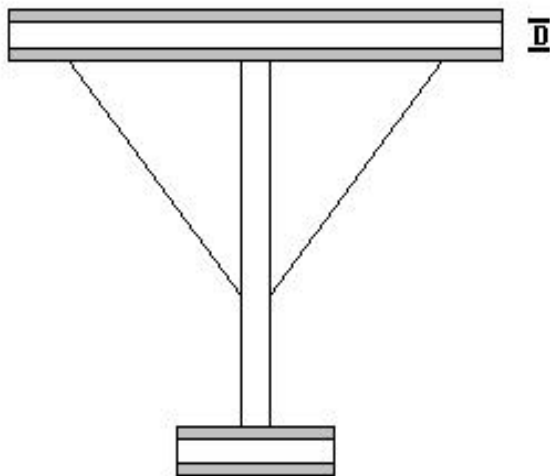
- In ICF coaches it was found that the spindle rod of SAB often broke due to bending of spindle while negotiating a curve. The play for the SAB is only in the vertical plane and not in the horizontal plane. Secondly sufficient support is also not provided leading to high oscillations on bad tracks. To overcome the above said defect, an articulation bracket is provided only for vacuum braked stocks, which facilitates the SAB to move laterally along with the bogie whenever it is negotiating a curve.



ARTICULATION ASSEMBLY

Modification done on Equalising stay:

- The 13 tonne bogies stay pins were often found in bent condition and have to be removed only by gas cutting, but there was no problems noticed in the 16 tonne bogies. It was also observed during POH that about 80% of stay rod pins of 13 tonnes bogies are received in bent and 40% have to be removed by gas cut.
- The reason is that the diameter of the pin used for 13 tons bogie is only 24 mm when compared to 31 mm diameter pin used in 16 tons bogies.



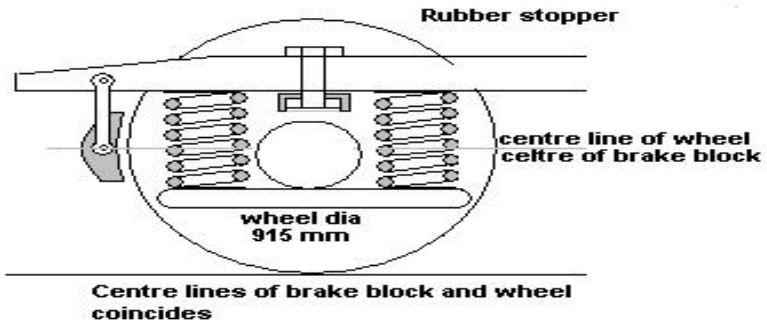
D = 24 mm for 13 tons cap equalising stays

D = 31 mm for 16 tons cap equalising stays

- To prevent frequent replacement, the equalizing stays have been standardized with 16 tons capacity for all the newly manufactured coaches.

Modification on Axle box crown bolt:

- During POH, it was found that the axle box housing bolt arrangement has to be replaced due to damages and also during maintenance difficulties were experienced to maintain a constant crown clearance between the bogie frame and the axle box due to working out of bolts. This is mainly due to hitting of the bolts on the run.



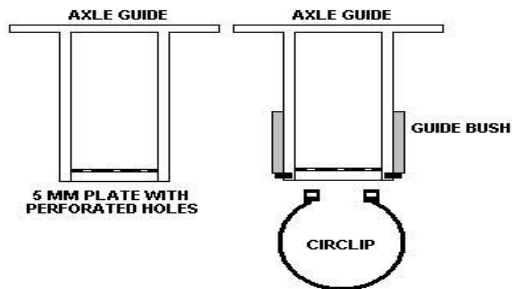
- To overcome the above problem, a rubber stopper is provided with the bolt to dampen the shock, to enable to adjust the clearance under the operating condition in case of wheel wear and fatigue of springs. It also enables for the easy replacement of the rubber pads without lifting the coach.

Modification done in the axle guide arrangement:

- Often the guide cap in the axle guide assembly is found dropped. The normal practice is to weld a strip with a bolt

and tighten the guide bush at the bottom with a nut. During run, this also drops down due to the vertical and lateral oscillation. The dropping of guide cap results in damages to the threaded portion at the bottom of the guide, since it comes in contact with the dashpot directly.

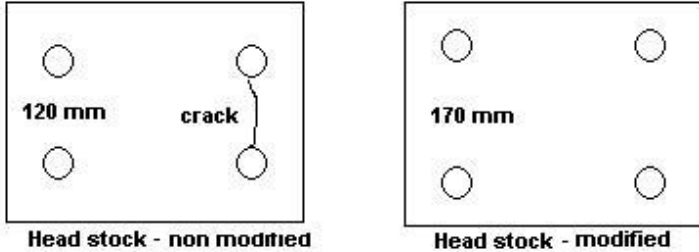
- To overcome the above problems, the guide cap is completely eliminated by carrying out two modifications on the guide. The purpose of providing the guide cap is to allow the oil from dashpot into the guide with restrictions and also to secure the guide bush in position.
- To allow the oil from dash pot into the axle guide a 5 mm plate with perforated holes is welded with the axle guide at the bottom from inside.
- A circlip is used to secure the guide bush in position.



Modification done on the headstock:

- In the earlier design the vertical pitch hole distance on the headstock for fitment of buffer was only 120 mm. As the resisting area was reduced due to the lesser pitch hole distance, the headstock were getting crack.

- To prevent cracking of headstock, the vertical pitch hole distance for buffers on the headstock is increased from 120 mm to 170 mm



Modification on Buffer rubber pads:

- In the earlier design, 14 pads of 20 tonne-inch capacities were being used with a dividing plate interposed between them. But it was found that mixing of old and new pads lead to damage to the pads, as seating was not uniform and also leads to headstock failures. To avoid this, modified rubber pads of 40 tonne-inch capacities (1030 kg-m) of 32 mm thickness are recommended. This leads to reduction in the maintenance required for the buffer in open line.
- The modified rubber pads have increased contact area between the pads, to prevent damages to the rubber pads.

Dimensional check report for the bogie frame:

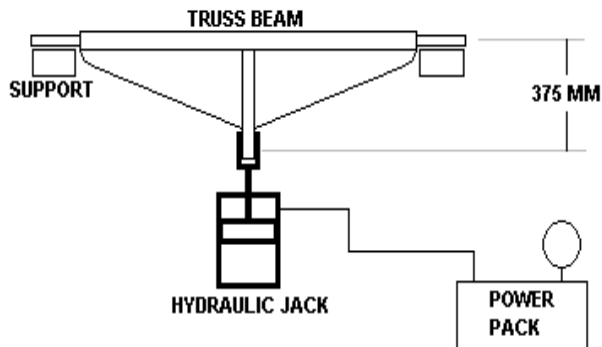
It was found that the designed tolerance was not being maintained in the bogies during manufacturing and to avoid failure of axle guides at the joint, a dimensional check list is separately formed for non-AC, AC and power cars.

Modification done on the brake beam of Air braked stock:

- Often it was found that the brake beam was failing near the central stiffener because of corrosion due to water accumulation. Also there was no provision for hanging the brake beam with a safety wire rope from bogie headstock. To avoid this, now stiffeners of 3.15mm and drain holes are provided. As there was no proper testing procedure for accepting the brake beams, a testing procedure also is suggested.

Testing of Brake Beam:

Apply a tensile load of 12 tonnes between the brake shoe ends and the floating lever end. On 12 tonnes load, an elastic deformation of 3mm is permitted. On removal of load, the truss beam should come back to its normal position. However a permanent deformation of not more than 0.5 mm is permitted.



LATEST MODIFICATION ON COACHES

- Change in securing arrangement of anchor link, similar to that of Fiat Bogie.
- Use of Hopper type Shutters in place of banjo type frosted Shutters in toilets. Provision of ventilator with Arc shape fins with LAV for proper circulation of Air.
- Provision of Resetting Handle with wire rope on end panel for the resetting of ACP from ground itself and APD for Guard van valve and its handle. Increase of vent hole dia in PEAV from 4 to 8 mm.
- Reduced width of brake shoe head by 5 mm from inside.
- Crash worthiness of the coaches is increased by making following modification;
- Mirrors are rounded at the edges, berths are rounded in the corners, side seat backrest holding arrangement is shifted to the inner side, sunk in type mirror shelf, modified berth chain, etc.

2.12 RIDING INDEX

The assumptions for the formulation of certain standards of assessing comfort is purely from the point of view of vehicle oscillations transmitted to passengers only. The human sensation of comfort is dependent on displacement, acceleration and rate of change of acceleration. Basically, these indices are function of the amplitude of vibration and frequency of vibration. In other words, the product of these values could be used as measure of comfort/discomfort.

However the sensation of smooth riding is also affected by other factors like temperature, humidity, noise, dust & various

psychological factors experienced by a passenger during run. The ride index is just a number with no units and its value gives us an indication of the riding comfort of a vehicle. The index is easily calculable during field trials by measuring the vertical/lateral accelerations using standard accelerometers.

Ride Index gradations are as follows:

Riding Index	Appreciation	Fatigue limit
1.0	Very good	>24 hrs
1.5	Almost very good	-do-
2.0	Good	-do-
2.5	Almost good	13 Hrs
3.0	Satisfactory	5 – 6 Hrs
3.25	Satisfactory with limitations	5 Hrs
3.5	Just satisfactory	2.8 Hrs
4.0	Able to run	1.5 Hrs
4.5	Not able to run	45 minutes
5.0	Dangerous	15 minutes

RI criteria applicable on Indian Railways:

	Preferred limit	Max
Coaches	3.25	3.5
Wagons	4.25	4.5
Loco	3.75	4.0
EMU/DEMU		4.0

The ride index as described above gives the average riding quality of a vehicle over the chosen length of track (generally one kilometre). However, individual acceleration peaks also have an effect on the comfort of the passengers. Accordingly, limits for maximum acceleration values have also been laid down for coaches and locomotives. For details, the Third Criteria Committee Report of RDSO may be referred.

The Following Measures Should Be Given to Maintain Ride Index in ICF coach:-

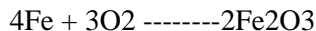
Proper checking of primary suspension arrangement. Checking free height & height variation of primary suspension springs and grouping. Ensure sufficient level of oil in the telescopic hydraulic dash pot. Gap between safety loop & axle box lug should be within limit i.e. 40 mm. proper pairing of springs on secondary suspensions. Free height of spring should be within limit. Ensure proper working of shock absorber. Proper checking of side bearer for oil level & wear on bearing piece/plate should be within limit. Proper checking of silent bushes fitted in bolster for proper matching with centre pivot.

Proper checking of buffing gears for buffer face contact. Plunger stroke should not be more than 127 mm & less than 51 mm. All securing bolts & nuts should be properly fitted. Proper checking of draft gear. Coupling should be fully tightened evenly. Other securing nuts, washers, cotters should be in proper position. Anchor links should be intact with good silent block bushes. All break gear pins should be provided with proper bushes. Dynamo pulley & belt should not be loose. It should also be ensured that there is no wheel defect such as flat faces (not more than 50 mm), deep flange, skidded wheel, sharp flange, thin flange etc. In addition, the Ride Index can also be improved by ensuring proper p/way maintenance, signal defects & good engine man ship of the driver.

2.13 CORROSION AND ITS PREVENTION

Introduction: When metals are put into use in various forms they are exposed to environment containing liquids, gases etc. As a result of this the surface of metal starts deteriorating. This type of deterioration or destruction may be direct chemical attack or electrochemical attack.

Definition: corrosion is a chemical process of oxidation with metal to its surroundings, covering it into metal oxide, carbonates, hydroxide and sulphides. Oxidation takes place only when steel surface exposed to atmosphere or moisture. Chemical reaction is as follows:



Example: rusting of iron. When iron is exposed to atmospheric conditions rusting of iron takes place. During this exposure a layer of reddish scale and powder of oxide is formed and iron becomes weak.

Effect of corrosion: Corrosion of materials is liable to performance of the product; lose their strength, ductility and certain other mechanical and physical properties.

With the introduction of all steel coaches corrosion has become a major problem. Once starts it is very difficult to control it. This requires replacement of the component. This is much costlier than to save the existing part by proper and timely attention.

Corrosion in ICF coaches: Corrosion in ICF coaches is very common. Corrosion repairs to coaches are mainly carried out during POH in workshops. Corrosion repairs are also done during

midlife rehabilitation of coaches that are 12 to 13 years old especially at CRWS, Bhopal next POH in 24 months.

During POH all the under frame members are thoroughly inspected to locate corroded members. Corrosion is indicated by flaking of paint, flaking of metal, pitting and scale formation. Components that is not visible from both sides such as sole bar and trough floor should be examined by tapping with a spiked hammer.

Particular attention should be paid to the more vulnerable members and locations given below.

1. Sole bars, body pillars, turn under and trough floor below lavatories in all types of coaches and luggage compartments of SLRS.
2. Sole bars, body pillars, turn under and pillars above lifting pads.
3. Sole bars, body pillars behind the sliding doors of SLRS
4. Sole bars, body pillars, turn under at the door corners & near coach body bolster.
5. Headstock

Inspection of under frame member for corrosion attention should be done as per technical pamphlet no 7602(rev: 1)

Reason of corrosion in ICF Coach:

1. Accumulation of water, dust and salty discharge under luggage compartment in coaches.
2. Incorrect fitness of side panels.
3. Galvanic cell formation between steel and aluminium near window area.

4. Seepage of water at corners and ends due to water accumulation on floor.
5. In sufficient surface preparation before welding.
6. Frequent use of concentrated acids for the cleaning of toilets.
7. Leaky push cocks, flusher valves.
8. Missing/defective commode chutes resulting in splashing of toilet discharge leads to corrosion of under frame members.
9. Carrying of perishables items like fish in SLRS and Parcel vans and insufficient cleaning after unloading.
10. Entry of water through gaps in window sills.
11. Cracks in body panels and roof left unattended.
12. Painting defects left unattended.
13. Damage to under frame and trough floor due to flying ballast in dynamic condition.
14. Acid spillage from batteries.

Need of Corrosion prevention:

1. To avoid premature detachment of coaches and wagons in service.
2. Corrosion makes wagons unfit for loading. This has a bad effect on earning capacity of railways.
3. There will be a shortage of wagons fit for loading if wagons are detached for corrosion repairs.
4. Detachment of coaches for corrosion repairs has an adverse effect on the normal composition of trains.

5. In monsoon season seepage of water through corroded panels spoils the consignment and railway is forced to pay compensation for the damage.
6. Manpower material and time involved in corrosion repairs can be controlled through proper anticorrosion measures.
7. Losses of railway revenue i.e. losses to the nation.

Always Remember the Saying: - ‘A STICH IN TIME SAVES NINE’ while dealing with corrosion.

Inspection during POH:

1. Inspection of sole bars, body pillars and turn under: Examine visually and with the help of a spiked hammer from below the coach and the inspection holes in the turn under. If corrosion is suspected at places without inspection holes 100mm dia hole should be cut at the bottom of turn under for examination. If corrosion is noticed in the bottom half of the sole bar the trough floor to be cut to a width of 300mm for inspection. In case of heavy corrosion the side wall to be cut to a width of 500mm.
2. Inspection of headstock: Examine visually inner and outer headstock, stiffening behind buffers and the junction of sole bar and the headstock for corrosion. Examine the base buffer assembly carefully.
3. Trough floor: Examine trough floor adjoining the lavatories and under the luggage compartment of SLRS and Parcel vans for corrosion with the hammer.

Corrosion Repairs During POH:

1. Repairs to under frame members:

Repairs to under frame members should be carried out as per RDSO pamphlet no C7602 for ICF coaches. Corrosion resistant steel sheet for trough floor, pillars, sidewalls and roof should conform to IRS M-41-97. Electrode IRS class B2 of approved brands. Paint red oxide zinc chromate primer is-2074-62. Bituminous anti corrosive solution to IRS-P30-96.

2. Repairs to Headstock: Only 8mm thick sheet is to be used headstock repairs.
3. Repairs to Sole bar: The new sole bar section to be welded from both inside and outside.
4. Repairs to Side Wall Members: For repairs to side and end wall members' interior fittings interior panels & window frames are to be stripped. Repairs to be done as per RDSO sketch No. 76019.
5. Repairs to Trough Floor: For trough floor repairs plywood flooring to be stripped. Repairs to be done as per RDSO instructions.
6. Repairs to Roof: Special attention to be paid at locations where gutter mouldings are and where ventilators are fitted. RDSO instructions to be followed.

HOW TO MINIMIZE CORROSION

Corrosion in rolling stock cannot be eliminated altogether. Hot and humid conditions in our country are helpful for corrosion. A change in climate also has an adverse effect. However timely action during repairs and maintenance will minimize corrosion.

DURING POH

1. Thorough inspection giving extra attention to areas prone to corrosion.
2. Turn under repairs to be carried out with 5mm thick plates.
3. Only 8mm thick SS sheets to be used for head stock repairs.
4. Use stainless steel trough floor and inlays for toilets.
5. Use of 13mm compregre floor board instead of plywood.
6. Use PVC sheets for toilets and compartment floor.
7. Use stainless steel plates with drain holes in doorways.
8. Provision of tubular structure below lavatory area.
9. Corten steel is used for panel repairs.
10. Apply two coats of primer and three coats bituminous solution on all under gear members.

IN OPEN LINE

1. During pit line examination check thoroughly all under gear and under frame components, trough floor and headstock etc. for corrosion. If corrosion is noticed take proper anticorrosive measures.
2. Drain holes and drain pipes should be clear so that water stagnation is eliminated.
3. All water leakage to be arrested at the earliest.
4. Proper repairs to damaged PVC floor.
5. Gaps in window sills to be filled up.
6. Deficient/defective commode chutes to be made good.
7. Hosing of coach interior is to be avoided.
8. Avoid strong acids for toilet cleaning.
9. Body patches to be painted, carry out paint touch up where paint is peeled off.

During IOH all vulnerable areas are to be properly inspected after Cleaning of turn under holes.

How to apply anti corrosive paint in coaching stock.

- I. 1st coat ----- zinc chromate
- II. 2nd coat ----- zinc chromate, red oxide
- III. 3rd coat ----- bituminous thin black solution
- IV. 4th coat ----- Bituminous red brown solution
- V. 5th coat ----- Bituminous primer thick black
- VI. 6th coat ----- bituminous primer silver gray

Exterior paint schedule for coaches

At every 5th POH of a coach or if the condition of paint is not good adopt 9 days painting schedule. (A—schedule) otherwise choose 5days paint schedule.

A-schedule (9—days)

- | | | |
|---------------------|---|-------------------------------------------------|
| 1 st day | — | Remove old paint |
| 2 nd day | — | One coat of red oxide zinc chromate primer |
| 3 rd day | — | One coat of brush filler followed by spot putty |
| 4 th day | — | Filler 2nd coat (spot putty if necessary) |
| 5 th day | — | Rub down with silicon carbide paper |

6 th day	–	One coat of under coat
7 th day	–	Flat with silicon carbide paper. One coat of enamel finishing.
8 th day	–	Flat with silicon carbide paper. 2nd coat of enamel finish
9 th day	–	Lettering and miscellaneous work

C-Schedule

1 st day	–	Washing with soap solution touch up damages with primer
2 nd day	–	Spot putty if necessary and one coat of under coat
3 rd day	–	Flat with silicon carbide paper apply one coat of finishing Enamel
4 th day	–	Flat with silicon carbide paper apply second coat of finishing enamel.
5 th day	–	Lettering and miscellaneous work

Suggestions to Prevent Corrosion:

- 1) Supervisors involved in maintenance of rolling should be familiar with areas prone to corrosion.
- 2) Supervisors should educate their technicians about areas prone to corrosion.
- 3) Identify corrosion prone areas and inspect them thoroughly during pit line examination, sick line attention, ROH/IOH.

- 4) Suitable preventive measures to be adopted to save the affected component. In case of heavy corrosion replace the component.
- 5) Ensure painting of wagons during ROH. painting/ paint touch up during IOH and sick line attention.
- 6) Supervisors should educate their cleaning staff so that they follow proper cleaning technique.
- 7) Ensure water tightness of covered wagons.
- 8) Educate Shunting staff so that they perform smooth shunting without damaging the rolling stock.
- 9) Ensure proper cleaning of wagons by the contract staff after Unloading.
- 10) Electrical staff to be counselled about the corrosive effect of acids from batteries.

These small steps will go a long way in minimizing corrosion in rolling stock

BRAKE POWER CERTIFICATE (B.P.C)

This is certificate jointly signed by guard, driver and C & W supervisor prepared in triplicate by C & W supervisor after ensuring vehicle attached in train is fit to run and required amount of vacuum/pressure is maintain in engine and brake van/last vehicle. It contains train no., engine no., load, break up of load, brake power of the train, amount of vacuum/pressure in engine and brake van and first and last two vehicles number respectively.

Revised format of BPC for coaching trains was advised vide board's letter No.98/M(C)/137/19 Pt. dated 25.08.06 S 121/2. As detailed below, certain practical situations/limitations where in the original BPC become invalid, need to look into:-

- i) Two trains starting from different stations and amalgamating into one train at an en route station.
- ii) Train originating from one station and disintegrating into two /more trains at an en route station
- iii) Trains requiring revalidation of BPC as per provisions of RPC-4 category 3 (a) , 3(b) and 4 at terminal station or wherever train engine is changed at en route station, If no TXR staff is posted at such station.

To take care situation as above, it has been decided that.

- a) For trains as in (i) above The BPCs for individual trains shall be clubbed at the intermediate amalgamating point, revalidated and the train worked up to the destination.
- b) For trains under the category (ii) above, the originating station shall issue separate BPCs for all the trains which are to be formed after disintegration at any intermediate station. At the intermediate station the respective BPCs shall move along with the train after revalidation.
- c) Whenever revalidation of BPC is to be carried out at NONTXR station, It is proposed that the exercise be carried out jointly by Guard and Driver as is prevalent for GDR checks of freight

For the purpose of checking brakes continuity and revalidation of BPC , whenever required , it must b ensured that the value of BP,FP in the locomotive and the rare most brake van are recorded afresh each time whenever the train engine is changed or the rake composition is altered.

There are four types of B.P.

Description	Colour	Brake Power %	Validity	Remarks
Coaching Train	White	100%	Max. 3500 Km	
Vacuum Bk. Safe to run exam. (Goods)	Pink	85%	800 to 1000 Km	
Ordinary Intensive exam	Green	90%	One Trip/up to destination	
Premium Rake exam	Green	95%	12+3 days	
CC Rake	Yellow	100% - ordinary For – spl. class For–A-spl. class	i) 4500 Km or 20 Days ii) 6000 ,, ,, 30 Days iii) 7500 ,, ,, 35 ,,	

The level of the air pressure/vacuum on the train engine and the brake van gauges as well as the percentage of operative cylinders should be recorded on a prescribed certificate and signatures of the driver and the guard of the train should be obtained by the Engineer (C&W) as per the procedure laid down

by each Railway. No train should be allowed to leave with an inoperative/defective Brake cylinder on any coach after pit attention. Trains which have been attended on pit line should have 100% brake power. Trains which are attended on platform or where secondary examination has been dispensed with or en route should have minimum 90% brake power.

Indian Railways

Annexure 1.1

BRAKE POWER CERTIFICATE

1. Date	<input type="text"/>
2. Station/Railways	<input type="text"/>
3. Train No.	<input type="text"/>
4. Load	<input type="text"/>
5. Engine No.	<input type="text"/>
6. Attached at	<input type="text"/>

7. Vac./Air

Pr.ready

8. Vac/Air Pr. On
Departure

Air Pressure (kg/cm ²)		Vac. cms of Hg
FP	BP	

In Engine

In Brake Van

9. Pressure of Brake Power

Air Brake Train

100%

Vacuum Brake Train

9. A.i) Total No. of brake/Vac/Cylinders

No. of operative Brake Vac. Cylinders

10. Individual numbers of two coaches next to the Engine and at rear in case of Vacuum trains and of 4 middle coaches also in case of Air Brake Trains

Engine end

Middle

Rear end

“THIS CERTIFICATE IS VALID PROVIDED THE RAKE INTEGRITY IS NOT BROKEN OR CHANGED, OR THE TRAIN ENGINE IS NOT CHANGED . IF RAKE INTEGRITY IS BROKEN OR THE TRAIN ENGINE IS CHANGED , THIS CERTIFICATE SHOULD BE REVALIDATED BY ENGINEER (C&W) THROUGH ENDORSEMENT IN THE COLUMN PROVIDED ON REVERSE AFTER ENSURING BRAKE CONTINUITY , PROVIDED THE COACH(ES) BEING ATTACHED , IF ANY HAVE BEEN MAINTAINED AS PER EXTANT INSTRUCTION.”

Driver’s name & signature

Guard’s name & signature

Engineer (C&W)

(Space for en route endorsement & Driver’s remarks on the reverse)

11. Driver remarks & en route endorsements by Engineer(C&W)

Station/ Rly. Where examined	Engine No.	No. of vehicles without brake power			Percent age of brake Power	Signature of Engineer
		Isolated D.V.	Malfunctioning SAB	Brake Rigging		

IMPORTANT

1. The incoming Driver shall handover the certificate to relieving Driver. If he is leaving the train without relief, it shall be deposited with the authority nominated to receive it, who will give it to the outgoing Driver.
2. The outgoing Driver & Guard will satisfy themselves from the coach nos. given in item 10 that the certificate pertains to their train.
3. It is responsibility of the Driver of train to satisfy himself that the brake power certificate is proper and valid, before working the train shall handover the certificate to relieving driver. If he is leaving the train without relief, it shall be

deposited with the authority nominated to receive it, who will give it to the outgoing Driver.

4. For the all types of coaches fitted with air springs in secondary suspension, all air springs should be in inflated condition. In case one or more air springs are in deflated condition, they should be isolated by isolating cock for air springs. Speed restriction of 60 kmph shall be imposed until the condition of air spring is rectified.

Brake Van Equipment: Similarly, other brake van equipment for which Mechanical Train Examining staff is responsible to supply, should be provided according to the instructions of each Railway. As per RDSO's letter no. MC/CB/28 dt 19.5.2000, racks have to be provided in the SLRS for provision of portable control telephones, portable train lighting equipments, portable fire extinguisher, wooden wedges/skids and stretcher. Railways can modify existing emergency equipments rooms in the guard's compartment to provide racks for keeping the above mentioned items except fire extinguisher

In view of emergency use, all originating trains should be provided following items in front & rear SLRs:-

- i) Fire Extinguishers DCP type -in engine (to be supplied by Loco Shed)
- ii) Fire Extinguishers DCP type in AC Coach, SLR, Pantry car(to be supplied by C&W)
- iii) Wooden Wedges (To be supplied by C & W)
- iv) Wooden or Steel Ladder (To be supplied by operating dept.)
- v) Stretcher (To be supplied by Medical dept.)
- vi) First Aid Box (To be supplied by Medical dept.)
- vii) Electrical Box (To be supplied by ETL dept.)

viii) Field Telephone Set (To be supplied by S & T dept.)

Formation Of Block Rake: For the purpose of maintaining the coaches & rakes in good condition & to avoid public complaints the Chief Mechanical Engineer in consultation with the Chief Operating Superintendent Of The Railway shall form BLOCK RAKES for each of the long distance trains & the inter railway trains & also nominate spare of coaches adequate no. of the block rakes to replace sick block rake coaches.

Destination Board: Each coach on originated rake should be provided with destination board of approved size by the Primary Maintenance Depot.

Fire Extinguisher: Approved type of Fire Extinguishers should be provided on all originating trains according to number prescribed by railways in Brake Van , Postal Van , Dining Cars AC Coaches etc. These fire extinguishers should be periodically checked after every 3 months & completely refilled after 1 year. These Fire Extinguishers should not be over due for testing & refilling.

Deficiency Rolling Stock (DRS) For Coaching Stock: Railway should devise system for detecting deficiencies. Reports of deficiencies/defects in Rolling Stock (DRS) reports in the Performa should be prepared for each mail/express/passenger originating train in duplicate by the Engineer (C & W) Electrical (TL) and should be signed jointly with the RPF representatives. Reports for mechanical deficiencies should be prepared on specified Performa and may be altered by each Railway on the basis of the items most prone to theft on their system. This should be done soon after the maintenance of the rake is complete in the sick/washing lines. In case the train starts from the platform itself, these reports should be

prepared by jointly by C & W and electrical department. DRS Cards should be prepared in duplicate in which original copy is kept as a record copy and carbon copy is handed over to train guard. After the coaches have been jointly checked. And DRS reports have been made, the coaches should be pad locked/key locked and the key and report should be sent to the platform Engineer *(C & W).

Coach Maintenance History Card: Every coaching depot shall have computers for maintaining the coach maintenance history in software programmed which should be compatible with the programmed of the coaching workshop.

The “Coach Maintenance History Card” (MHC) for each of its coaches. The card will contain records of maintenance schedules including POH and special repairs in shops. It will also show the history of the coach from the time the coach is placed in service will its condemnation and will give details of all major repairs wheel changing bogie changing etc.

The complete history book of each coach, consisting of maintenance history cards, date card, trial card etc. will however, be maintained by the base workshop. When a coach is sent for POH or special repairs, a copy of its maintenance history card should be sent by its base depot to the workshop for record in its complete history books.

3. LHB – COACHES

3.1 Introduction to LHB Coaches

(Linke Hoffmann Busch GMBH – German)

NEW GENERATION LHB COACHES



LHB COACH RAKE VIEW (IMPORTED)



Indian railways have been manufacturing passenger coaches of “Schlirien” design for more than 50 years. Although continuous efforts were being put to upgrade these coaches, due to constraints/limitations in the design, we could not cope up with quality and speed of the Railway transport in the developed countries.

It was felt to imbibe technology in-use, in the developed countries so as to affect a quantum jump in quality and speed of Railway coaches.

“M/s Alstom and Linke Holfmann Busch (LHB)” are one of the leading manufacturers in transport sector having presence in most of the European countries. Coaches manufactured by them are running in many countries across the world.

LHB coach body is designed and manufactured by leading German company Linke Holfmann Busch GMBH and Bogies for these coaches is designed and made by M/s FIAT, Switzerland which is now a part of Alstom group.

Indian Railways entered into a TOT agreement with M/s. Alstom Germany for manufacture of LHB type of Coaches. Accordingly, their inception and mass production in Railways started in 2002 and population is growing day by day.

3.1.1 BENEFITS TO RAILWAYS

- **A longer coach:** LHB coaches are approximately 1.7 meters longer than the conventional ICF type coaches. This means “more travel space”, “increased seating capacity”, “wider bays and doorways” etc.
- **A lighter coach:** Weight per meter length of LHB coach is approximately “10%” lesser than the conventional coach. This not only means lower haulage costs but also less wear and tears of the coaches and track.
- **A higher speed coach:** LHB coaches are designed to run at a maximum speed of 180 kmph. Even for speeds of 200 kmph, no major changes are required.
- **Lesser maintenance required:** Lesser maintenance required due to Use of superior materials with longer life.
- **Wheel slide protection (WSP) system based on microprocessor:** It detects the variation of speed between the 4 wheels of the coach and if any wheel is rotating at a lower speed, the particular wheel brake is released automatically. This protects the wheel from skidding.
- Bogie with less moving parts.

- Items of wear & tear do not require replacement/renewal before 10 lakh km.
- Entrance doors flush with side wall allowing automatic car washing.

3.1.2 BENEFITS TO THE PASSENGER

- **Better ride quality:** With improved ride comfort - ride index reduced from over 3.0 to 2.5 at a speed of 160 kmph.
- Plush interiors comparable to international standards.
- Improved air-conditioning through better duct designing & humidity control.
- Bigger size sealed windows filled with “argon” gas for a panoramic view & better heat insulation.
- Modular “oriental” & “western” style toilets with Controlled discharge toilet system (CDTS) This system works on electro- pneumatic principle where in, the waste generated from the coach lavatories during run is collected in a retention tank and is disposed off away from the station limits and avoid soiling of station premises.
- Well equipped pantry with hot cases, deep freezer, bottle coolers etc.
- Flush type swiveling berth reading light.
- Polycarbonate transparent centre tables.



LUGGAGE RACK

LHB COACH INTERIOR



European Style Toilet

Indian Style Toilet

3.1.3 SAFETY RELATED PROVISIONS:

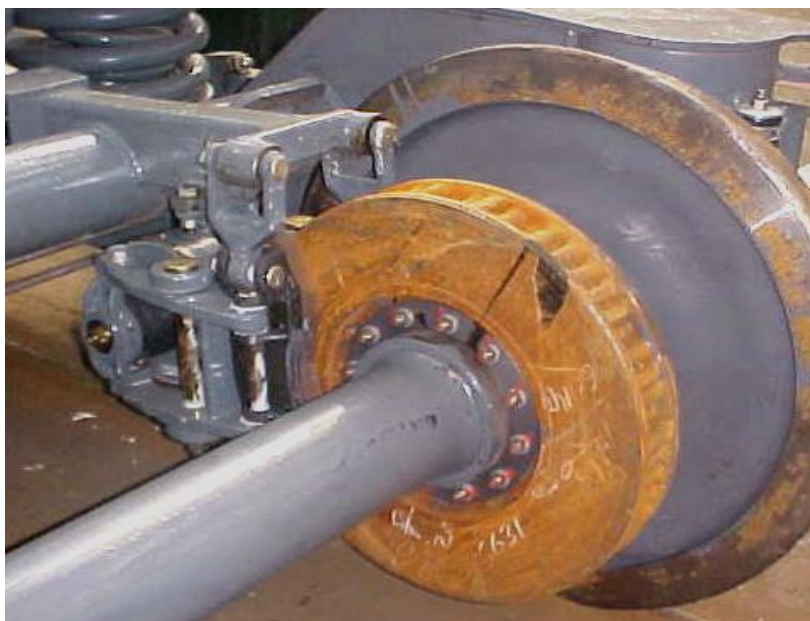
- Four emergency exit windows for faster passenger evacuation during emergencies.
- Wider vestibule designs for smooth inter coach movement with luggage.
- Convenient to operate emergency alarm pull operation and Fire - retardant furnishing controls the spreading of fire and prevents higher damages.
- Tight lock centre buffer coupler gives anti-climbing feature, during accident, leading to lesser injury to the occupants of the coach.

3.2 SALIENT FEATURES OF LHB COACHES

These coaches are longer by 1.7 meters than the ICF coaches and hence more number of passengers can be accommodated in a given coach. As the length of the coach is longer the number of coaches required to form a formation is reduced and hence overall cost of maintenance becomes less.

These coaches are fitted with Axle Mounted Disc brakes to have an effective brake power to stop the train within the short braking distance. As the brake forces are acting on the Discs which are mounted on the Axles, the wear on the wheel tread caused due to brake application on tread is eliminated and hence the life of the wheels are considerably increased.

These coaches are fitted with Wheel slide protection device to prevent the wheel from getting skid. Due to various reasons it is possible for any one of the wheel to have lesser speed when compared to the other three wheels and in such a case it releases the air from the brake cylinder of the affected wheel automatically to prevent the wheels from getting skid.



These coaches are fitted with Brake accelerator in the Brake pipe to bring BP pressure to zero during emergency brake application. The brake accelerator connects the Brake pipe with exhaust during emergency application to facilitate faster exhaust of air from the brake pipe.

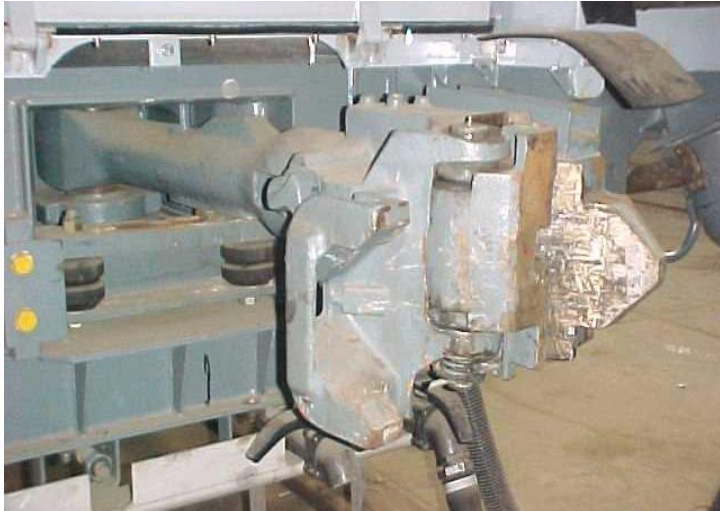
These coaches are provided with FIAT bogies, which are designed to run at a speed of 160 KMPH. The wheelbase of Bogie is 2560 mm.

These coaches are fitted with earthing device to prevent damages to the Roller bearings. These coaches are fitted with roof mounted AC package units.

These coaches are fitted with Controlled discharge Toilet system designed to discharge the human waste when the speed

reaches above 30 KMPH. The objective of this toilet system is to keep the station premises clean and hygienic.

These are fitted with tight lock AAR centre buffer coupler with anti-climbing feature to prevent the climbing of one coach over another in case of accidents.



The following equipments are operated by Microprocessor controlled system

- Wheel slide protection device.
- Controlled discharge toilet system.
- Water pumping device.
- Roof mounted AC package units

The riding index of LHB coach is 2.75 when compared to 3.25 in case of ICF Coaches.

Up-graded design for passenger safety/comfort like; Ergonomically designed seats as per Indian anthropometrics data,

Large windows with good visibility, Luggage racks with in-built reading lamps, Insulation against noise, No visible screws in the interior.

Use of fire retardant materials, Hand – safe feature in all automatic sliding doors, Anti – skid PVC flooring, UIC vestibules and auto - closing vestibule door.

Functionally designed pantry area is easily accessible AC unit controls. The passenger emergency alarms signal devices (emergency alarm pull box) are provided inside passenger compartment. This is to avoid operation of PEASD by unauthorized persons from outside. There is no mechanical linkage like a chain and this handle directly operates the PEA valve for venting the brake pipe pressure.

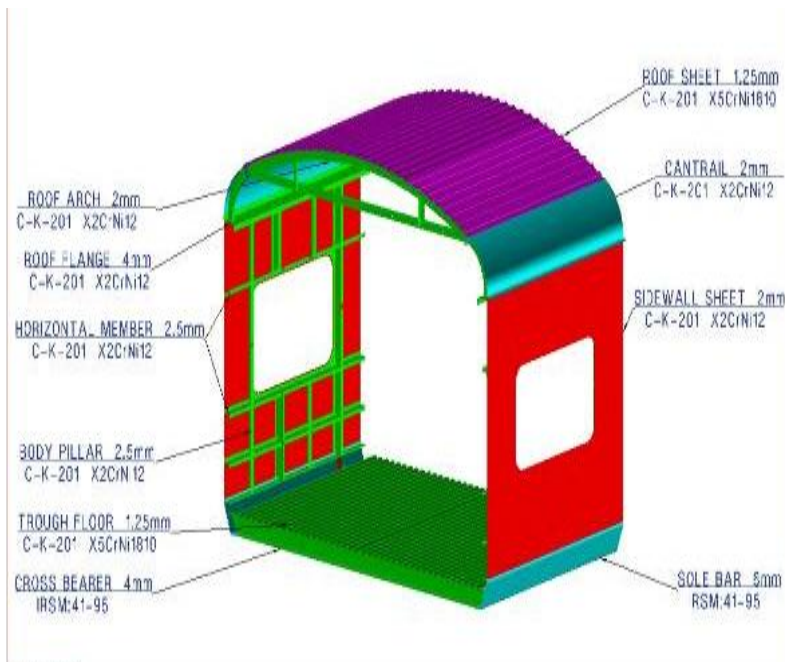


DESIGN FEATURES OF LHB COACHES

Description	LHB Coach	ICF Coach
Length over body	23540 mm	21337 mm
Length over buffers	24000 mm	22297 mm
Overall width	3240 mm	3245 mm
Overall height	4039 mm (AC 3 tier 4250 mm)	4025 mm
Max distance between inner wheels	12345 mm	11890 mm
Distance between centre pivots	14900 mm	14783 mm
Window opening	1180 x 760 mm	1200 x 550 mm
Height of compartment floor from Rail level under tare	1303 mm	
Max CBC drop under gross load and worn conditions	75 mm	
Minimum height from Rail level	102 mm	
Max height (empty)	1105 mm	1105 mm
Minimum buffer height (loaded)	1030 mm	1030 mm
Wheel base	2560 mm	2896 mm
Wheel dia (New)	915 mm	915 mm
Wheel dia (Cond)	845 mm	825 mm
Speed potential in kmph	160 upgradeable to 200	140 max
Max Axle load permissible	16 t	
Ride index	2.5 to 2.75	3.25
Speed Potential (Kmph)	160	140
Axle Box Guidance	Articulated	Rigid
Dampers-Primary	Hydraulic	Dashpot
Bogie Frame	Without Headstock	With Headstock

3.3 COACH SHELL

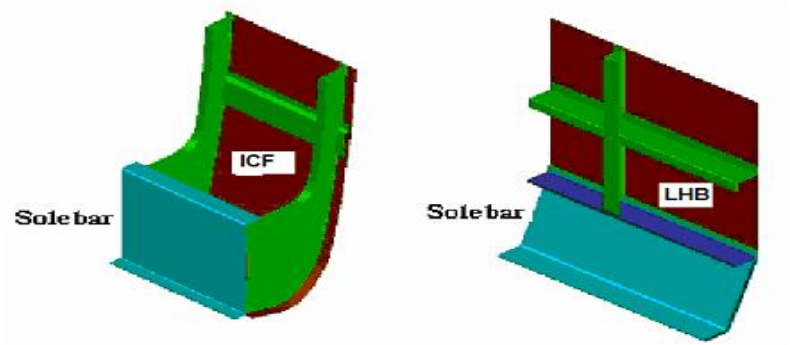
The entire shell is made from stainless steel and low corrosion steel. All the structural elements with section thickness above 5mm and more are made from Corten steel. Trough floor and roof panels are made from Austenitic stainless steel. Other structural members and side members and sidewall panels are made from ferritic stainless steel. The shell design eliminates turn-under and other pockets causing corrosion in conventional coaches.



Various types of steels used in construction of LHB Coaches

Shell Assemblies	Steels Used	Composition
Side Wall, End Wall And Roof structure	Ferritic Steel X2 Cr8	C-.03%, Cr-10 to12% Si-1%, Mn-1.5%
Roof Sheet and Trough floor	Austenitic Steel X5 CrNi18-10	C-.07%, Cr-18% Ni-10%, Si-1%, Mn-2%
Under Frame	Corten Steel IRS-M-41	C-.01%, Cr-.35 to.6% Ni-2 to 4 %,Si-0.3to0.7%, Mn-0.25%

The C – Shaped section Sole bar is used in the LHB coaches when compared to Z-shaped in ICF coaches



Special Design feature of LHB coach flooring:

16 mm composite board made from cork panels glued to “Makore” wood has been used. Flooring panels are lightweight, strong, warp resistant and also resistant to vibrant/impact forces. These floors are specially treated for fire resistance; these are also resistant to moisture, cigarette burns, staining, aging etc. The intermediate cork layer imparts nice insulation characteristics to the floor panel. The “floating” floor is supported by rubber- metal decoupling elements, for absorption of structural vibrations. Interlocking joints of vertical & horizontal members is adopted for structural joints

3.4 FIAT BOGIE.

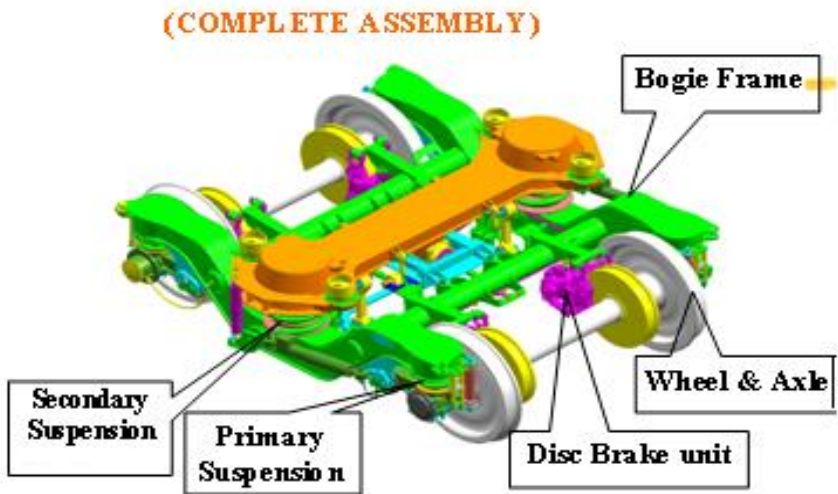
The LHB coaches are provided with the FIAT bogies to run at a speed of 160 KMPH.

Limitations of ICF all Coil Bogie

- The longitudinal and lateral movements of the wheels cannot be controlled independently as generally required for High-speed bogies.
- Since there is vertical space constraint between the top and bottom bolster, it is not possible to provide softer secondary suspension springs which are required for the high speed trains to control the dynamic movements of the bogie bolster and coach body.
- Headstocks increase the yaw inertia of the bogie frame and thereby, influence the tendency for hunting. The wheelbase of ICF all coil bogie is 2896 mm. This large wheelbase affects curve negotiations and thereby increases wheel flange wear.

- Since the brake forces are offered on the wheel tread by clasp brake, it could not give sufficient retardation during brake application which in turn increases the emergency braking distances. The life of the wheel is also reduced due to tread wear.

3.4.1 FIAT BOGIE PARTS



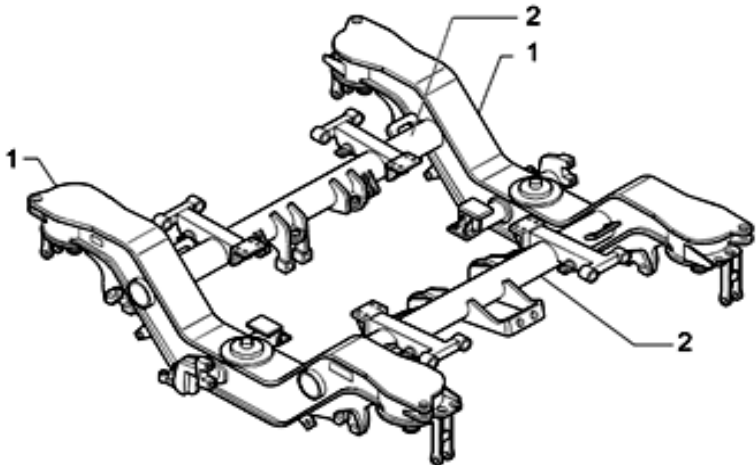
- Design obtained from M/S Alstom-LHB, Germany as part of LHB-TOT contract
- Adapted at RCF for various coach variants
- Fit to run up to 180 kmph
- Superior ride quality
 - Bump stops in primary and secondary suspension
 - Miner pads in secondary suspension

- Yaw, lateral and vertical dampers
- Nested spring sets with 2 helical and one rubber spring in secondary
- Less wear and tear

3.4.2 BOGIE FRAME

1.-SIDE FRAME

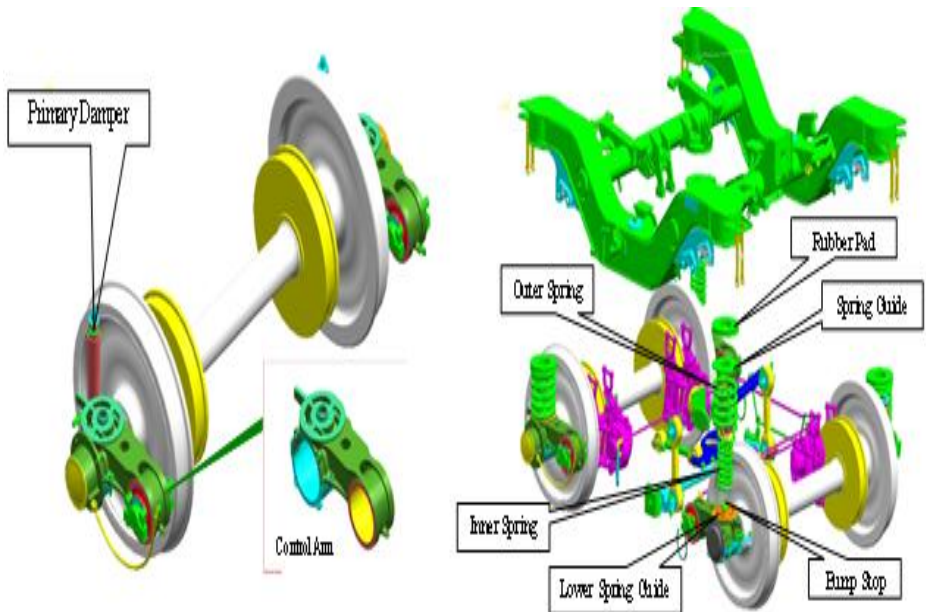
2.-CROSS BEAM(Ø140X Ø168X2506 SEAMLESS PIPE)



- Solid welded frame -steel sheets (ST-52) and forged, steel cast parts to material GS20MN5V; DIN 17182 (weld able).
- Two side frames connected by two cross beams -support brake units various brackets on frame.
- The bogie frame rests on the primary suspension spring units and supports the vehicle body by means of a bolster beam. The bolster beam is connected to the bogie frame by secondary suspension.

Primary suspension

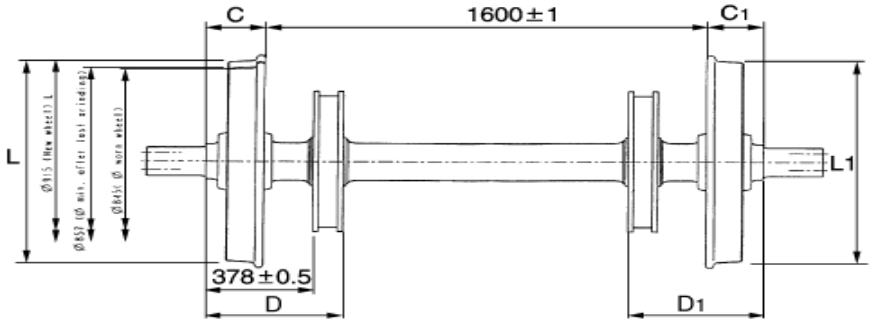
- Two coil springs, one vertical damper, articulated control arm, elastic joints connecting the axle bearing to the bogie frame
- Better curve negotiation.



3.5 Wheel and Axles

- Two brake disks (4), diameter 640 mm and width 110 mm.
- Two wheel disc of tread dia 915 (New), 845 (worn)

Dimensions of wheel set:



The following differences must be respected:

$$|L - L_1| \leq 0.5 \text{ mm}$$

$$|C - C_1| \leq 0.5 \text{ mm}$$

$$|D - D_1| \leq 0.5 \text{ mm}$$

Wheel diameter: New wheel dia 915mm, worn wheel dia 845mm

Wheel Re-profiling and balancing:

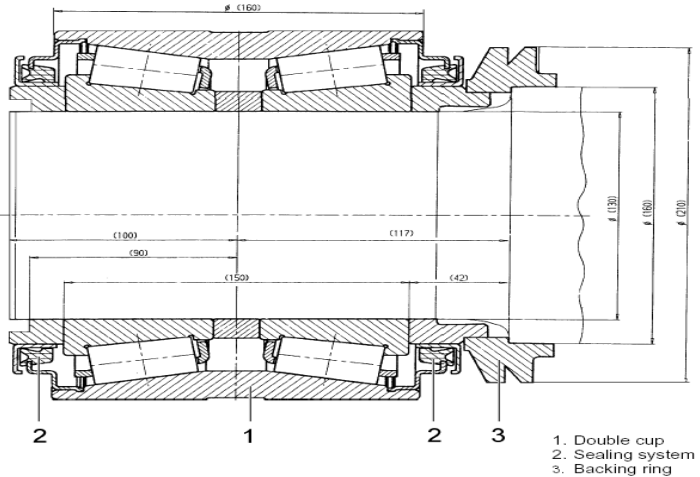


FIG. 1-4 AXLE BEARING LONGITUDINAL SECTION

1. Double cup
2. Sealing system
3. Backing ring

- Dynamic balancing 320rpm
- Less than/equal to 50gm.m
- Glue the needed weights.

AXLE BEARINGS

- Taper roller cartridge type bearing
- Pre-assembled unit.
- Maintenance free- overhaul 1.2 million km.
- Sensors for detecting speed

DISC BRAKE SYSTEM

- Axle mounted disc brake
- Two discs per axle of dia640
- Inbuilt slack adjuster in brake cylinders
- 35mm brake pads

SECONDARY SUSPENSION

- Nest of flexi-coil springs inner and outer, rubber spring and secondary pad
- Vertical dampers
- Lateral dampers
- Yaw dampers
- Anti-roll bar
- Anchor Links

PRINCIPLES OF FORCE TRANSMISSION

- Vertical forces: Body-secondary springs-bogie frame-primary springs/ball joint control arm-axles.

- Lateral forces: Body-Secondary Springs-Bogie Frame-Ball Joint Control Arm-Axles.
- Longitudinal traction efforts and braking powers: Body-Traction Centre-Traction Rods-Traction Lever-Bogie Frame-Control Arm-Axles.

Curve Negotiation: An Articulated Control Arm (SGCI TO IS:1865) Is Connecting Axle Bearing And Side Frame Through Elastic Connection, Which Will Provide Flexibility Between Axle And Side Frame.

Fiat Bogie Frame Fabrication: Sequence of Operations.

- **Stage- i:** Fitting of top flange, bottom flange, web and 6 ribs.
- **Stage-ii:** Fitting of control arm bracket, inside stiffener, brake head bracket, bkt for vertical damper.
- **Stage iii:** Robotic welding of above items.(mfr. M/S IGM ROBOTER system as Austria)
- **Stage iv:** Yaw damper assembly Bkt. & curve roll link Bkt. Tacking.
- **Stage v:** Full welding of bogie frame on manipulator.
- **Stage vi:** Flame straightening of side frame.

3.5.1 SALIANT FEATURES:

Wheel Base	mm	2.560
Diameter of new wheels	mm	915
Diameter of max. worn wheel	mm	845
Distance between the wheels	mm	1600
Brake disc diameter	mm	640
Bogie width	mm	3030
Bogie length	mm	3534
Bogie weight	kg	6300

Speed limit: Up to 160KMPH without any modification & up to 200KMPH with minor modification

Riding index for Chair car: VERTICAL - 2.75 & LATERAL - 2.5

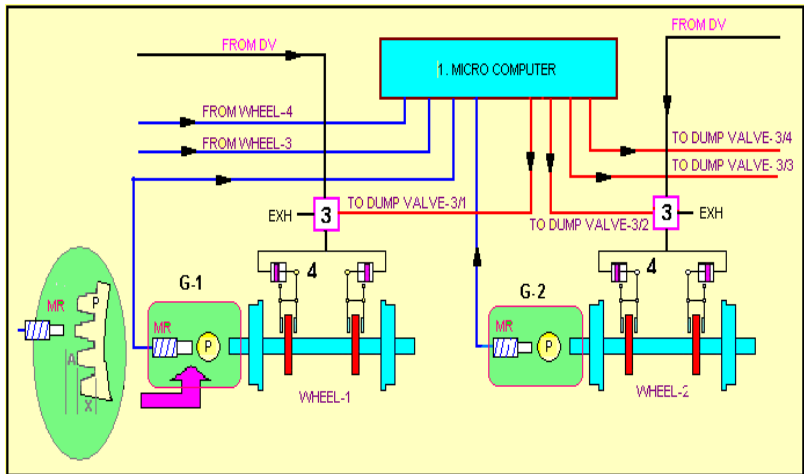
Comparison of salient features of fiat bogie against I.C.F. Bogie

S.N.	I.C.F.	FIAT
1	Speed=140 Kmph	Max operating speed=160 kmph tested speed=180 kmph Potential for operation=200 kmph
2	Bogie Frame I Type	H Type Construction
3	Wheel Base =2896 Mm	wheel base = 2560 mm
4	Wheel Dia =915 Mm	915 mm(new) 845 mm (worn)
5	Clasp Type Brake	Axle Mounted Disc Brake
6	Spherical Roller Bearing	Tapered Roller Bearing

7	Primary Single Spring	Primary nested spring =2 nos.
8	Limited Noise Control Features	Noise Controlled By Using Thick Rubber Pad
9	Secondary spring on L.S. Beam	Secondary spring directly mounted on side frame (no L.S. Beam)
10	Coach Load Is Transferred Through Side Bearer (100%)	Through bogie body connection to side frame via sec. Springs.
11	Center Pivot Transfer Traction And Shock Load	Pivot assembly on transverse beam and bracket on dome take traction/braking, shock load.
12	Ride Index Transverse=3.5 Vertical=2.5	Transverse=2.75 vertical=2.5
13	Anti-roll bar has not been provided.	Anti-roll bar has been provided to curb the tendency of roll.
14	Maintenance. Reqd. 1) axle box guide arrangement 2) spherical roller bearing 3) clasp bearing 4) more pin joints	Very little maintenance. In P.O.H.
15	Weight Of Bogie=6.2 T	Weight Of Bogie=6.3 T

3.5.2 Wheel Slide Protection device:

In LHB coach pneumatically controlled Disc brake system is used. During brake application, factors like variation of co-efficient of friction (due to composition of brake pads and disc) and adhesion between rail and wheels and various other factors may cause difference in RPM (rotation per minute) of axles on the same coach. This may lead to wheel skidding/ flat tyres. To prevent this, a Wheel Slide Protection (WSP) device is provided in these coaches.



3.5.3 Main Components and their functions:

Part No	Name	Qty	Function
1.	Micro Computer	1 Per Coach	Gets input from speed sensors, compares with reference speed and gives output signal to Rapid Discharge Valve to open or close in case of variations.
G-1 & G-2	Speed Sensor	1 Per Axle	It consists of a fixed Magnetic Resistor (MR) and a Phonic Wheel (P) having 80 teeth, fitted on the axle. It gives tachometric pulse signal to Micro Computer due to variation in air gap (A and A +X) between the phonic wheel and the magnetic resistor.
3.	Rapid discharge valve (dump valve)	1 Per Axle	It is an Electro-Pneumatic Valve which is connected in series with the Brake Cylinder (BC). It regulates the BC (Part No-4) Pressure by disconnecting the DV from BC and also by connecting the BC with atmosphere when the output signal is received from Micro Computer.

Principle of working:

The rotation of each axle is constantly measured and compared with a reference speed (The RPM of the fastest wheel of the coach) for that coach. In case there is a variation in RPM among the wheels, WSP automatically releases the brakes of the wheel with slower speed accordingly, so that the RPM of all the wheels become uniform.

Working:

The limit of variation of speed and acceleration are defined as threshold values. The Micro Computer constantly compares the signals from the speed sensor mounted on each axle with the reference speed. If the speed/ acceleration of any axle are crossing the present threshold values, it gives signal to the respective Rapid Discharge Valve to release the BC pressure accordingly, thus maintaining the speed/acceleration within the threshold level.

Advantages of LHB coaches

- Better payload to tare ratio.
- Better safe guard for corrosion.
- Increased coach availability due to reduced maintenance.
- Higher carrying capacity of 78 passengers in chair car.

Air Brake Testing Procedure for LHB Coaches:

On arrival of the rake on pit line, completely drain the AR tank (125 litres & 75 litres) of all the coaches by opening the drain cock, to remove the water in air.

Initially, couple the BP hose of the test rig with the BP hose of the rake & then charge the BP pressure to 5.0 kg/cm^2 . Keep the FP angle cock of both end power cars in close position. Check the FP gauge fitted in the power car, if the gauge does not show any pressure, the NRV of all the coaches are ok. If, FP gauge shows any pressure, the NRV of some coach in the rake is defective. In this condition, check the rake for NRV defective by taking the coaches in parts. NRV found defective in particular coach should be replaced.

Open all the four cocks of rake, couple BP & FP hose pipe of test rig with the BP & FP hose pipe of the rake. Charge the BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. After building of

pressure in BP & FP, disconnect the test rig BP & FP hose pipe from the rake hose pipes & open both the angle cocks, due to which air pressure will be exhausted in atmosphere & brake will be applied. Wait for 20 to 25 minutes.

After 20 to 25 minutes, check the complete rake from one end. Note down the coach nos. found with released brake cylinder. Check whether, AR tank of the coach is charged or empty. If AR tanks found empty, write down Empty AR on the respective coach. If found charge, pull manual release of DV to check whether CR tank is charged / empty. If CR found empty, write down Empty CR on respective coach. With this, all the defects in the rake can be checked.

Again, connect BP & FP hose pipe of the rake & test rig & then charge BP to 5.0 kg/cm^2 & FP to 6.0 kg/cm^2 . Connect BP & FP gauges with dummy on free end of other end power car.

Check the BP & FP pressure gauges in front power car, BP pressure should show 5.0 kg/cm^2 & FP pressure should show 6.0 kg/cm^2 . If there is any difference in any pressure, check by fitting master gauge if still the pressure is not showing 5.0 kg/cm^2 in BP & 6.0 kg/cm^2 in FP, check for leakage & attend.

Close the BP & FP angle cock of test rig for 03 minutes. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm^2 in 03 minutes.

Attend the coaches in which AR empty & CR empty are found. Check the AR tank & pipe line from the back of the brake panel for leakage. Similarly, check CR tank & pipe line & dummy plug on the brake panel. If defect is still noticed after attending the leakage, then mark the coach sick for detailed investigation & single car testing in sick line.

Start the pressure & charge the BP to 5.0 kg/cm^2 & FP to 6.0 kg/cm^2 . Drop the BP pressure by 1.6 kg/cm^2 , brake should apply in all coaches. Start the leakage checking with the help of soap solution from one end. During soap solution testing, check all the BP & FP hose pipe, all hose pipe connectors, Main pressure pipe line, Angle cocks, Brake cylinder pipe line, CDTS pipe line. Similarly, check & attend leakage in components on Brake panel like DV, FP & BP filter, NRV, all isolating cock, brake indicator, brake accelerator & brake cylinder with soap solution.

Isolate the isolating cock on Brake panel & check all brake calipers & brake pad of all cylinders. In isolated condition, all brake pads should be released simultaneously. Similarly, on opening of isolating cock all Brake cylinder should operate & brakes should apply.

Check the brake indicator when brakes are applied, indicator should display red colour. However, when the brakes are released from isolating cock the brake indicator should display green colour. If on brake release condition, brake indicator is not showing green or on brake applied condition brake indicator is not showing red, then the brake indicator is defective. Repair / replace the brake indicator.

The BP & FP pressure gauges in the others end power car should show pressure 3.4 kg/cm^2 & $5.8 - 6.0 \text{ kg/cm}^2$ respectively. If any difference in above pressure is noticed that means there is any cross connection in BP & FP connection. Attend the same & ensure BP pressure 3.4 kg/cm^2 & FP pressure $5.8 - 6.0 \text{ kg/cm}^2$.

Charge the BP & FP pressure to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Check the brake indicator of complete rake, all coaches should be in released condition. If any coach is not released, it means that the CR of that particular coach may be

overcharged & there is an internal defect in DV. Mark the coach sick for detailed investigation.

Check PEASD of at least 03 coaches. During PEASD checking, brakes should apply in all coaches & the brake accelerator should operate. Coach numbers should be noted in maintenance diary.

Now close the pressure supply from the test rig. Operate the emergency guard van valve of front power car guard van. BP pressure should become 0.0 kg/cm^2 in approx. 25 to 30 sec in front power car & approx. 40 to 50 sec in rear power car. Open the pressure supply & charge BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Now again close the pressure supply from the test rig. Operate the emergency guard van valve of rear power car guard van. BP pressure should become 0.0 kg/cm^2 in approx. 25 to 30 sec in rear power car & approx. 40 to 50 sec in front power car.

Check for any significant difference in time for droppage of BP pressure to 0.0 kg/cm^2 between front & rear power cars. If any, there may be blockage in BP line of any coach. If found, attend the same. Continuity test of the rake is now completed.

In both the power cars, check the condition & mounting of hand brake cables fitted on both the brake cylinders. Rotate the hand wheel fitted in guard van clockwise to apply the brakes, after full rotation brake should apply in both the brake cylinders & hand brake indicator should show red. Rotate the hand wheel anti clockwise, now brakes of both the cylinders should get release & hand brake indicator should show green.

Charge the BP & FP to 5.0 kg/cm^2 & 6.0 kg/cm^2 respectively. Close the BP & FP angle cock of test rig for 03 minute. Monitor the leakage in both BP & FP. The leakage should not be more than 0.6 kg/cm^2 in 03 minutes.

Isolate the isolating cock of BP & FP of the test rig & angle cock of BP & FP of the cock. Uncouple both hose pipes & open both the angle cocks of coach. After draining of pressure from both the BP & FP hose, release the complete rake by pulling the manual release handle of the DV of each coach & ensure the brake indicator of all coaches should display green colour. Ensure that all BP, FP & BC gauges fitted in power car are calibrated & showing correct reading.

3.6 WSP Testing

Initially with no pressure, the WSP processor in all the coaches should be OFF. If any processor is in ON condition, there is problem in any of pressure switch, wiring or K-05 relay. Attend the same.

Start the BP & FP pressure. The processor should automatically ON when BP pressure reaches 1.6 to 2.0 kg/cm² in M/s KNORR WSP system & when FP pressure reaches in M/s FTIL WSP system.

Check & attend for loose/proper fitment of WSP components like speed sensor, junction box, dump valve, dump valve connector & pressure switch.

Drop the BP pressure by 1.6 kg/cm², brake should apply in all the coaches. Now check the WSP processor for correct reading '99' on the electrical panel inside the coach. If the reading shows '99', it means that the WSP system is OK. Operate the test button on the processor to check the proper working of dump valves. The dump valve should operate in a sequence & pressure should be exhausted from brake cylinder. If the dump valve is not operated in proper sequence attend the same. Similarly, check & attend the

WSP system of all the coach. All the WSP system should be in operating condition in the rake.

Single car test procedure

pressure	BP	Specified	$5 \pm 0.1 \text{ kg/cm}^2$
	FP		$6 \pm 0.1 \text{ kg/cm}^2$

Please ensure that all the pipe fittings, brake equipment are properly fitted and in place before starting the testing.

Item	Test Parameters	Specified value
1.0	Reservoir Charging	
1.1	Charging time of AR ($0 - 4.8 \text{ kg/cm}^2$)	$175 \pm 30 \text{ sec. (FTIL)}$ $60 \text{ to } 120 \text{ sec. (KB)}$
1.2	Charging time of CR (6.0 litre) ($0 - 4.8 \text{ kg/cm}^2$)	$165 \pm 20 \text{ sec. (FTIL)}$ $160 \text{ to } 210 \text{ sec. (KB)}$
1.3	BP Pressure	$5.0 \pm 0.10 \text{ kg/cm}^2$
1.4	CR Pressure	$5.0 \pm 0.10 \text{ kg/cm}^2$
1.5	FP Pressure	$6.0 \pm 0.10 \text{ kg/cm}^2$
2.0	Sealing test (Allow the system to settle for 2 min. after charging BP & FP. Observe the rate of leakage).	
2.1	BP (Less than 0.1 kg/cm^2 in 5 minutes)	$< 0.1 \text{ kg/cm}^2$
2.2	FP (Less than 0.1 kg/cm^2 in 5 minutes)	$< 0.1 \text{ kg/cm}^2$
3.0	Full Brake Application	
3.1	Reduce BP from 5.0 to 3.4 kg/cm^2	Brake should apply with in 3 – 5 Sec.
3.2	Brake Accelerator	Should not respond
3.3	Maximum BC pressure	$3.0 \pm 0.1 \text{ kg/cm}^2$

3.4	Leakage in BC Pressure within 5 minutes	< 0.1 kg/cm ²
3.5	All brake cylinders	Should be Applied
3.6	Both side Brake indicators	Should show Red
4.0	Release after Brake Application	
4.1	Charge BP (up to 5.0 kg/cm ²)	5.0 ± 0.1 kg/cm ²
4.2	All brake cylinders	Should be Released
4.3	Both side Brake indicators	Should show Green
5.0	Over Charge Protection	
	Check the overcharging of CR it should not be overcharged more than 0.1 kg/cm ² in 10 second.	Less than 0.1 kg/cm ² in 10 sec.
6.0	Emergency Application	
6.1	Reduce BP to 0 kg/cm ²	0 kg/cm ²
6.2	Brake accelerator should respond	blast of air
6.3	Charging time of brake cylinder(0 – 3.0 kg/cm ²)	3 – 5 Sec.
6.4	Max. brake cylinder pressure	3.0 ± 0.1 kg/cm ²
6.5	All Brake Cylinders	Should be Applied
6.6	Both side Brake indicator window	Should show red
7.0	Release after emergency Brake application	
7.1	BC release time (from 3.0 kg/cm ² to 0.4 kg/cm ²)	15 - 20 Sec.
7.2	All Brake Cylinder	Should be Released
7.3	Both side Brake indicator window	Should show Green
8.0	Graduated brake application and Release	
	Graduated brake application and Release (Minimum 7 steps)	Brake should apply & release corresponding to decrease & increase of BP Pressure.
9.0	Test for Pressure switch for Anti skid device	
9.1	Charge the Feed pipe/Brake pipe* pressure	
9.2	Anti skid device	Should get power supply at 1.8 ± 0.2

9.3	Anti skid device * For FTIL - FP & For KBI - BP.	kg/cm ² Power supply should cut off at 1.3 ± 0.2 kg/cm ²
10.0	Isolation Test	
10.1	Close the isolating cocks for Bogie –1 & 2	
10.2	Reduce BP pressure to full brake application	Brake should not be applied
10.3	Both side Brake indicators	Should show Green
10.4	Open both isolating cock	Brake should apply corresponding to opening of isolating cock for bogies
10.5	Both side Brake indicators	Should show Red
10.6	Again close the Isolating cock of bogie 1 & 2 one by one.	Brake should Release
10.7	Both side Brake indicators of bogie 1&2	Should show Green one by one
11.0	Sensitivity Test	
11.1	Reduce the BP pressure at the rate of 0.6kg/cm ² in 6 seconds.	Brake should apply within 6 sec
12.0	Insensitivity Test	
12.1	Exhaust BP pressure at the rate of 0.3 kg/cm ² Per minute	Brake should not be applied.
13.0	Passenger Emergency Pull Box testing	
13.1	Pull the emergency pull box handle & check	BP pressure should remain at 2.0 ± 0.2 kg/cm ²
13.2	Brake accelerator	Should respond
13.3	Check BP Pressure exhaust from emergency	Should exhaust

13.4	brake valve Indicator Lamp on outside the coach Both side	Should glow
13.5	Brake indicators	Should show Red
13.6	After resetting, check exhaust from emergency brake valve	Should stop
13.7	Both side Brake indicators	Should shows Green
14.0	Hand Brake test (Power car only)	
14.1	Apply hand brake by means of wheel	Should work smoothly
14.2	Both side Hand Brake indicators	Should show Red
14.3	Check Brake Cylinders provided with hand brake lever	Should be Applied
14.4	Movement of flex ball cable	Yes Should be proper
14.5	Release hand brake by means of wheel	Should work smoothly
14.6	Check the Brakes	Should release
14.7	Both side Hand Brake indicators	Should show green
15.0	Emergency brake by guard van valve (Power car only)	
15.1	Drop BP Pressure by means of guard valve	Brake should Apply
15.2	Brake accelerator should respond	Blast of air
15.3	Both side Brake indicators Hand Brake indicators	Should show red Should show green
15.4	Reset guard van valve	Brake should releases
16.0	Manual release test	
16.1	Apply full brake application and pull manual release wire of DV; it should be released in one brief pull of Manual release valve.	CR Drops to zero, Brake releases.
17.0	WSP test	
17.1	Check the Speed sensor air gap between sensor and Phonic wheel by means of feeler gauge. (At least at four different locations)	KB - 0.7 to 1.5 mm FTIL -1.5 to 2.5 mm

17.2	Charge the BP/FP Pressure at full specified value.	
17.3	Check the WSP Micro Processor	Should activate at $1.8 \pm 0.2 \text{ kg/cm}^2$
17.4	Check the WSP Micro Processor code.	Should show code 99
17.5	Check the Dump Valve venting by test mode	Should vent one by one in proper sequence
18.0	Check clearance between brake disc & brake pad	1.5 mm

4. MODERN COACHES

4.1 DEMU COACHES

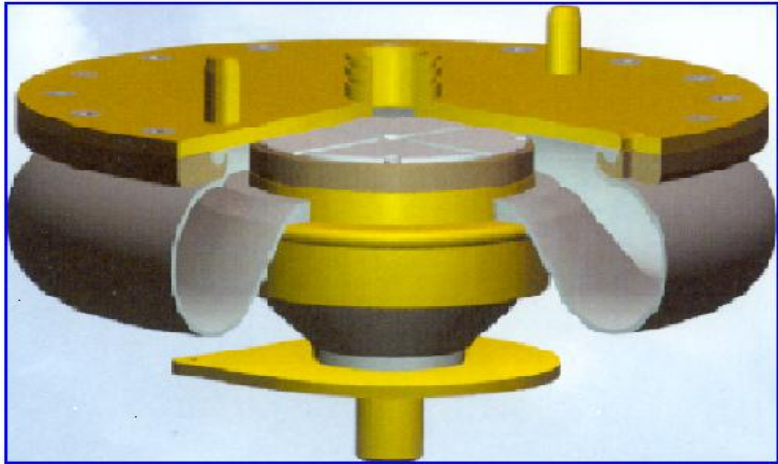
The special features of High Horse Power DEMU coach; These coaches are fitted with Air springs in the secondary suspension to maintain a constant buffer height irrespective of loaded condition to give comfortable riding to the passengers.



Bottom bolsters, Stirrup links and Equalizing stays are eliminated. It is provided with an emergency spring inside the air spring to support the bolster in case air spring fails. Schaku couplers are provided and Side buffers are eliminated.

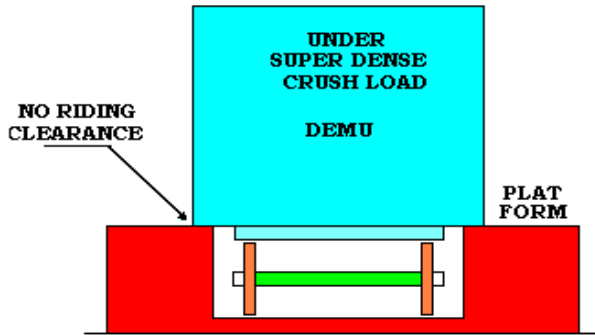
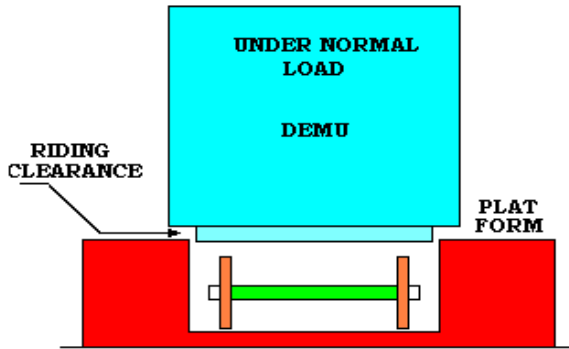
4.2 Air Spring

Air spring is a rubber bellow containing pressurized compressed air with an emergency rubber spring providing various suspension characteristics to maintain a constant Buffer height irrespective of the loaded condition.



In suburban trains like DEMU, the number of passengers entraining (Super Dense Crush Load) in to the coach cannot be controlled and hence the payload of the coach increases from 18 tons to 34 tons. This abnormal increase of payload reduces the Riding Clearances between the Coaches and Wayside platforms and also reduces buffer height resulting in severe hitting of coach on the plat forms.

Due to the Super Dense Crush Load the bolster springs become solid, which in turn damages / breaks the Coil springs resulting in discomfort to the passengers. To overcome the above problems an Air Suspension (Air spring) is introduced in the secondary suspension to maintain a constant buffer height irrespective of loaded conditions by varying the pressure of air inside the air spring.



Components of Air Suspension

Air spring

Leveling valve

Duplex check valve

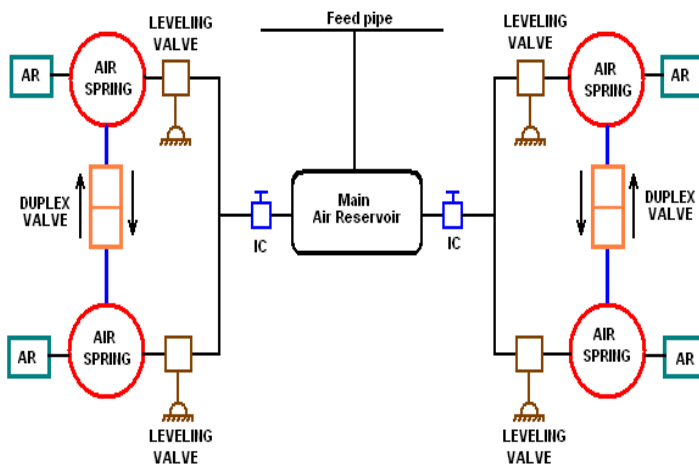
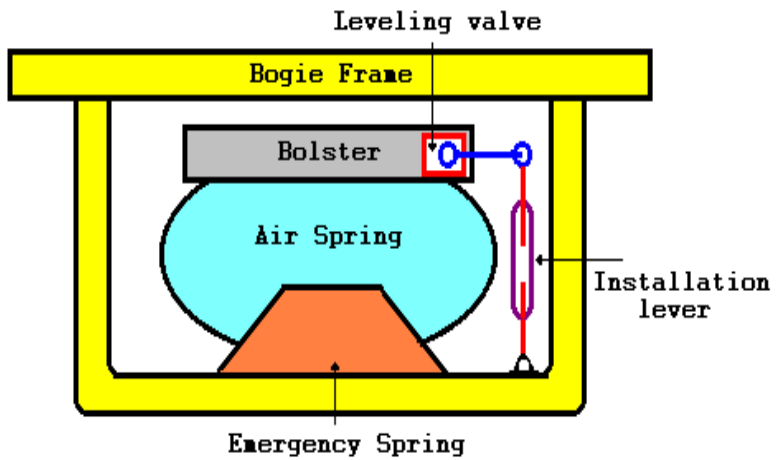
Auxiliary Reservoir

Emergency spring

Installation lever with adjusting Screw rod

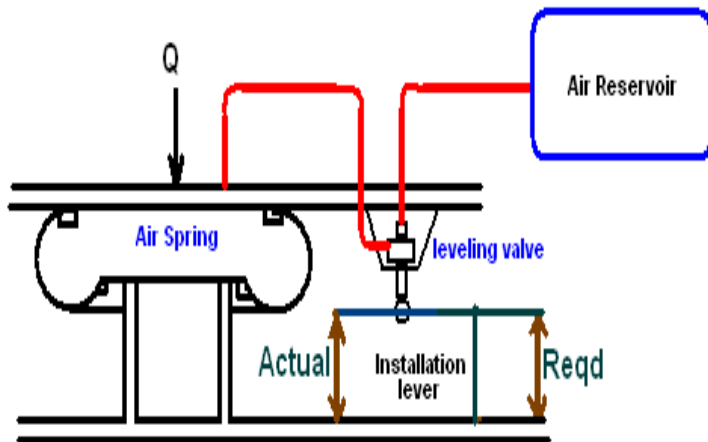
Main Air Reservoir

Isolating cock



Leveling valve:

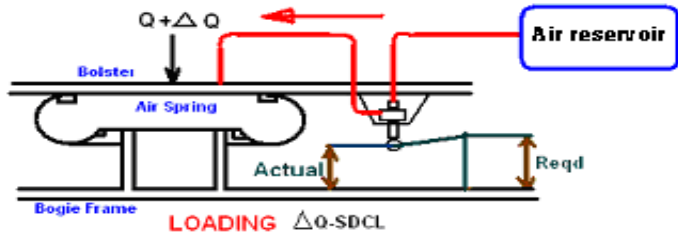
The leveling valve is fitted with Top bolster and is designed to move up and down along with bolster. Under normal condition, it is designed to take LAP position when the actual buffer height is equal to the required buffer height.



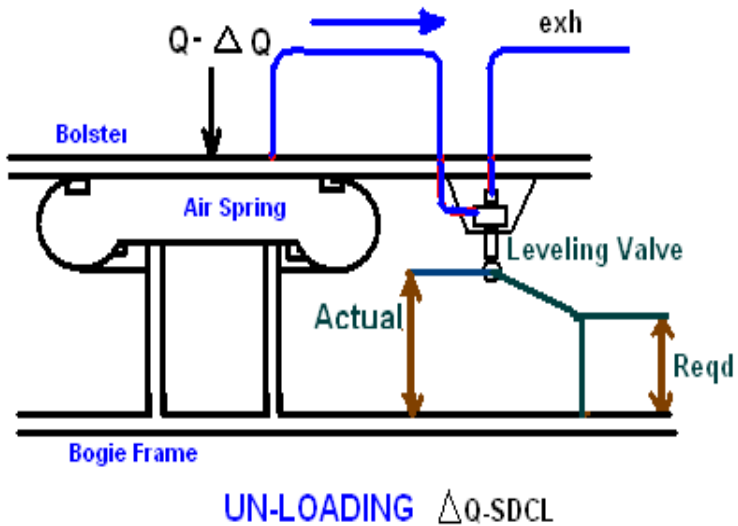
EQUALISATION

Q- normal Load

The function of leveling valve is to connect the main reservoir with the air spring to admit more air in to the Air spring, whenever the actual buffer height is less than the required buffer height due to abnormal increase in the Pay load (Super Dense Crush load).



It also connects the air springs with exhaust to release the excess air from air spring, whenever the actual buffer height is more than required buffer height due to reduction in the Pay load after detraining of passengers from the coach



Installation lever:

It is fitted between the levelling valve and bottom of the bogie frame. The function of installation lever is to operate the levelling valve automatically by moving the handle of the levelling valve up and down according to the condition of the load. The up and down movement of handle of levelling valve admits the compressed air in to the Air spring or releases the compressed air from the air spring through levelling valve in proportion to the pay load of the coach.

Duplex Valve:

It is a double check valve provided between the two Air springs of the same bogie. It operates with a Pressure differential of 1.5 bar. Basically it comprises of two check valves side by side, arranged so that air can flow in either direction whenever the air pressure differential exceeds the pre-set value of 1.5 bar. Whenever a burst of air spring occurs on one side, this valve will ensure that no severe tilt or twist occurs during movement of the coach.

Both the check valves of Duplex valve remains closed, if the pressure between the two springs is within 1.5 bars. When the differential air pressure exceeds the preset value, the air at higher pressure overcomes the spring pressure and flows to the lower pressure via the check valve. The flow continues till the differential reaches the preset value.

In case of burst of Air Spring, the air leaks to atmosphere. Due to high-pressure differential, the Duplex check valve releases the air from the intact air spring through burst air spring. Thus

complete coach will gradually come down and rest on the emergency rubber springs.

Auxiliary reservoir of Air Spring:

It is fitted with the Air spring. The capacity of this reservoir is 20 Ltrs. There is an orifice kept between air spring and additional reservoir. It acts as an Air damper to overcome vertical and lateral oscillations so as to increase the riding comfort.

Main Air reservoir:

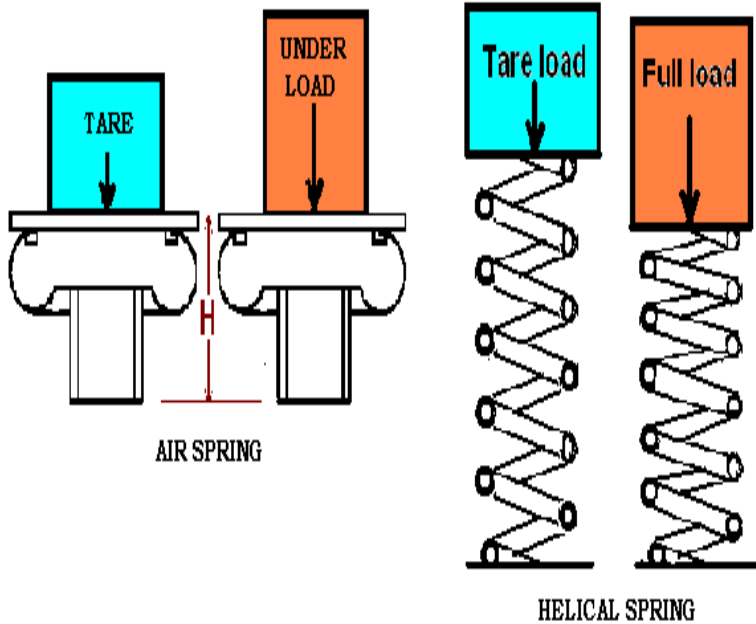
The capacity of the main reservoir is 150 ltrs and it is exclusively used for feeding the compressed air in to the Air Spring.

Emergency Springs:

The function of emergency spring is to support the top bolster to prevent tilt of coaches whenever the Air spring bursts.

4.2.1 Comparison of Helical coil springs with Air Springs:

Unlike steel springs, air springs retain their height under changing loads. The low natural frequency of air spring suspension remains virtually constant. In case of coil spring, deflection is proportionate to the load. Therefore under high payload situation, space constraint becomes critical, leading to the use of stiffer springs resulting in unsatisfactory ride behaviour and reduced speed potential. Air springs through their control mechanism offer a load proportionate stiffness, constant floor height and better ride behaviour with higher speed.



Advantages of Air Suspensions

Capable to sustain Super Dense Crush Load of suburban traffic at high speeds. It maintains a Constant floor height of coach. It facilitates excellent riding comfort with riding index of 2.5. Safe running due to the excellent Air Damping. Low design height. Unusual noise emitted due to hitting of coaches on the plat forms is eliminated. The Stirrup links, Coil springs and equalizing stays are eliminated and therefore easy to maintenance.

5. DOUBLE DECKER COACHES

Double Decker coaches are manufactured in RCF.

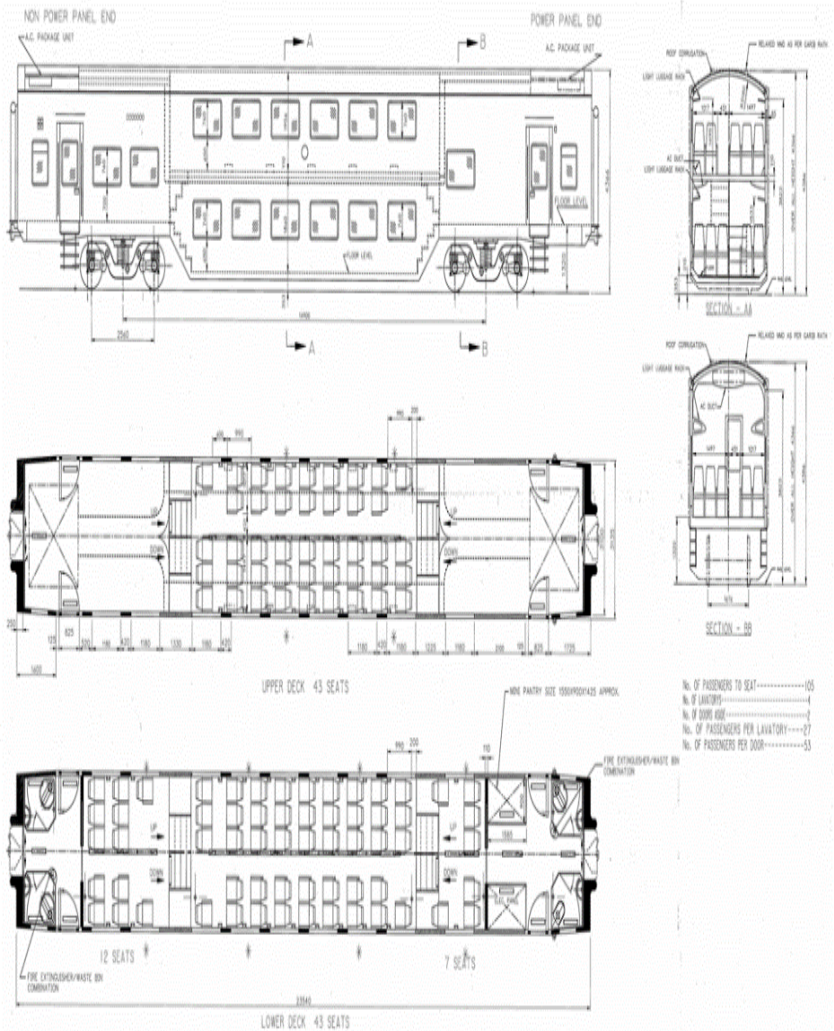


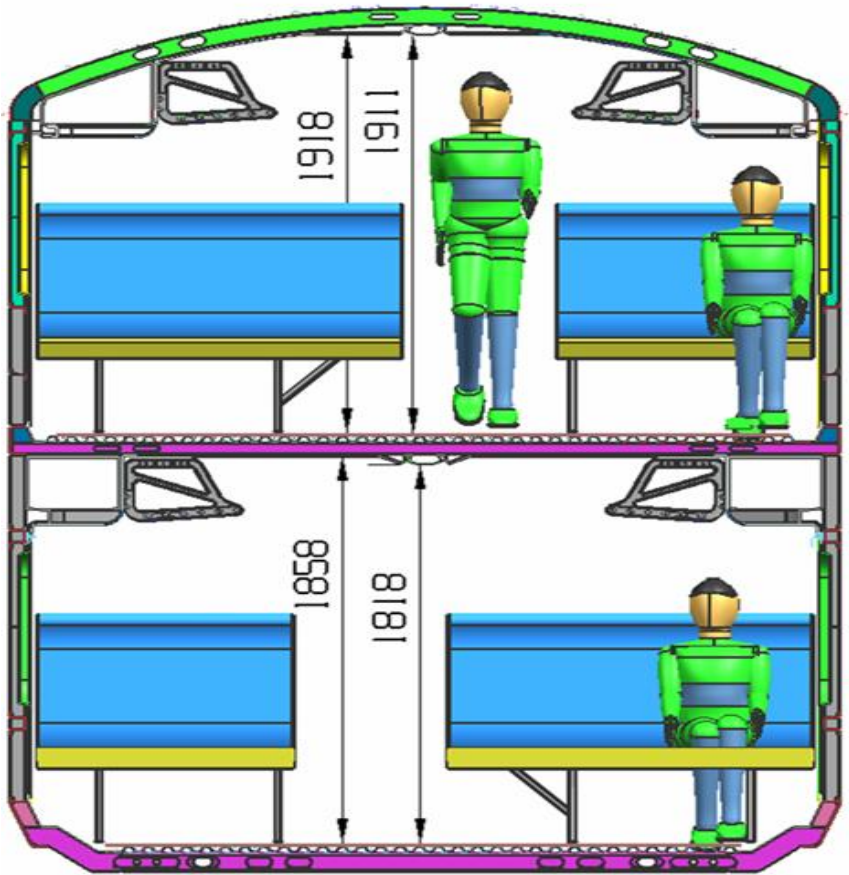
Presently only AC Double Decker coaches are manufactured.

The coach height is 121 mm more than other LHB coaches at top centre (Height of Double Decker coach is 4386 mm at top centre).

Width is reduced by 115 mm (width is 3135 mm)

Seating capacity is 120 seats (only chair car).





These coaches are provided with Type 'H' tight lock CBC coupler.

Four toilets with CDTS are provided in each coach.

These coaches are provided with FIAT Bogie having air spring in the secondary suspension.



These coaches are provided with FIBA (Failure Indication & Brake Application device)

6. AIR BRAKE

The brake system in which compressed air is used in the brake cylinder for the application of brake is called air brake.

Competition from other form of transport has warranted the Railways to run trains at higher speed, heavier load etc. to achieve this better and reliable braking is required. The vacuum brake has got its own limitations like brake fading, increased application and release timings etc., in practice it is not reliable to run trains in higher altitudes due to insufficient vacuum levels in brake van and train engine. Hence to overcome the above problems, it has become necessary to introduce Air brake system to control the speed of the train and to stop it within a reasonable distance, irrespective of length, load of the train, distance covered and altitude of the train.

Advantages of Air brake over Vacuum brake system

Uniform brake power is possible throughout the train in air brake, but it is not possible in case of vacuum brake, since the pressure drop at the rear of the train is up to 20%. The propagation rate of compressed air is 260 m/sec to 280 m/sec. when compared to 60 to 80 m/sec. in the case of vacuum brake. The Air brakes have potentiality to run trains longer than 600 metres length. The air brake trains have potentiality to run heavier trains than 4500 tons, Shorter braking distance, Suitable for higher altitudes, Compact and Easy to maintain, Consumption of spare parts is very less, Simple brake rigging, Quicker application and release, so

better punctuality can be achieved, Better utilisation of rolling stock since less maintenance and pre departure detention.

Differences between Air Brake and Vacuum brake

SN	Air Brake	Vacuum Brake
1.	Air brake works on compressed air at 5 Kg/Cm ² maintained in brake pipe	Vacuum brake works on atmospheric pressure at 1.03 Kg/Cm ²
2.	At the time of brake application compressed air is admitted in to the brake cylinder up to a max of 3.8 Kg/Cm ²	In vacuum brake air at atmospheric pressure is admitted
3.	Distributor valve is the main functioning unit in the air brake system	Vacuum cylinder is the main functioning unit in the vacuum brake system.
4.	Brake application is caused by the outward movement of the piston	The inward movement of the piston causes brake application.
5.	Brake cylinder is connected to auxiliary reservoir during brake application and to exhaust during brake release through the distributor valve.	Vacuum cylinder is directly connected to train pipe during brake application and release.
6.	For any reason, if the cylinder has to be made inoperative, it can be conveniently done by closing the isolation cock.	For any reason if the cylinder has to be made inoperative, the train pipe nipple or the syphon pipe has to be dummied.
7.	On either ends of brake pipe and feed pipe angle cocks are provided	No angle cocks are provided in the train pipe.

	for closing and opening.	
8.	Air hoses are used to provide flexible connection between adjacent vehicles.	Hosepipes are used to provide flexible connection between two adjacent vehicles.
9.	Palm ends (or) coupling heads are used on the coupling side of air hoses.	Universal couplings are used on the coupling side of hose pipes.
10.	M.U washers are used to make airtight joints on palm ends.	I.R washers are used to make airtight joints on universal couplings.
11.	In case of train parting, brake application is automatic by venting out air pressure from BP through air hoses.	In case of train parting brake application is automatic by admission of atmospheric air in to the vacuum cylinder through hosepipes.
12.	Emergency braking distance is 632 metres. (4500 tonnes trailing load, level track at 65 KMPH speed)	Emergency braking distance is 1097 metres. (4500 tonnes trailing load, level track at 65 KMPH speed)
13.	No brake power fading.	There is always a brake power fading to the extent of 20 %.
14.	Uniform brake power is possible throughout the train due to the higher propagation rate.	Uniform brake power is not possible due to the lower propagation rate of atmospheric air in the vacuum.

6.1 Types of Air Brake System

There are two types of air brakes namely;

- Direct release (Mainly used on American Rail Road)
- Graduated Release (Used on Indian Railways)

Direct release system

In direct release system the brake cylinder pressure cannot be reduced in steps by increasing the brake pipe pressure in steps during release. The brakes are released immediately, as soon as releasing of brake is initiated.

Brake pipe pressure in Kg/Cm ²	Brake cylinder pressure in Kg/Cm ²
3.5	3.8
3.8	0
4.0	0
4.2	0
4.5	0
5.0	0

Graduated release system:

In this system the brake cylinder pressure can be reduced gradually in steps in proportion to the increase in brake pipe pressure.

Brake pipe pressure in Kg/Cm ²	Brake cylinder pressure in Kg/Cm ²
3.5	3.8
3.8	0

4.0	0
4.2	0
4.5	0
5.0	0

The inherent inexhaustibility feature in Graduated release system facilitates in locking of air pressure in the brake cylinder, during brake application. This helps the driver to control the train effectively over gradients irrespective of repeated brake application. Hence it is preferred in Indian Railways due its topography.

Note: In both the types brake application is directly proportional to the reduction in brake pipe pressure.

The Air Brake System is further classified into;

1. Single pipe air brake system.
2. Twin pipe air brake system.

Single pipe system:

There is only one pipe called brake pipe running from loco to the brake van in order to get continuity of air for the application and release of brakes.

Twin pipe system:

In addition to the brake pipe, there is one more pipe called feed pipe, running from loco to the brake van to charge the auxiliary reservoir continuously to 6 Kg/Cm².

6.2 Components of air brake equipment

Sl. No	Description	Twin pipe system		Single pipe system
		U/F Mounted	BMBS	Goods Stock
1.	Brake pipe	01	01	01
2.	Feed pipe	01	01	-
3.	Cut off angle cocks	04	04	02
4.	Brake cylinders	02	04	01
5.	Distributor valve	01	01	01
6.	Auxiliary reservoir Capacity	02 100 litres	01 200 litres	01 100 litres
7.	Isolating cock	05	05	01
8.	Centrifugal dirt collector	02	02	01
9.	Check valve	01	01	-
10.	Air hoses	04	04	02
11.	Palm ends	04	04	02
12.	Control Reservoir	01	01	01

Distributor Valve assembly

The distributor valve assembly consists of a valve body, a common pipe bracket, and a control reservoir. All the pipe connections from brake cylinder, auxiliary reservoir and brake pipe are connected to distributor valve through the common pipe bracket. The pipe bracket remains on the wagon/coach when the distributor valve is removed for overhaul and maintenance without

disturbing the pipe connections. The control reservoir is directly connected to distributor valve through common pipe bracket. An isolating cock is provided either on the distributor valve or on the adaptor to isolate the distributor valve when found defective. A manual release valve is provided at the bottom of the distributor valve by which the brakes in a particular vehicle can be released manually by pulling the handle.

Brake Cylinder

The brake cylinder receives compressed air from auxiliary reservoir after being regulated by the distributor valve and converts to mechanical brake power by outward movement of its piston assembly. The compression spring provided in the brake cylinder brings back the rigging to its original position when brake is released.

Different sizes of Brake Cylinders

Size of the cylinder	Mounted on	Stock
355 mm diameter / 14 inches	Body	Coaching & Goods Stock
304 mm diameter / 12 inches	Body	Brake Van
203 mm diameter / 08 inches	Bogie	Coaching Stock

Cut-off Angle Cock

Cut off angle cocks are provided on either ends of the brake pipe and feed pipe. These cocks are used at the time of uncoupling of wagons/coaches. This has a vent feature. Once the cock is closed it allows the air trapped in the air hose to atmosphere. When MU washer or hose assembly itself has to be

changed, the cut off angle cocks are closed which in turn isolates the brake/feed pipe from further charging and allows the entrapped air in the hose to flow out, to carry out the repairs safely. It also serves as dummy for the rear of the wagon/coach and the front of engine. When the handle is parallel to the pipe the cock, it is in open position and when at right angles to the pipe, it is in closed position.

Control Reservoir

Control reservoir is mounted on the common pipe bracket. It always maintains a pressure of 5 Kg/Cm² after charging. It works as a reference pressure to operate the different sub-assemblies/valves provided in the distributor valve to facilitate application and release of brakes. The brake pipe pressure acts in the top of the diaphragm and control reservoir pressure acting at the bottom of the diaphragm.

Auxiliary Reservoir

In air brake system, compressed air is required to be sent to the brake cylinder for brake application. If the compressed air is to be sent from the loco to brake cylinders of each coach, it will not be possible in the case of accident such as train parting. Hence it has become necessary to ensure sufficient quantity of compressed air with required pressure is always available in every rolling stock before the trains are despatched. That is why all the rolling stocks are provided with Auxiliary reservoirs to store the compressed air.

Dirt Collector

Dirt collectors are provided on branch pipes of both feed pipe and brake pipe. These are meant for removing dust, moisture

and scale particles from air before it enters the distributor valve and auxiliary reservoir. This is achieved by centrifugal action.

Check Valve with choke

This is a one way valve / non-return valve which allows the compressed air from feed pipe to auxiliary reservoir and it prevents the back flow of air from auxiliary reservoir to the feed pipe to avoid fall in auxiliary reservoir pressure in the event of failure of air supply from feed pipe. The choke provided in the check valve controls flow of air so that auxiliary reservoirs on the entire train can be filled uniformly. This is provided between the feed pipe and auxiliary reservoir.

Isolation Cocks.

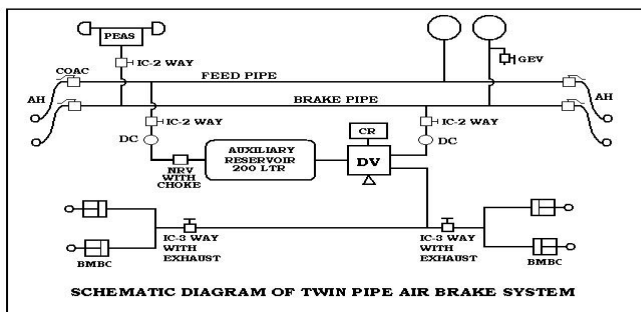
There are five isolation cocks provided in the coaching stock. Locations of these cocks are given below.

Location	Nos.	Remarks
Between brake pipe and DV	01	
Between Distributors valve and brake cylinders.	02	(2 Cylinders)
Between feed pipe and auxiliary reservoir.	01	
Between passenger emergency valve and brake pipe	01	

Differences in Air brake systems of Coaching stock and Goods Stock

Sl. No	Description	Coaching Stock	Goods Stock
1	System	Twin pipe	Single pipe
2	Size of Brake pipe	25 mm	32 mm
3	Size of feed pipe	25 mm	-
4	Number of brake cylinders	02 (U/F Mounted) 04 (BMBS)	01
5	Auxiliary reservoirs	02 (U/F Mounted) 01 (BMBS)	01
6	Capacity of each AR	100 Ltr (U/F Mounted) 200 Ltr (BMBS)	100 Ltr 75 Ltr (BVZC)
7.	PEAS	Available	Not available

Twin pipe air brake system for passenger stock

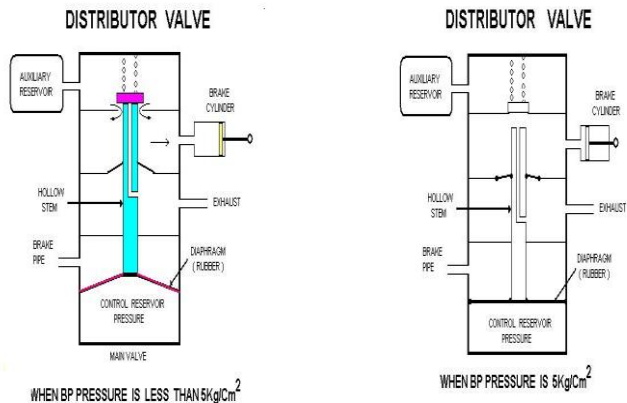


6.3 Working principle of Air Brake

Under normal conditions the Brake pipe is charged with 5 kg/Cm² from the Loco. The control reservoir and the Auxiliary reservoir are also charged with 5 kg/Cm² from BP through Distributor valve in case of single pipe system. In twin pipe system the auxiliary reservoir is charged to 6 kg/Cm² through feed pipe.

When the brake pipe is 5 kg/Cm², the brake cylinder is connected to exhaust through distributor valve in order to keep the brakes in released position fully.

Whenever the brake pipe pressure is reduced below the CR pressure, the DV connects the auxiliary reservoir with the brake cylinder and the air from AR is sent into the brake cylinder to apply the brake. Whenever the brake pipe pressure is equal to CR pressure, the DV disconnects the BC from AR, and in turn connects the BC with Exhaust for the release of brakes fully.

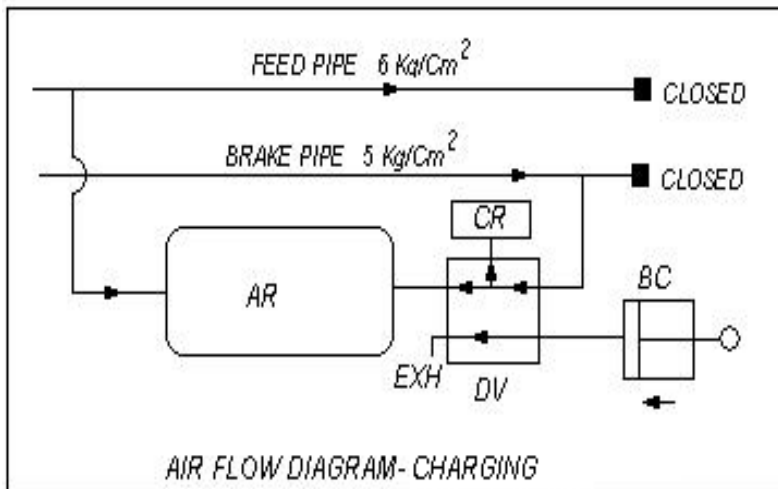


Processes involved in working of Air brake system

- Charging
- Application
- Release.
- Manual Release

i) Charging of Air brake system

Brake pipe is charged with 5 Kg/Cm² by the drivers brake valve from the Loco. Feed pipe is charged with 6 Kg/Cm². AR is charged with 6 Kg/Cm². (Up to 5 Kg/ Cm² it is charged by both brake pipe and feed pipe. Beyond 5 Kg/Cm² & up to 6 Kg/Cm² it is exclusively charged by feed pipe.) The CR is charged through the distributor valve to 5 Kg/sq cm from BP. During charging Brake cylinder is connected to exhaust through distributor valve, to keep the brakes in released condition.



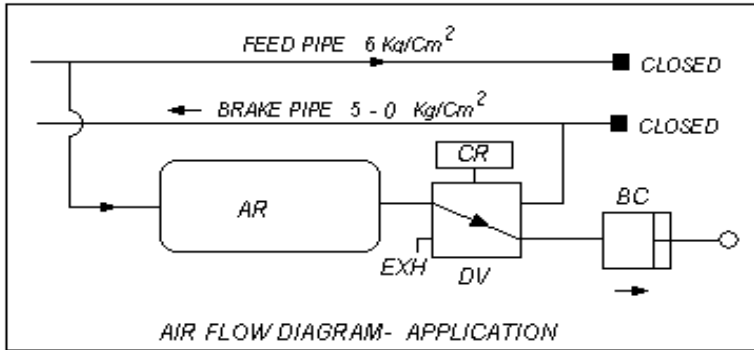
ii) Application of brake in Air brake system

For application the brake pipe is reduced in steps as given below.

Stages	BP pressure is reduced by
Minimum Reduction	0.5 to 0.8 Kg/Cm ² .
Service application	0.8 to 1 Kg/Cm ² .
Full service application	1 to 1.5 Kg/Cm ² .
Emergency application	Above 1.5 Kg/Cm ² .

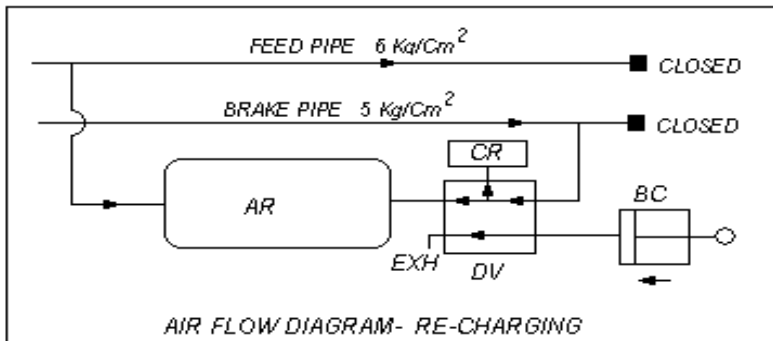
When the brake pipe pressure is reduced in steps as shown above, the air from AR is sent into BC to a maximum pressure of 3.8 Kg/ Cm², during full service application as well as emergency application. During minimum reduction and service application the admission of air from AR in to BC is directly proportional to the reduction in the BP pressure.

Note: Before AR is connected to BC, the AR and CR are disconnected from BP, and BC also is disconnected from Exhaust. The AR is continuously charged to 6 Kg/Cm² during brake application by Feed pipe. The CR pressure should remain at 5 Kg/Cm². However there may be a little drop in CR pressure during brake application, due to the design.



iii) Releasing/Recharging of Air brake system

During release, the BP pressure is increased in steps. When the BP pressure is increased in steps, the brake cylinder is disconnected from AR and in turn connected to exhaust. The air from Brake cylinder is released / vented progressively depending upon the increase in the brake pipe pressure. When the brake pipe pressure is brought to 5 Kg/Cm² the air from brake cylinder is completely exhausted and the brakes are released fully.



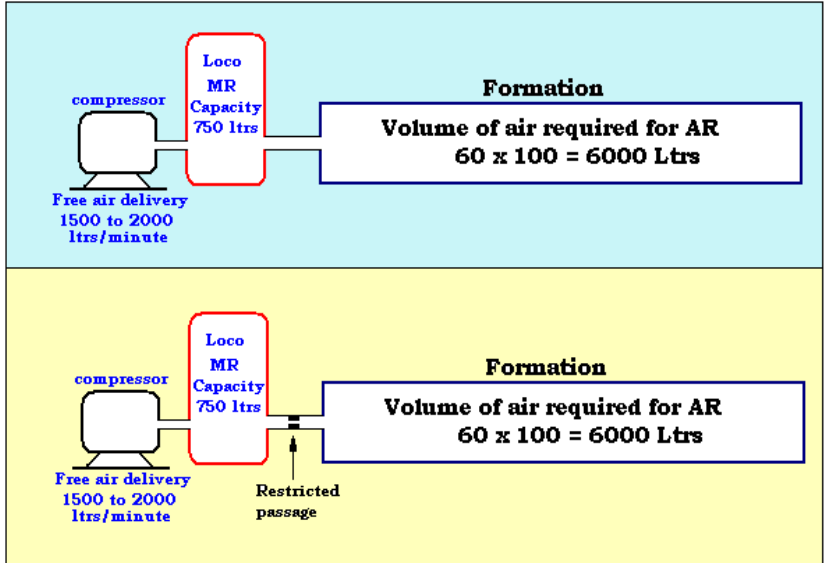
iv) Manual Releasing

Whenever the loco is detached, BP pressure is brought to zero and brake application takes place due to the existence of CR pressure at the bottom of the main diaphragm. To release the brakes manually, the hollow stem in the DV should be brought to the normal position by releasing the air from CR. To facilitate this, the release valve provided at the bottom of the DV is given a brief pull. During this operation, the air from CR is released which in turn brings the hollow stem to the normal position to connect BC with exhaust for releasing of brakes.

6.3.1 Requirement of choke for charging of Auxiliary reservoirs

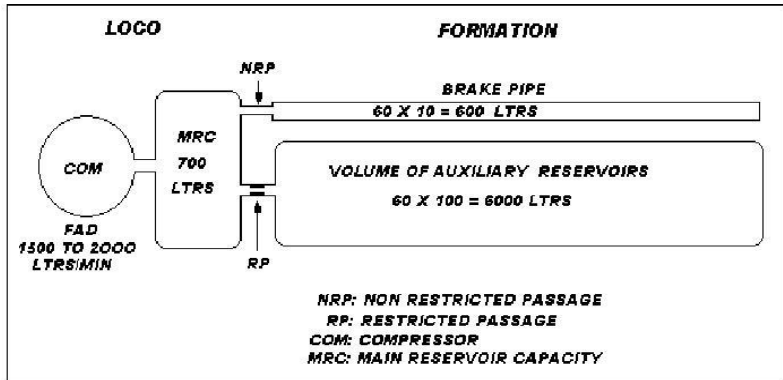
With 100 ltrs capacity AR on each wagon, for a formation of 59+1 wagons approximately 6000 litres of air is required for charging the auxiliary reservoirs.

Main reservoir capacity of loco is only 750 litres, if the auxiliary reservoirs are charged directly without any restrictions; the main reservoir pressure will drop abruptly, which is not safe. In order to prevent the MR pressure from dropping abruptly, the air brake system is designed to use only the air delivered by the compressor (free air delivery) to charge the AR and to maintain MR pressure within prescribed limits. Hence auxiliary reservoirs are charged through restricted passage (choke).



6.3.2 Ensuring complete charging of the system

While charging the formation, Brake pipe is charged first before Auxiliary reservoirs. The volume of air required for charging the brake pipe for one wagon is only 10 litres. So a formation which consists of 58+1 wagons requires approximately 600 litres of air for charging the brake pipe when compared to 6000 litres in the case of auxiliary reservoirs. As the free air delivery of compressed air from the loco is about 1500 to 2000 litres per minute at normal speed, moreover only 600 litres of air only required for the brake pipe, it is charged to the required pressure within a minute (60 Seconds).



Even though gauge fitted with brake and the feed pipe in the brake van records a minimum of 4.8 Kg/Cm² and 5.8 Kg/Cm² respectively within a minute, AR and CR are yet to be charged to the required pressure, for which it takes about 180 to 240 seconds. Hence to ensure full charging of the system at least 4 minutes to be allowed, then only brake application will be effective.

Requirement of twin pipe system in coaching stock

➤ Charging time of Auxiliary reservoirs

As the free delivery of compressed air from the loco is 1500 litres to 2000 litres per minute at normal speed, to charge 6000 litres of air in the auxiliary reservoirs, it takes about 180 to 240 seconds.

- To charge AR by 5 Kg/Cm² = 240 Seconds (Maximum)
- To charge AR by 1 Kg/Cm² = 48 Seconds (Maximum)

➤ **Application time:**

The application time is the time taken by the Distributor valve to admit a pressure of 3.6 Kg/Cm² in to Brake cylinder from the Auxiliary reservoir during Full service application or Emergency application.

- The application time for the coaching stock is 3 to 5 Seconds.
- The application time for the Goods stock is 18 to 30 seconds.

After the Full service or Emergency brake application the brake cylinder gets a maximum pressure of 3.8 Kg/Cm² from Auxiliary reservoir.

➤ **Releasing time:**

The releasing time is the time taken by the Distributor valve to release the air from Brake cylinder from 3.8 Kg/Cm² to 0.4 Kg/Cm².

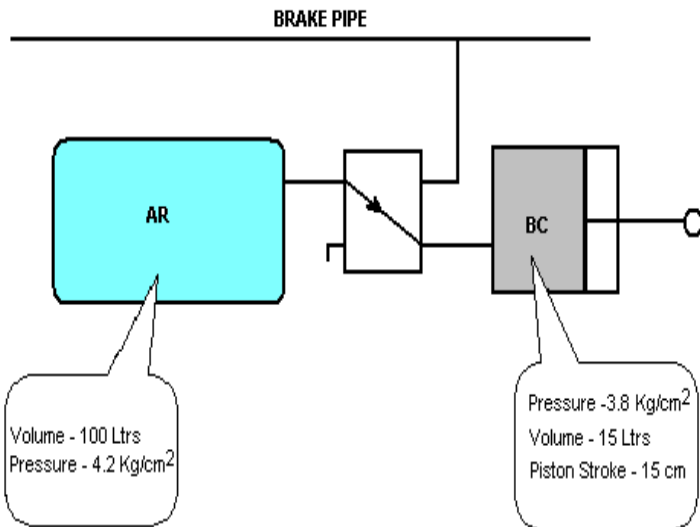
Note: The releasing time does not depend upon the piston displacement but it depends upon the BC pressure only.

- The releasing time for the coaching stock is 15 to 20 Seconds.
- The releasing time for the Goods stock is 45 to 60 seconds.

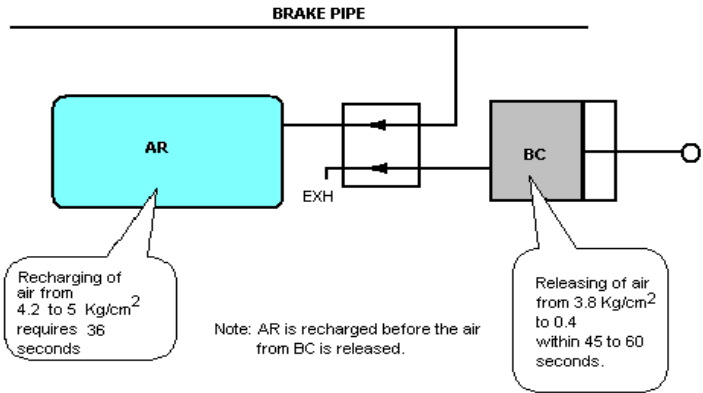
The difference in the application time and release time between the coaching and goods stock DVs is achieved by varying size of the choke in DV between the AR and BC for the application, and by varying size of the choke in DV between Brake cylinder and Exhaust for the release. Hence the DVs of coaching &

freight stocks are not interchangeable, since the application and release timings are different for coaching and freight stock.

During brake application, as the air from Auxiliary reservoir is sent in to brake cylinder, there is always a reduction in the AR pressure and it is likely to drop to 4.2 Kg/Cm². hence during release, it must be ensured that before the air from brake cylinder is released completely, the AR should be recharged to 5 Kg/Cm², so that the system can be kept ready for next brake application.

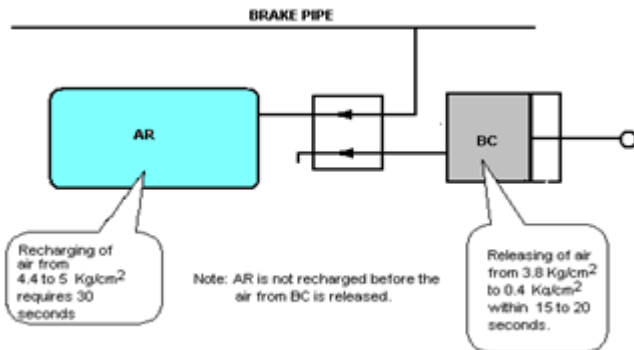


To charge AR from 4.2 to 5 Kg/Cm² the DV takes approximately 36 Seconds, and to release the air from BC from a pressure of 3.8 Kg/Cm² to 0.4 Kg/Cm² the DV takes 45 to 60 Seconds in the case of goods stock.

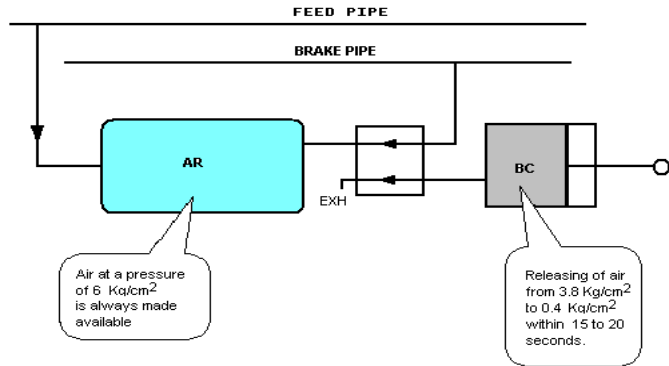


From the above facts, as it is possible to recharge the AR from 4.2 to 5 Kg/Cm² within the release time of 45 to 60 seconds, a Single pipe system itself is sufficient for the Goods stock.

In the case of coaching stock, to release the air from BC from the pressure of 3.8 Kg/Cm² to 0.4 Kg/Cm² the DV takes 15 to 20 Seconds. And to re-charge AR from 4.2 to 5 Kg/Cm² after application, DV takes approximately 36 Seconds.



From the above fact, it is clear that it is not possible through DV to recharge the AR from 4.2 to 5 Kg/Cm² within the releasing time of 15 to 20 seconds for the Coaching stock.



Hence it has become necessary to introduce one more pipe called feed pipe to recharge the AR always to 6 Kg/Cm², from the other end of the AR within the release time of 15 to 20 seconds and there by auxiliary reservoir pressure is maintained to optimum level for repeated brake applications.

6.3.3 Passenger emergency alarm system

Passenger emergency alarm system is provided between the main brake pipe and the alarm chain. When the alarm chain is pulled, the air pressure from the Brake pipe is vented out through the 8 mm choke provided in the Passenger emergency alarm valve. Due to the sudden drop of air pressure from the brake pipe in the system, the airflow indicator in the Locomotive deflects from its normal position and also gives hooting signal. By this the driver

comes to know about the drop in BP in the formation and he applies the brakes to stop the train.

The passenger emergency alarm system consists of two main parts.

- Passenger emergency alarm valve (PEAV)
- Passenger emergency alarm signal device (PEASD)

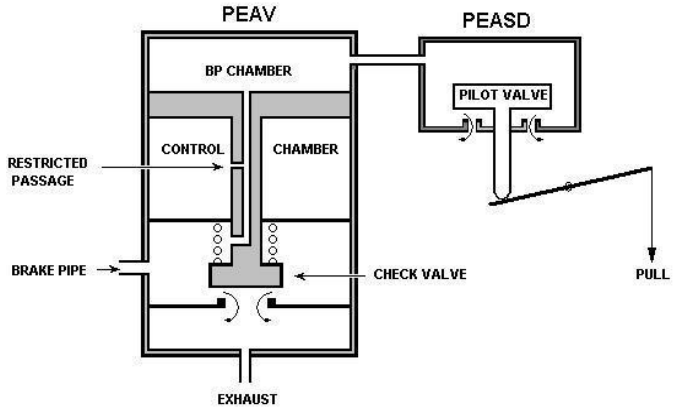
The passenger emergency alarm valve (PEAV) consists of a spring loaded hollow piston fitted with a check valve at the bottom. It has also got a control chamber at the bottom of the piston and a brake pipe chamber at the top of the piston. An 8 mm diameter exhaust port is provided at the bottom of the valve to release the air from main brake pipe. The brake pipe chamber available at the top of the piston is connected with the PEASD through branch pipes.

The PEASD consists of a pilot valve which can be operated by pulling the chain by the passenger. It is also provided with two numbers of exhaust ports to facilitate the removal of air from the top of the piston (Brake pipe chamber) by pulling the chain.

WORKING

During charging the brake pipe chamber and the control chamber of PEAV is charged with 5 Kg/Cm², the control chamber is charged through the restricted passage. The air which is available at the brake pipe chamber at the top of the piston is also made available at the top of the pilot valve of PEASD. During charging

the spring loaded check valve closes the passage between main brake pipe and the exhaust of PEAV. (Ref. fig)



When the chain is pulled by the passenger, the pilot valve in PEASD is lifted first. The air from brake pipe chamber of PEAV is then released through the exhaust ports of PEASD and in turn brings the pressure at the top of the piston to zero immediately. Due to the existence of control pressure at the bottom of the piston, the hollow piston gets lifted, which in turn connects the main brake pipe with the exhaust to deplete the air from main brake pipe to initiate brake application.

Resetting of PEASD

Unlike vacuum brake, where in turning the disc will automatically reset the valve, in air brake system in addition to the turning the disc, the key which is integral part of PEASD has to be turned by 90 degree clockwise.

In recent modification a wire rope is connected to the PEASD so that it can be reset from ground level eliminating the need to climb the coach for resetting the PEASD.

6.4 Trouble shooting faults in air brake system en-route

The major problems noticed in the air brake system are

BP punctured / Hose burst, FP punctured / Hose burst, AR pipeline punctured or damaged, Malfunctioning of DV, Malfunctioning of PEAS.

- **BP punctured / Hose burst**

In case of single pipe system, if brake pipe is punctured the brakes get applied on the full formation. The affected wagon should be detached from the formation.

In case of twin pipe system, if the brake pipe is punctured, the brake pipe of the affected coach can be by passed without detaching the coach by connecting the FP of the affected coach with the BP of the adjacent coach. A specially made intermediate coupling made by welding the FP and BP palm ends together is available to establish these connections.

- **FP punctured / Hose burst**

The train has to be run with single pipe system isolating the FP pipe from the first coach itself.

- **AR pipeline punctured or damaged**

If the branch pipe between the FP and AR is punctured, the Isolating cock provided on the branch pipe of FP of the particular coach can be isolated and that particular coach will work on single pipe system. If the branch pipe between the common pipe bracket and AR is punctured, both the isolating cocks on the BP and FP branch and also the DV to be isolated and the particular coach will not have brake power, this has to be endorsed on the BPC.

- **Malfunctioning of DV.**

DV to be isolated and ensure the brakes are released. It has to be endorsed in BPC.

- **Malfunctioning of PEAS₂**

In the case of leakage through PEAV, if the leakage is not arrested even after resetting the PEASD, isolate the cock provided between the BP pipe and the PEAV.

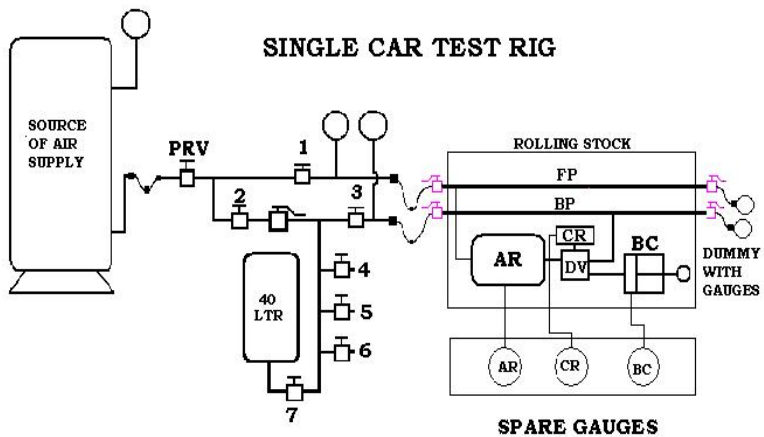
6.5 Single car testing

The different tests conducted with a Single car test rig;

1. Leakage in Feed pipe.
2. Leakage in Brake pipe.
3. Brake cylinder filling time.
4. Brake cylinder releasing time.
5. Sensitivity test.
6. Insensitivity test.
7. Emergency application test.

8. Piston Stroke.
9. Leakage in the Brake cylinder.
10. Graduated Application test.
11. Graduated release test.
12. Working of PEAS.
13. Working of GEV.
14. Manual release Test.

Procedure for conducting of Single Car Test Rig



1. LEAKAGE IN FP AND BP.

- Charge the system fully.
- Close the Cock No. 1 and 3.
- Observe the pressure drop in FP and BP for three minutes.

The leakage rate in the FP and BP should not be more than

0.2 Kg/Cm ² in one minute in FP
0.2 Kg/Cm ² in one minute in BP for coaches
0.1 Kg/Cm ² in one minute in BP for wagons

2. BC FILLING TIME

- Charge the system fully
- Bring the A-9 valve to full service application position.
- Observe the BC pressure.
- The BC pressure should reach to 3.6 Kg/Cm² within.

3 to 5 seconds for Coaching stock
18 to 30 seconds for Goods stock.

- Observe the maximum pressure. It should be 3.8 Kg/Cm².

3. BC RELEASING TIME

- Bring the A-9 valve to release position.
- Observe the BC pressure.
- The BC should drop from 3.8 Kg/Cm² to 0.4 Kg/Cm² within

15 to 20 seconds for Coaching stock
45 to 60 seconds for Goods stock.

4. SENSITIVITY TEST

- Open the cock No.7 and Charge the system fully.
- Close the Cock No.2 and Open the cock No.4.
- Wait for 6 seconds and close the cock No.4. (This will reduce the BP pressure by 0.6 Kg/Cm² in 6 sec automatically)
- Observe the Brake cylinder. The brake should be in applied condition.

5. INSENSITIVITY TEST

- Open the cock No.7 and Charge the system fully.
- Close the cock No.2 and Open the cock No.5.
- Wait for 60 seconds and close the cock No.5. (This will reduce the BP pressure 0.3 Kg/Cm² in 60 seconds automatically)
- Observe the Brake cylinder. The brake should not be in applied condition.
- Observe the BP and CR pressure. Both should be at 4.7 Kg/Cm²

6. EMERGENCY APPLICATION TEST

- Close the cock No.7 and Charge the system fully.
- Close the cock No.2 and Open the cock No.6.
- Observe the Brake cylinder pressure. The maximum BC should be 3.8Kg/ Cm².

7. PISTON STROKE

After the emergency or full service application measure the piston stroke. It should be within

65 ± 10 mm for coaching stock (UF mounted)
85 ± 10 mm for goods stock –Empty
130 ± 10 mm for goods stock - load
25 to 32 mm for BMBC
87±10 mm for BTPN
70 ±10 mm for BVZC
120±10 mm for BOBRN

8. LEAKAGE IN BC

- After the emergency brake application observe the leakage in the Brake cylinder.
- The leakage in the BC should not be more than 0.1 KG/Cm² in 5 minutes.

9. GRADUATED APPLICATION TEST

- Charge the system fully.
- Reduce the BP pressure in steps through A-9 valve.
- Observe the BC pressure. The pressure should increase in steps.

BP	BC
5.0	0
4.5	1.25
4.2	2.0
4.0	2.5
3.8	3.0
3.5	3.8

10. GRADUATED RELEASE TEST

- Increase the BP pressure in steps through A -9 valve.
- Observe the BC pressure. The pressure should decrease in steps.

BP	BC
5.0	0
4.5	1.25
4.2	2.0
4.0	2.5
3.8	3.0
3.5	3.8

11. WORKING OF PEAS.

- Charge the system fully.
- Pull the alarm chain from inside the coach.
- Observe the BP pressure and BC.
- BP pressure should drop and brake should apply.
- Reset the PEASD.
- Observe the BP pressure and BC.
- BP pressure should reach to 5 KG/Cm² and brake also should release.

12. WORKING OF GEV (Guard Emergency Valve)

- Charge the system fully.
- Operate the GEV handle.
- Observe the BP pressure and BC.
- BP pressure should drop and brake should apply.
- Bring back the GEV to normal position.
- Observe the BP pressure and BC.

	brake pressure is reduced at the rate of 0.6 Kg/cm ² in 6 seconds		
	b) Brake application when brake pressure is reduced at the rate of 0.3 Kg/cm ² in 60 seconds	Brake should not apply	
5.	Emergency brake application and release		
	a) Maximum brake cylinder pressure	3.8 ± 0.1Kg/cm ²	
	b) Manual release of brake cylinder after emergency application	Brake cylinder should get fully released	
6.	Graduated application and release		
	a) Application	Brake pipe pressure decreases in steps and Brake cylinder pressure builds up in steps	
	b) Release	Brake pipe pressure increases in steps and Brake cylinder pressure reduces in steps	
7.	Leakage in Brake cylinder pressure in 5 minutes after emergency application	0.1 Kg/cm ² within 5 minutes	
8.	Piston stroke	25-32 mm	

9.	Passenger alarm system a) Pull handle b) Reset PEASD	(1) Air to exhaust from PEAV. (2) Brake should apply (3) Coach indication light should glow Exhaust of air should stop and indication light should extinguish	
10.	GEV test a) Pull valve handle b) Normalize the handle c) Testing of Brake pipe and Feed pipe in guard's compartment	Brake pipe air to exhaust. Brake should apply Air exhaust to stop Gauges should register variation in Brake pipe and Feed pipe.	
10.	Dirt collector	Cleaned / Renewed	

6.6 BOGIE MOUNTED BRAKE SYSTEM

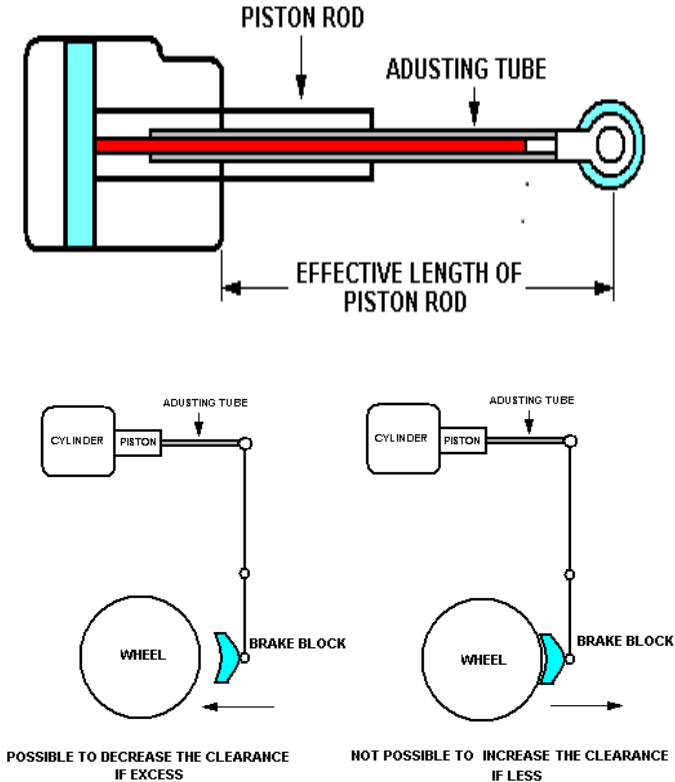
In order to overcome the problems faced due to the breakages and malfunctioning of SAB en-route, and also due to the frequent breakages and replacement of Cast Iron brake blocks, Bogie Mounted Brake System is introduced. In this system, the brake rigging in the under frame and SAB's are eliminated by mounting the cylinders directly on the bogie frame itself. Since the brake force available is less, High friction 'K' type composite brake block is used to overcome the deficiency in brake power.

6.6.1 Special features of Bogie Mounted Brake System

- External slack adjusters are eliminated.
- High friction composite “K” type brake blocks are used, whose life is increased by 5 to 6 times than that of cast iron brake blocks.
- It has an in-built slack adjuster by which the effective length of the piston rod can be increased by 305mm automatically; whenever the piston stroke exceeds 32mm due to wear on the brake blocks and the wheel.
- Totally 4 Nos. of 8” size brake cylinders (2 per bogie) are used in place of two Nos. of 14” cylinders in standard body mounted air brake system.
- The cylinders are mounted between central longitudinal members connecting the bogie transom and the head-stock on either side. It is provided with less No. of brake fittings, therefore easy to maintain.
- Unusual noise emitted by the anti-vibration bracket in case of SAB, on run is completely eliminated.
- The forces acting on the levers and truss beams is only 40% when compared to under frame mounted system, therefore the wear on the brake gear components are less, and hence the frequent replacements of these components are minimised.
- As the forces acting on the Truss beam is only 1 tonne, when compared to 3.2 tonnes in the under frame stock, 13 tonnes capacity truss beams are sufficient.

6.6.2 Bogie Mounted Brake Cylinders:

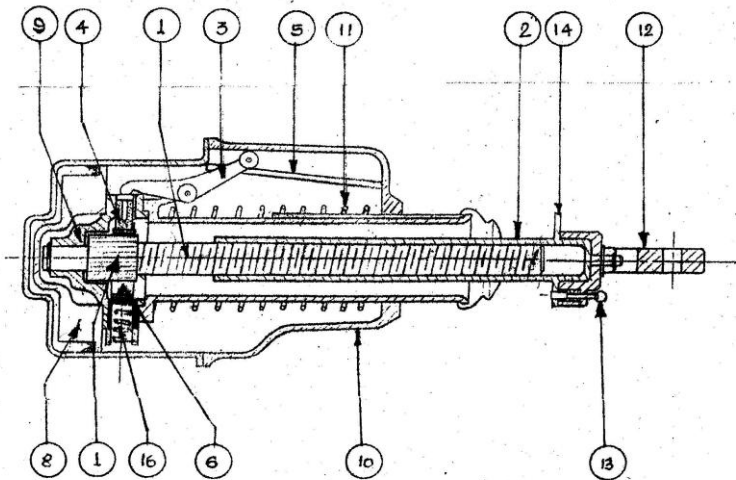
The Bogie Mounted Brake Cylinders are provided with an in-built slack adjuster to maintain a constant brake block clearance automatically. It is a single acting slack adjuster by which the clearance between wheel and brake block can be decreased automatically by increasing the effective length of piston rod whenever the piston stroke exceeds 32mm due to wear on the brake block and the wheel. The adjustment takes place during return stroke.



If the clearance between wheel and the brake blocks is less due to any reason, it does not bring the required clearance automatically.

6.6.3 Main parts of Bogie Mounted Brake Cylinder

The main parts of the Bogie Mounted Brake Cylinders are:



- 1.Adjusting Screw with ratchet; 2.Adjusting tube; 3.Rocker arm; 4.Plunger pin; 5.Roller plate; 6.Pawl housing ring; 7.Pawl; 8.Piston; 9.Trunnion body; 10.Front Cover; 11.Piston return spring; 12.Cross head; 13.Latch; 14.Resetting plate; 15.Pawl spring; 16.Plunger spring

Adjusting screw and the spindle

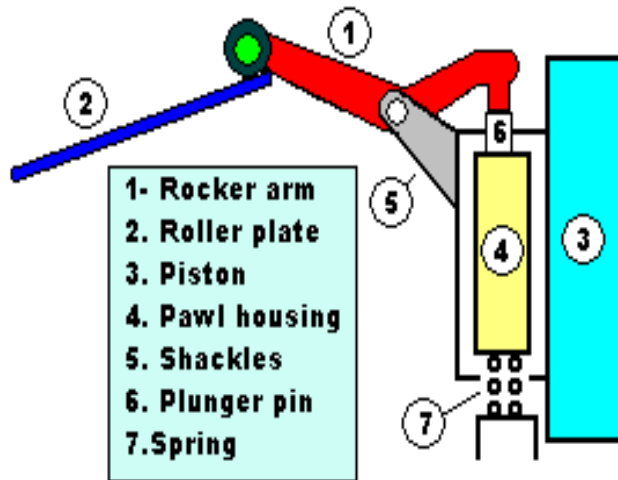
- It increases the effective length of piston rod automatically, whenever the piston stroke increases 32 mm due wear on the wheel and the brake block.
- It facilitates to increase or decrease the effective length of piston rod manually, whenever brake blocks are changed or piston stroke is adjusted.

Adjusting screw and Ratchet assembly

- The adjusting screw is with ratchet one end. The adjusting screw is provided with a double start thread with a pitch of $1/8''$ (3.15mm). The ratchet is provided with 18 numbers of teeth.
- When the adjusting screw completes one full rotation, it makes the adjusting tube to move forward by $2 \times 1/8'' = 1/4''$ (6.33mm)
- If the ratchet is moved/turned by one tooth, the adjusting screw is turned by $3600 \div 18 = 200$, which inturn moves the adjusting tube outward by $1/4 \times 1/18 = 1/72''$ (0.33mm).
- From the above, it is clear that, to move the adjusting tube forwards automatically by $1/4''$ it requires 18 return strokes.

Rocker Arm

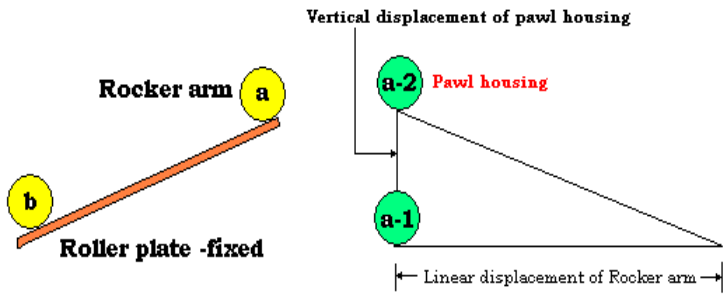
- The Rocker Arm is fitted with piston head by means of shackles and it moves along with the piston head.



- The roller end of the rocker arm slides over the roller plate, and on the other end of rocker arm rests on the pawl housing through the plunger pin.
- The function of rocker arm is to press the pawl housing ring downward during return stroke and it allows/permits the pawl housing ring to move upwards during forward stroke.

Roller Plate

- The Roller plate is fixed at an angle with the front cover by means of bolts. The function of Roller plate is to displace the pawl housing vertically when the rocker arm moves horizontally. (OR) it converts the linear displacement of rocker arm into vertical displacement of pawl housing.

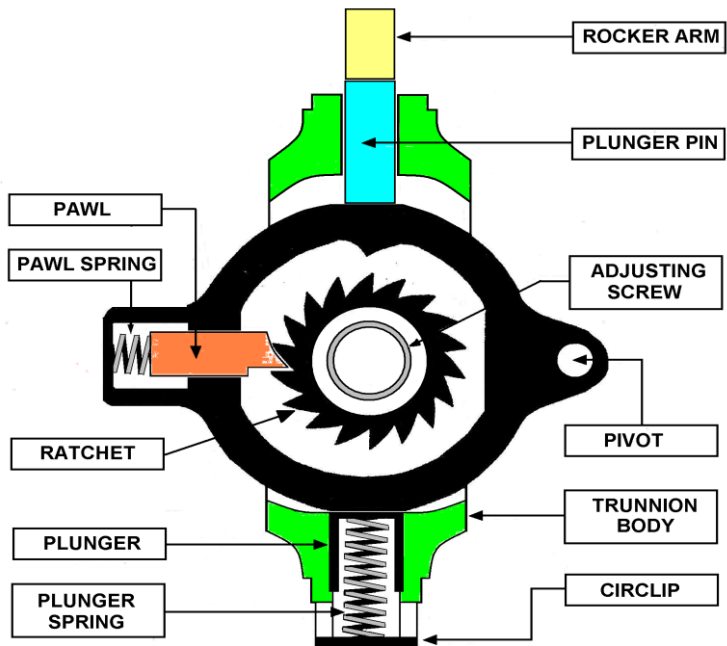


Note: When rocker arm at 'a' , the pawl housing ring at 'a-1'

- The rocker arm should be kept horizontal position facing to the gauge face of the wheel in BMBS due to the following reason;
- When the brake is applied the piston rod which is connected to the floating lever moves in a circular path with respect to lever's fulcrum point. This horizontal position of rocker arm facilitates the piston to move linearly outward as well as vertical downward along with the floating lever during brake application.
- If the vertical displacement of the piston is prevented by keeping rocker arm facing upwards will result in brake binding due to the jamming of piston with the cylinder.

Pawl Housing Ring / Pawl

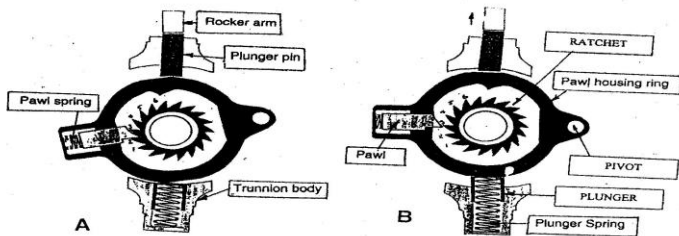
- The pawl-housing ring is pivoted with pivot pin of trunnion body at one end and the other end of the pawl housing ring moves/turns freely.



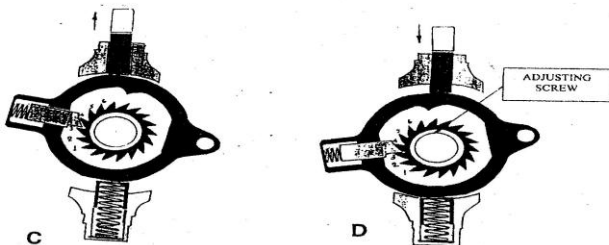
- A spring-loaded pawl is housed at the free end of the pawl housing. At the bottom of the pawl housing a spring loaded plunger/sleeve is kept between trunnion body and the pawl housing to move the pawl housing upwards/outwards during forwards stroke. At the top, a plunger pin is kept between the rocker arm and the pawl-housing ring to move the pawl ring downward/inward during return stroke.
- The function of pawl housing and the pawl is to turn the ratchet by one tooth whenever the piston stroke exceeds 32mm to increase the effective length of piston rod during return stroke automatically.

Working of in-built slack adjuster

- When the piston stroke is within 32mm, the spring-loaded pawl in the pawl housing moves between the two teeth of the ratchet and keeps the effective length of piston rod unaltered.



A. POSITION OF PAWL & RATCHET, WHEN THE BRAKE IS IN RELEASED POSITION
 B. POSITION OF PAWL & RATCHET, WHEN THE PISTON STROKE IS WITH IN 60mm.



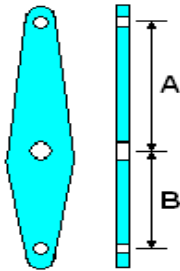
- When the piston stroke exceeds 32mm during the forward stroke due to the wear on the brake block and the wheel, the pawl slips and takes the position of next tooth in the ratchet.
- During the return stroke, the rocker arm pushes the plunger pin inwards/downwards which in turn turns the pawl-housing ring clockwise. The pawl which is housed in the pawl housing turns the ratchet with the adjusting screw by

200 causing the adjusting tube to move forward by 1/72” to increase the effective length of the piston rod.

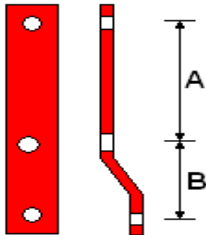
Parts of Brake Rigging:

Lever- Straight, Lever – Z shaped, Lever Hanger, Connecting Link.

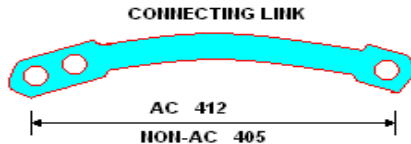
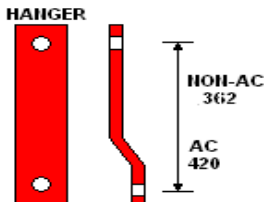
DIMENSIONS OF BRAKE RIGGING -BMBS



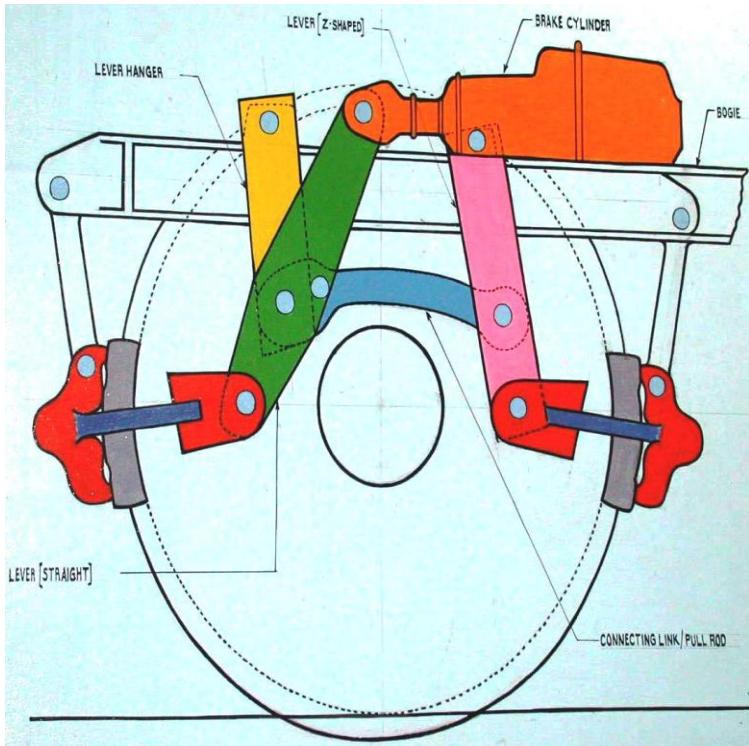
LEVER -STRAIGHT	A	B
HOH-AC	302	158
AC	366	174



LEVER- Z SHAPED	A	B
HOH-AC	256	134
AC	311	148

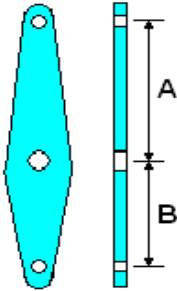


The schematic diagram of Brake rigging of BMBS is given below.



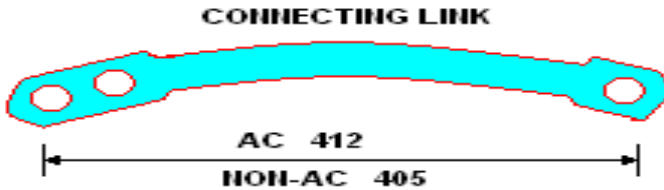
Precautions to be followed while maintaining the Bogie Mounted Brake System

- Ensure the bogies are provided with the high friction composite “K” type brake blocks. Co-efficient of Composite K- type brake block is 0.28 - 0.3
- Ensure that the floating levers are not interchanged between AC and Non AC coaches.

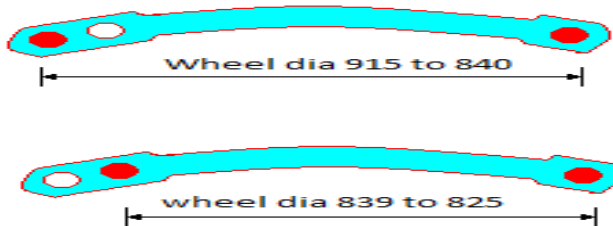


LEVER -STRAIGHT	A	B
HOH-AC	302	158
AC	366	174

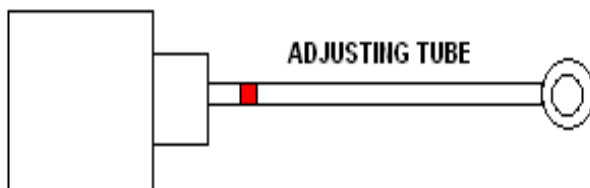
- Ensure the levers are not reversed. Ensure the connecting links (pull rod) are not interchanged between AC and Non-AC coaches.



- Ensure the connecting link (pull rod) is not reversed. Whenever the wheel diameter is reduced to 839mm, ensure the brake gear connection is shifted to next inner hole of pull rod.



- Ensure 38mm packing is given between dashpot and the axle box wing whenever the wheel diameter is reduced to 839mm. whenever the red mark is seen on the adjusting tube; replace all the brake blocks since further take up of clearance is not possible.



- Ensure correct size of brake gear pins and bushes are used in brake rigging, and the piston stroke is within 32mm. If more, the in-built slack adjuster is defective, replace the brake cylinder.
- Ensure the rocker arm end is kept horizontal and facing towards the gauge face of the wheel.

Difference between under frame Mounted & Bogie Mounted brake system

SN	Description	U/F Mounted brake System	Bogie Mounted brake System
1	Slack Adjuster	External	Internal
2.	Type of Slack adjuster	Double Acting	Single Acting
3.	Capacity of Slack adjuster	450 mm	305 mm

4.	Size brake cylinder	14 Inches	08 Inches
5.	Number of Cylinders	02/Coach	04/Coach
6.	Brake Force available on the Brake head	3 Tonne (Non mod) 2.2 Tonne (Modified)	1 Tonne

Procedure for replacing the Brake Blocks & adjusting the piston stroke:

Disengage the cross head from the adjusting tube, by pulling the latch. Turn the adjusting tube clockwise to decrease the length of adjusting tube (effective) length of piston rod. After replacing the brake blocks, apply the brake and check the piston strokes. If piston stroke is correct, engage the cross head with the resetting plate by releasing the latch. If the piston stroke is more, increase the length of adjusting tube, to decrease the clearance between wheel and brake block. If piston stroke is less, decrease the length of adjusting tube, to increase the clearance between wheel and brake block. After adjusting the piston stroke, ensure the cross head is locked with adjusting tube with the latch.

Maximum Stroke:

^ This is the stroke beyond which the piston cannot come outward. It is 95mm for coaching stock.

Working stroke:

This is the stroke at which, the in-built slack adjuster increases the effective length of the piston rod automatically whenever the clearance increases due to wear on the brake block and the wheel. It is 32mm for coaching stock.

The angle at which the roller plate is kept with horizontal position determines the working stroke. The roller plate should be kept at an angle of 10.50 with horizontal to have a working stroke of 32 mm for coaching stock.

Number of return strokes required to increase the effective length of piston rod automatically in BMBS

- 72 return strokes required for 1”
- 36 return strokes required for ½”
- 18 return strokes required for ¼”

Requirement of in built single acting slack adjuster in BMBC

The bogie mounted brake cylinders are designed to maintain a clearance of 6 to 8 mm between the wheel and brake block when the piston stroke is 25 to 32 mm. Generally the manual brake adjustment is done whenever the wheel diameter reduces and not if the thickness of brake block reduces. hence when a new brake block is fitted, before it could reach to condemning size it has to wear more than 35 mm, which in turn increases the clearance between the wheel and brake block gradually from 6 mm/8mm to 41/43mm. Piston stroke of up to 250 mm is required to have brake application in such case and it is not possible as the maximum piston stroke in BMBS is limited to 95

mm. hence inbuilt slack adjuster has become necessary to maintain a constant clearance between the wheel and brake block.

The inbuilt slack adjuster increases the effective length of piston rod automatically in order to maintain a constant clearance, whenever the piston stroke exceeds 32mm due to increased clearance on account of wear on the brake block and the wheel. The maximum pay out capacity of the piston rod is 305 mm.

6.7 DISTRIBUTOR VALVES

- Functions of Distributor valves:
- It connects AR with BC during Brake application, connects BC with Exhaust during brake release.
- It charges AR to 5 Kg/Cm² from BP during charging, disconnects the AR from BP during brake application, charges the CR to 5 Kg/Cm² from BP during charging and disconnects the CR from BP during brake application.
- It admits a maximum pressure of 3.8 Kg/Cm² during emergency as well as full service application. It admits the air from AR into BC in steps gradually, in proportion to the reduction in the Brake pipe pressure to facilitate graduated brake application and releases the air from BC in steps gradually, in proportion to the increase in the brake pipe pressure to facilitate graduated brake release.
- It reduces the BP pressure further by 0.4 Kg/Cm² in addition to the brake pipe pressure reduced by the driver from the loco to accelerate the brake application particularly during minimum reduction. It admits air from AR into BC to a pressure of 0.8 Kg/Cm² immediately

during brake application to overcome the resistance offered by the brake rigging.

- It applies the brake during sensitivity range, when the brake pipe pressure is reduced at the rate of 0.6 Kg/Cm² in 6 seconds. It does not apply the brake during insensitivity range when the brake pipe pressure is reduced at the rate of 0.3 Kg/Cm² in 60 seconds. It releases the air from CR, AR and BC during manual release. It isolates the brake system of the Rolling Stock whenever necessary.

Different types of distributor Valve, Their Manufacturers and present status

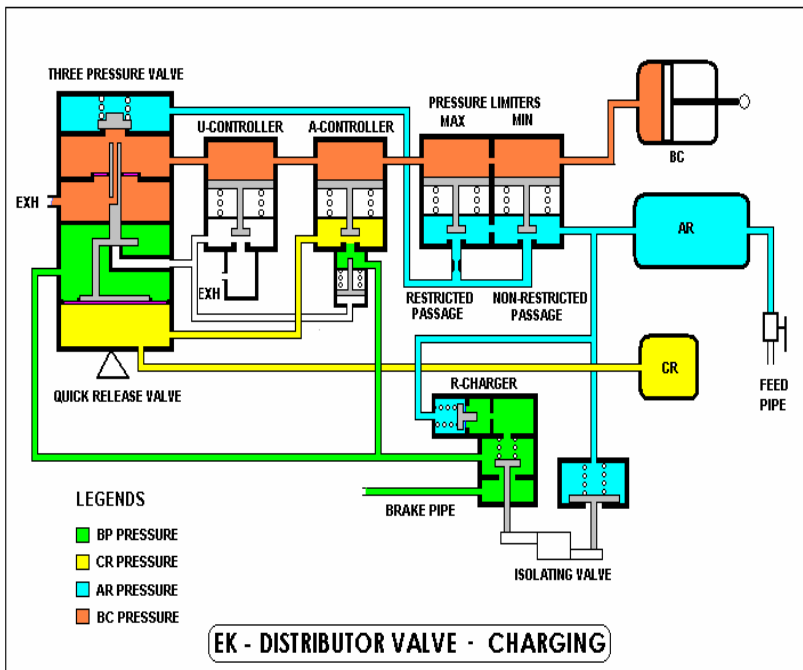
SN	Type	Manufacturers	Present status
01.	C ₃ W	M/s. Geysham and Co, Delhi.	Supplying.
		M/s. Faiveley Transport India Ltd, Hosur.	Supplying.
		M/s. Stone India Ltd, Kolkota.	Supplying.
		M/s. Bharath Brakes & Valves, Kolkota	Not Supplying.
02.	KEO (EK)	M/s. Escorts, Faridabad.	Supplying.
		M/s. Knorr-Bremse India Ltd, Faridabad,	Supplying.
03.	P4aG	M/s. S.D.Technical Services Pvt Ltd, Delhi.	Not Supplying.
		M/s. Westinghouse Saxby Farmer, Ltd, Kolkota	Not Supplying.

Mainly two types of DVs are used in Indian Railways

- EK type Distributor Valve & C3W Distributor Valve
- EK Type Distributor Valve

The different sub-assemblies of EK type distributor valve are;

- Three pressure valve
- U-Controller
- Minimum pressure limiter
- Quick release valve A-Controller
- R- Charger
- Maximum pressure limiter
- Isolating valve



Three-pressure valve

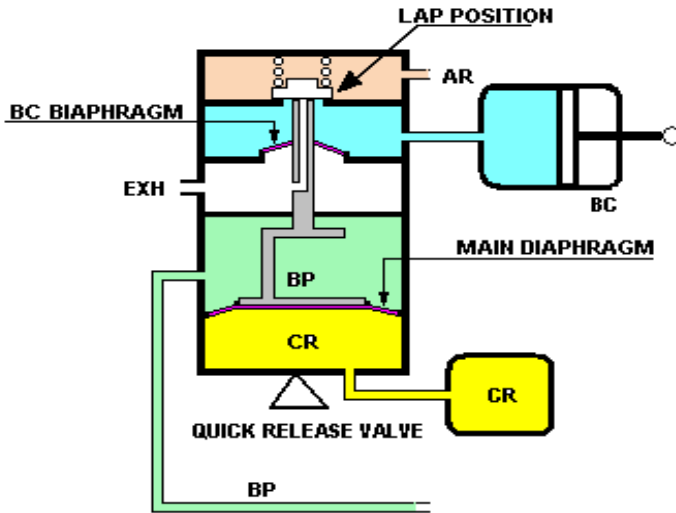
Three pressures, i.e. BP, CR & BC pressure acts on this valve, It connects AR with BC during brake application. It connects BC with Exhaust during brake release. It admits BC pressure in steps, when the brake pipe pressure is reduced in steps, to facilitate graduated application. It releases air from BC in steps, when the brake pipe is pressure is increased in steps, to facilitate graduated release.

6.7.1 'LAP POSITION' of distributor valve

This is the position of the Hollow stem of the Main Valve / Three pressure valve, in which the Brake cylinder is connected neither to AR nor to exhaust, during brake application / Release for the purpose of facilitating Graduated brake application / Release.

The hollow stem is designed to take LAP POSITION up to full service application in case of EK DV and even after Emergency application in case of C3W.

The Hollow stem takes LAP POSITION as soon as Brake cylinder gets sufficient pressure in proportion to the reduction in the BP pressure to facilitate graduated brake application and release, for this purpose in addition to the Main diaphragm one more diaphragm called BC diaphragm is connected with the hollow Stem.



During brake application, initially the hollow stem gets lifted, due to the difference of forces offered across the main diaphragm. The lifting hollow stem allows the air from AR into BC. As soon as BC gets sufficient pressure, which will offer a down ward force on the BC diaphragm equivalent to the upward force offered by the main diaphragm. Once the down ward force offered by the BC pressure on the BC diaphragm, equals the upward force offered by the main diaphragm, the hollow stem which is lifted initially, comes down to take LAP POSITION as shown in the figure.

U-Controller: The function of U-Controller is to reduce the Brake pipe pressure further by 0.4 Kg/Cm^2 , in addition to the brake pipe pressure reduced by the driver from the Loco, to accelerate the brake application.

Working:

During brake application, particularly during minimum reduction, as soon as three pressure valve is lifted from its normal position, the BP chamber of three pressure valve is connected to exhaust through the U-Controller. The air from BP chamber of three pressure valve is exhausted immediately. This exhaust of BP pressure causes quicker reduction in BP pressure, which in turn helps to lift the three pressure valve quickly, to facilitate quicker application of brakes during minimum reduction

As soon as BC gets a pressure of 0.4 Kg/Cm², the U-Controller closes the passage between BP and exhaust, which in turn prevents any further drop in BP pressure.

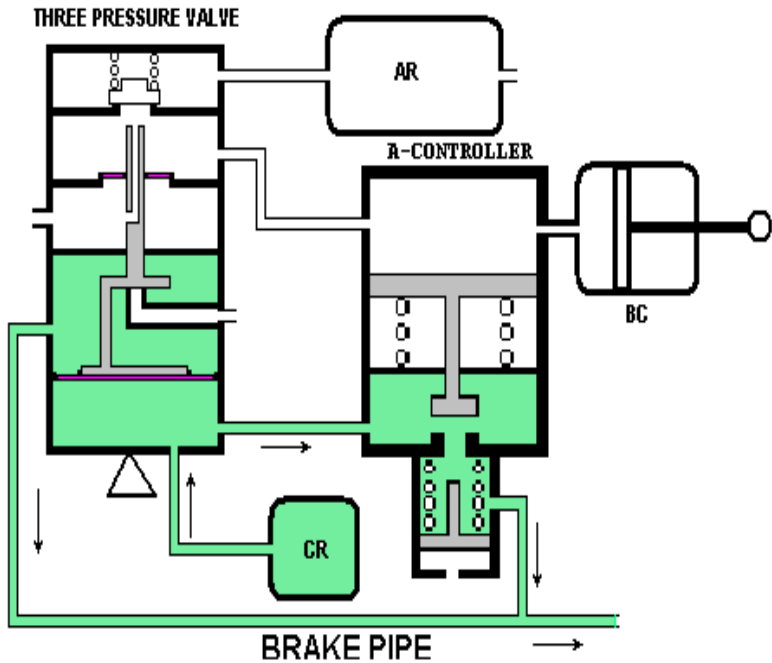
A-Controller: It charges Control reservoir to 5 Kg/Cm² from BP during charging and isolates the CR from BP, when the brake pipe pressure is reduced at the faster rate, during sensitivity range. It connects CR with BP, when the brake pipe pressure is reduced at the slower rate, during insensitivity range.

Note: This valve is normally kept in open position and synchronised with BC pressure. As soon as BC gets a pressure of 0.2 Kg/Cm² A-controller closes the passage between CR and BP during the brake application. The additional check valve provided at the bottom of the A-Controller closes the passage between CR and BP temporarily to prevent any loss in the CR pressure with the help of BP pressure, before it is permanently closed by the BC pressure.

Insensitivity range

It is likely that some leakage will crop up further in the train en-route, after the attention and dispatch. These small leakages should not lead to brake application, which can lead to detention to the trains. Hence a pressure drop of 0.3 Kg/Cm² in 60 seconds is kept as insensitivity range for the DV not to actuate the brake application. Where as the pressure drop during sensitivity range is 0.6 Kg/Cm² in 6 seconds. From the above it is very clear that the pressure drop during insensitivity range is 1/20th of pressure drop during sensitivity range. As the pressure drop is very less, the upward force offered by this pressure drop across main diaphragm also is less. This less force (1 Kg approximately at every second) is not at all sufficient to lift the hollow stem of the three-pressure valve. As the hollow stem is not lifted, AR is not connected to BC. We also know that there is a passage between CR and BP through A- Controller and this passage is closed as soon as BC gets a pressure of 0.2 Kg/Cm² during brake application. Since the BC is not at all getting any air from AR, the passage between CR and BP remains in open condition and in turn allows the CR pressure also to release along with the brake pipe pressure at the rate of 0.3 Kg/Cm² in 60 seconds.

As there is no pressure difference across main diaphragm at every point of time, the hollow stem is not lifted and thus brakes are also not applied during insensitivity range.



R-charger: R- Charger charges the auxiliary reservoir by allowing air from B.P. up to 5 kg/Cm² in both single and twin pipe system during charging. It prevents back flow of air from AR to BP during brake application.

Minimum and Maximum pressure limiters: The function of Minimum pressure limiter is to admit a pressure of 0.8 Kg/Cm² immediately in to the brake cylinder during brake application to overcome the resistance offered by the brake rigging.

The function of Maximum pressure limiter is to admit and limit to maximum pressure of 3.8 Kg/Cm² into brake cylinder even after emergency application.

Working:

Initially during brake application the air from AR is sent in to BC through two passages. One with restrictions and another without restrictions. As soon as BC gets a pressure of 0.8 Kg/Cm² the minimum pressure limiter closes the non-restricted passage and further admission of air from AR to BC is through restricted passage. When the BC gets a pressure of 3.8 Kg/Cm² the Maximum pressure limiter closes the non-restricted passage also. As both the passages are closed, the AR is completely disconnected from BC, and further admission of air from AR in to Brake cylinder is stopped.

Quick release valve: Quick release valve releases air from CR manually to facilitate manual release. The AR pressure can not be released by just pulling Quick release valve in case of EK make DV. For releasing AR pressure, DV handle has to be isolated.

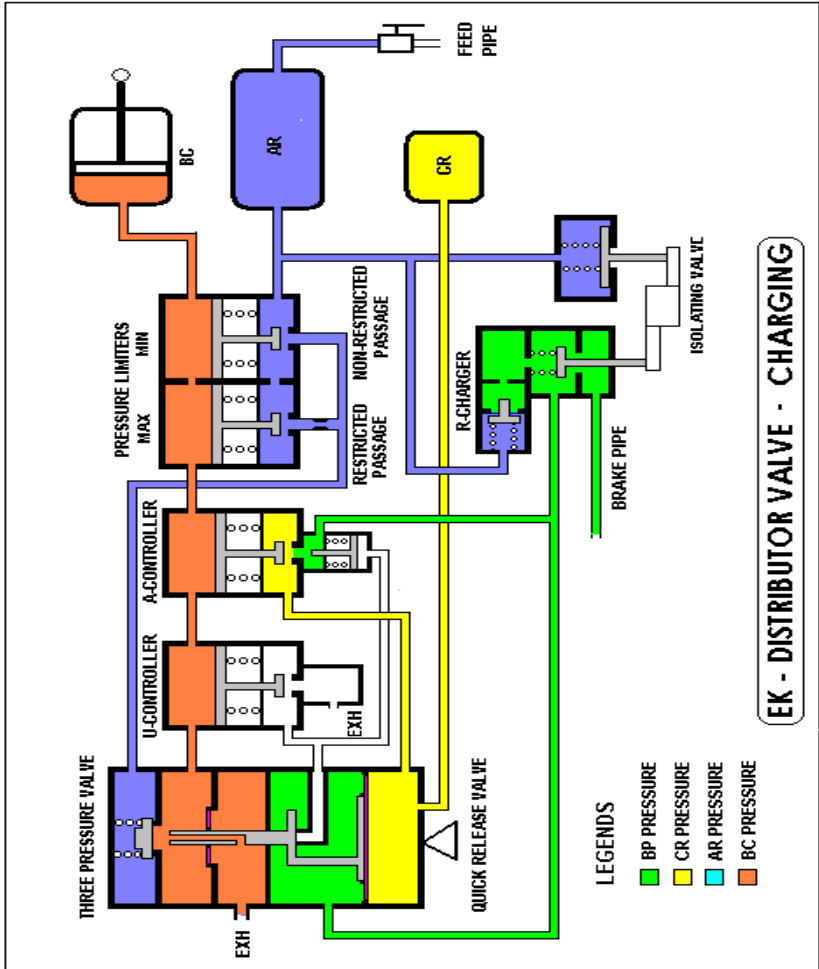
Isolating valve:The functions of isolating valve are to isolate the DV in case of malfunctioning, release the air from AR manually, and release the air from BC manually.

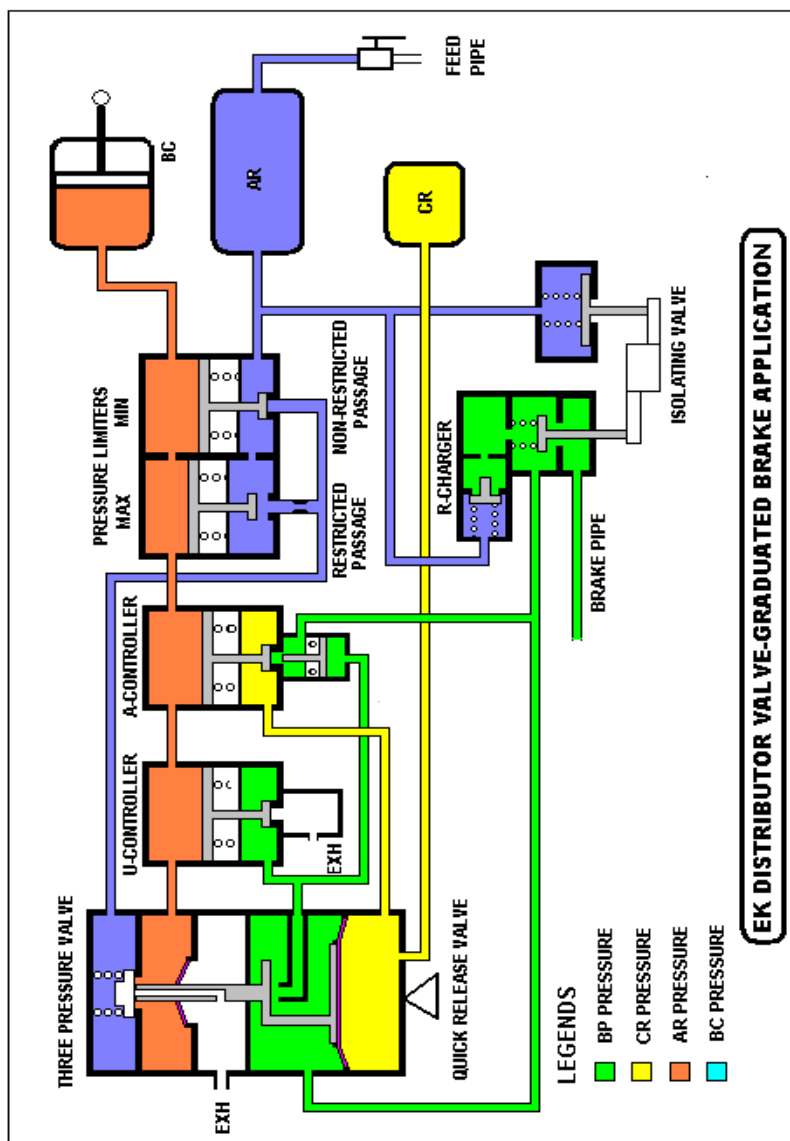
Working:

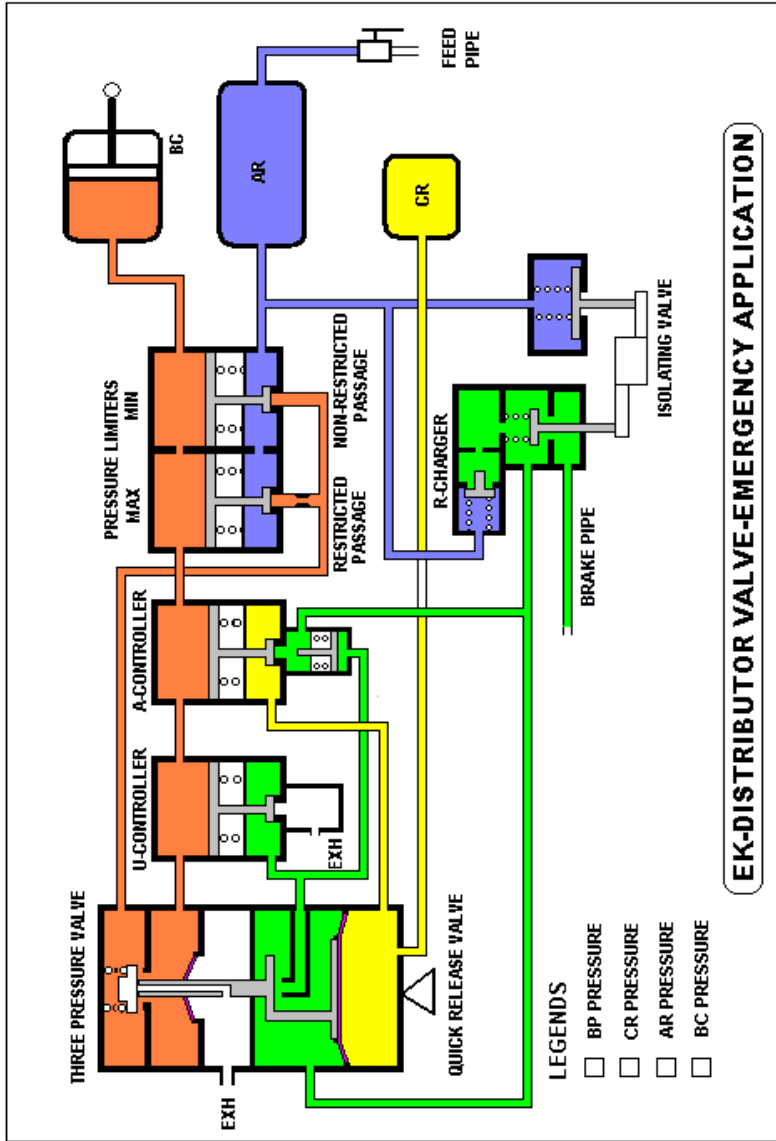
When the handle is in vertical (working) position the brake pipe is connected with DV. When the handle is in horizontal position, the Brake pipe is disconnected from DV. The AR and BC are connected to exhaust through the exhaust port provided in the isolating valve.

Note: Initially brake application will take place and after sometime the brake will release automatically, since BC is connected to Exhaust.

The sketch of EK type distributor valve with different sub-assemblies is given in the following pages. Path of air during charging, graduated and emergency application is shown in each page.







6.7.2 C3W distributor valve

Different sub-assemblies of C3W type distributor valve are;

Main valve, Cut off valve, Quick service valve, In shot valve, AR check valve, Double release valve, Isolating valve.

Main valve:

The functions of Main valve are;

- It connects AR with BC during brake application. It connects BC with Exhaust during brake release. It admits BC pressure in steps, when the brake pipe pressure is reduced in steps, to facilitate graduated application. It releases air from BC in steps, when the brake pipe pressure is increased in steps, to facilitate graduated release. It also acts as a maximum pressure limiter, to admit a maximum pressure of 3.8 kg/Cm² into BC during emergency brake application.
- Main valve is provided with two concentric pistons. One is larger and another one is smaller in area. During emergency brake application, leaving the larger piston in lifted position, the smaller piston along with hollow stem comes down to take LAP position as soon as BC gets maximum pressure of 3.8 kg/Cm².

Cut off valve:

- It charges Control reservoir to 5 Kg/Cm² from BP during charging. It isolates the CR from BP, when the brake pipe pressure is reduced at the faster rate, during sensitivity range. It connects CR with BP, when the brake pipe

pressure is reduced at the slower rate, during insensitivity range. It also charges AR to 5 kg/Cm² during charging.

Note: This valve is normally kept in open position and synchronised with BC pressure. As soon as BC gets a pressure of 0.2 Kg/Cm² Cut off valve closes the passage between CR and BP during the brake application, which in turn prevents any further drop in CR pressure.

AR- Check valve:

The functions of AR- Check valve are;

- To charge the auxiliary reservoir from B.P. to 5 kg/Cm² in single pipe system during charging through cut off valve. It prevents back flow of air from AR to BP during brake application.

Quick service valve:

- The function of Quick service valve is to reduce the Brake pipe pressure further by 0.4 Kg/Cm², in addition to the brake pipe pressure reduced by the driver from the Loco, to accelerate the brake application.

Working:

During brake application, particularly during minimum reduction, as soon as the brake pipe pressure is reduced, the BP chamber of Main valve is connected to Quick service bulb through the Quick service valve. The air from BP chamber of Main valve is allowed to expand suddenly by sending the air into the Quick service bulb. This sudden exhasut of air from BP chamber of DV

causes the BP pressure to drop by 0.4 kg/Cm², which in turn helps to lift the Main valve quickly, to facilitate quicker application of brakes during minimum reduction.

The air, which is sent into the Quick service bulb during brake application, is released through the exhaust port provided in the quick service valve during re charging.

Note: This valve is exactly opposite to that of Main valve.

In-shot Valve:

- The function of in-shot valve is to admit a pressure of 0.8 Kg/Cm² immediately in to the brake cylinder during brake application to overcome the resistance offered by the brake rigging.

Working:

The In-shot valve is provided with two passages, one with restriction and another without restriction. Initially during brake application the air from AR is sent in to BC through both the passages. As soon as BC gets a pressure of 0.8 Kg/Cm² the In-shot valve closes the non-restricted passage and further admission of air from AR is sent in to BC through restricted passage alone.

Double release valve:

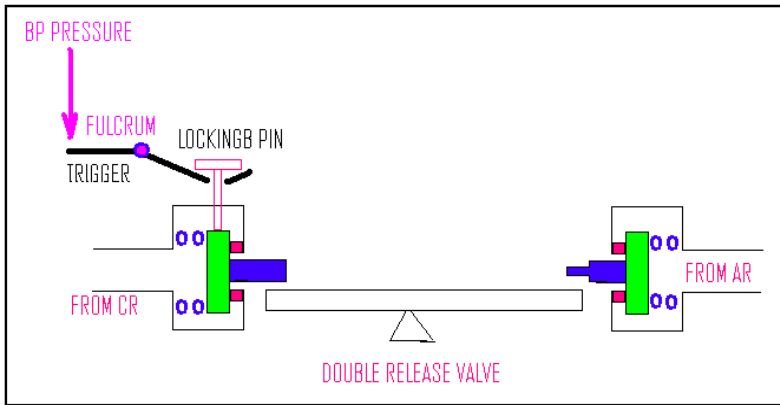
- The function of Double release valve is to release the air from CR as well as from AR manually to facilitate manual release.

Working

This valve is provided with two check valves.

CR check valve & AR check valve

When the release valve is pulled only once (Short pull) the air from CR is released completely. On continuous release, the air from AR can also be released.



NOTE: The CR check valve is provided with a Locking rod arrangement, which enables the releasing of air from CR completely for a short pull. When the handle is pulled only once, the locking rod which is kept over the CR check valve drops in front of CR check valve, which in turn keeps the CR check valve in open position till the air from CR is released completely.

The AR check valve is not provided with the Locking rod arrangement, why because, it is not necessary to release the air from AR during manual release.

Isolating valve:

- Isolating valve helps to isolate the DV in case of malfunctioning. It releases the air from BP chamber of main valve on isolation.

Working:

When the handle is in vertical (working) position, the brake pipe is connected with DV. When the handle is in horizontal position, the Brake pipe is disconnected from DV and the BP chamber of main valve of DV is connected to exhaust. The BP pressure in the main valve is brought to zero immediately, and the brake application will take place due to the existence of CR pressure.

The different colour codes for the distributor valves are;

- For Coaches: Green
- For Wagons: Black.

6.8 BRAKE BINDING

It is the phenomenon of binding the wheels by the brake gear system or when brake block is in contact with wheel tread while the driver's brake valve is kept in released position.

Implication of Brake Binding in the Railway System:

It has the direct bearing on the punctuality of trains. Nearly 30% cases of C&W punctuality losses were only on account of

“Brake Binding”. Besides punctuality loss, other consequences of brake binding on the Railway System are as under:-

- Damage to the wheels & sometimes coach detachments resulting revenue loss.
- Harassment to the passengers due to coach detachments resulting in their stranding in mid-section or change of coach.
- Poor Riding quality.
- Damage to the track.
- Damage to the Rolling Stock components such as Roller Bearings, springs etc.
- More tractive force needed to the locomotive.
- Unpleasant sound to the passengers.

Following are the factors causing “Brake Binding” in the coaches:-

C&W:

- Mal function of DV causing late release or leakage.
- Improper mounting of DV on common pipe bracket.
- Mal functioning of SAB.
- Isolating cock not working.
- Leakage in the brake system.
- Improper release of the rake while attaching/detaching/loco change by TXR staff at TXR stations.
- Defects in brake cylinder.
- Defects in dirt collector.
- Defects in brake gear.

LOCO & ITS OPERATION:

- Not giving proper release time after application.
- Variation of pressure/vacuum level during run/loco change.
- Malfunctioning of air flow meter resulting in non indication of ACP/leakage in brake system.
- Not stopping and resetting ACP/leakage after noticing air leakage through AFI.
- Inadequate pressure/vacuum creation/maintenance capacity of locomotive resulting in higher release time of the brakes.
- Driver misreporting brake binding to camouflage some other failure.
- Improper release of the rake while attaching/detaching/loco change by driver at non-TXR station.

OPERATING:

- Guard misreporting brake binding to camouflage some other failure.
- Improper release of the rake while attaching/detaching/loco change by guard at non-TXR station.
- Attachment of unexamined/untested stock after train maintenance and testing, especially VPU's and other special stock.
- Not locking SLR guard cabin resulting in unauthorized persons traveling and tampering with Guard valve and hand brake.

LAW & ORDER:

- Frequent ACP operation.
- Operations of DV handle for brake application during run.
- Closing of angle cock in the coach ends.
- Operation of hand brake from SLR by unauthorized occupants.

MISCELLANEOUS:

- Hitting by ballast/foreign material resulting in breakage of dirt collector/ drain plug of AR/other brake system components.
- Cattle run over resulting in damage to brake system.

Following measures should be taken to contain brake binding incidences:-

- **Ensure proper maintenance of DV:**
 - Check holes of common pipe bracket are one-to-matched with the corresponding location on the Common Pipe Bracket (CPB) seal.
 - Check collars provided on the CPB seals are uniformly projected.
 - Use small quantity of hard grease on the CPB before positioning of the seal to avoid displacement while mounting.
 - Check that release choke is clear.
 - Overhaul/Repair distributor valve with intermediate flange as a single unit.

- Check holes of Intermediate flange seal are one-to-one matched with respective location in the distributor valve.
 - Check collars provided on the seal are uniformly projected.
 - Check the valve is free from rubber bulging or deboned for valve plate (10) in KE type or valve (37) in C, W type.
 - Check for smooth movement of hollow stem in its guide during assembly. This may be ascertained by:
 - i) Movement of hollow stem. Check that hollow stem is not bent.
 - ii) Check that outer surface of the hollow stem is polished.
 - iii) Apply light coat of thin grease on the hollow stem.
 - Check the condition of CPB filter. This is ascertained by:
 - i) Clean CPB filter in every schedule.
 - ii) Clean vertical passage in CPB.
 - Identification of late releasing DV's during maintenance.
 - Locking of Distributor Valve isolating handle.
 - In the POH phosphating and rewaxing of the Distributor Valve Body be done to avoid corrosion.
- **Proper inspection of dirt collector**
- Clean Dirt collector in every schedule.
 - Provision of Dirt Collector cover.

➤ **Proper inspection of brake regulator**

- Identification of sluggish Slack Adjuster.
- Check that the barrel has no dent.
- Confirm that Traction sleeve passes smoothly inside the entire length barrel during assembly.
- Check axial play of the Adjuster nut with the spindle. Since actual measurement is difficult, excessive play must be felt while assembly.
- Make sure that the adjuster nut falls freely along the spindle when held vertical

➤ **Brake gear system**

- Adjust end pull rod hole and maintain length of pull rod such that the Equalising levers be in near vertical in brake applied position.
- Ensure that the Z-lever pins used with Equalising levers are polished.
- Ensure the corresponding bushes are without any oblong deformation.
- Radial clearance is maintained within 0.75 mm.
- Ensure that the Actuating rod is not twisted. The straightness is realized by smooth fitment of the Actuating rod with the both Equalising levers with the pins.

➤ **Brake Cylinder**

- Identification of sluggish brake cylinders during maintenance.
- Breathing passage clearing can be ascertained by avoiding greasing of Trunk during assembly and

cleaning annular space between Trunk and Front cover

➤ **Locomotive**

- Check for fluctuation in BP pressure.
- Check for moisture/oil/dirt content in compressed air.
- Dynamic Brakes of the locomotive should be operative.
- Ensure proper working of air flow indicator and audio visual system.
- Locked axle of the locomotive is avoided.

➤ **Train Handling**

- Wait for one minute at least after moving brake valve handle to release position after emergency application.
- Avoid extended application of the pressure surge to avoid over charging.
- Keep close watch in the air flow indicator to monitor incidence of excess leakage.
- Keep close watch in the Ampere meter reading for high current.
- Keep vigilant on tampering DV isolating handle position.
- Drain condensate from air reservoir, oil separator and filter.
- Open drain cock slowly so that condensate is carried out with the air.

- **Modification in coaches**
 - Brake Binding Indicator be provided on every coach.
 - Hand Brake application indicator be provided on every SLR.

- **ACP system**
 - Oversize choke of the ACP be eliminated.
 - Resetting key should be welded on the coach itself to properly reset the ACP.
 - Proper releasing of coaches should be ensured after every ACP on the adjoining coaches also.

Training to the staff - C&W as well as operating & loco staff.

- **BP/FP pipes**
 - The Brake pipe & feed pipes should be secured with ‘T’ bolts to avoid decoupling en-route.
 - Proper examination of feed pipe & brake pipes during maintenance.

- **System Improvement**
 - Introduction of Rolling out Examination to detect the coaches which are going in Brake binding condition. Also Rolling-In-Examination be ensured.
 - Moisture separator/Air Dryer should be provided in all the locomotives & R.T.R pipe lines to avoid ingress of moisture in the air Brake system.
 - Proper releasing of the rakes on the platform and on washing lines after maintenance.
 - Pre-tested slack Adjuster and Distributor Valves should be replaced on the coaches,

- Coaches attached from the yard should be tested with the rake on W/Line.

➤ **Others**

- Provisions of Quick Release pull rods.
- Pressure relief valve on the pipe line between Distributor Valve & the brake cylinder should be fitted so that the excessive pressure beyond 308 kg/cm² is avoided.
- Pad locking of Guard cabin of the front SLR should be ensured by the Operating.

Trouble shooting & the remedial measures

1) Leakage rate of the much higher than the permitted value of 0.2 kg/cm²/min in BP line.

CAUSES	REMEDY
Locate the defective coach, handle of the angle cock (one or more) not completely in 'ON' position.	Bring the angle cock handle to open position.
Angle cock leaking /defective, pipe threads & check nut joints leaking. Hose pipe cracked or coupling improper.	Tighten angle cock properly. Change hose coupling & angle cock, if defective.
M.U. washer at the coupling head defective.	Replace M.U. washer.
Drain plug of dirt collector loose/ leaking/ its seal damaged.	Change seal & tighten the drain plug.

Common pipe bracket flange joints or CPB filter cover loose/ seal defective.	Replace sealing ring or seal & properly tighten flange & filter cover.
DV to CPB studs loose/ seal defective.	Tighten stud nuts. Replace if defective.
Joints at PEAV branch pipe leaking.	Replace seals of flange joints & tighten joints properly.
One or more PEASD is not reset after operation.	Reset PEASD & observe. If hissing sound is heard from PEASD, replace it.
Guards emergency valve partially in opened condition or joints of branch pipe of pressure gauge leaking.	Keep the valve closed. Tighten the joints properly.

2) Leakage rate of the much higher than the permitted value of 0.2kg/cm²/min in FP line.

CAUSES	REMEDY
Flange joints of branch pipe to isolating cock or check valve loose. Seal of joint defective.	Tighten the joints. Replace sealing ring, if leakage still persists.
Locate the defective coach, handle of the angle cock (one or more) not completely in 'ON' position.	Bring the angle cock handle to open position.
Angle cock leaking /defective, pipe threads & check nut joints leaking. Hose pipe cracked or coupling improper.	Tighten angle cock properly. Change hose coupling & angle cock, if defective.

M.U. washer at the coupling head defective.	Replace M.U. washer.
Drain plug of dirt collector loose/ leaking/ its seal damaged.	Change seal & tighten the drain plug.
Drain plug of AR or drain cock loose/ leaking/ defective.	Identify defect & replace sealing washer. Tighten the joints on FP line.

3) Both the Brake Cylinder Pistons of One Coach not coming out on Brake Application.

CAUSES	REMEDY
System of the coach is not charged due to the dirt collector on BP clogged closing the BP supply.	Clean the dirt collector.
DV isolating cock kept close or brake cylinder isolating cock closed.	Open the isolating cocks of DV & BC.
BP pressure through C.P. bracket path clogged & air not reaching to DV.	Clean the holes of CPB.
Drain plug of CR loose or CR not well sealed to CPB.	Replace seal & tighten the CR drain plug.
Joint seal between CPB & sandwich piece or between sandwich piece & DV defective/cracked/loose.	Replace the joints if found defective.
DV defective.	Replace DV.

4) Brake Cylinder Piston Stroke of One or More Coaches is too less or in Excess.

CAUSES	REMEDY
Dimension 'A' of the SAB not properly set.	Set 'A' dimension properly.
Brake rigging horizontal lever, floating lever of equalizing lever jammed.	Rigging by lubrication.
Slack adjuster not functioning / defective.	Replace SAB.
Brake cylinder piston assembly is sticky.	Replace brake cylinder.

5) Brake cylinder piston of one or more coaches not returning back on releasing brake.

CAUSES	REMEDY
Dirt collector of related coach clogged	Clean dirt collector filter.
Cock of the brake cylinder branch pipe partially closed	Open the cock fully
BC piston jammed or brake rigging gears not moving freely	BC return spring lost its stiffness. Replace the BC. Agitate levers and lubricate.
Excess release time of DV	Rectify the leak in BP line with Teflon tape. BP release choke is closed with dirt, clean the released choke.
DV defective	Replace DV

6) Only one brake cylinder piston of a coach not returning back.

CAUSES	REMEDY
Brake rigging of the relative side jammed	Lubricate the lever joints
Isolating cock on BC branch pipe partially closed	Open isolating cock fully
BC piston assembly movement not smooth or return spring defective	Return spring is weak, replace the brake cylinder
Slack adjustor not functioning properly	Replace slack adjustor

7) Alarm chain system on chain pulling showing no response of either hissing sound or partial brake application.

CAUSES	REMEDY
Mechanical gearing of the chain line connected to operate PEASD defective	Correct the mechanism or lubricate it
Isolating cock of PEAV branch pipe may be closed or defective	Open isolating cock fully. If isolating cock is defective, replace.
PEASD defective	Replace it
PEAV defective	Replace PEAV

- 8) Brake cylinder air draining time is too long i.e., time taken is more than 20 seconds, piston is not returning to its original position**

CAUSES	REMEDY
Release choke of DV clogged	Replace DV
Return spring inside the brake cylinder lost its stiffness	Identify the defective BC and replace it
Brake rigging gear jammed	Lubricate the levers of the brake rigging
BC wear ring and piston packing creating trouble during return movement of the piston assembly	Replace BC
BC isolating cock partially closed	Check isolating cock and open it fully

- 9) Alarm chain system is not working even after chain pulling i.e. no signs of brake application.**

CAUSES	REMEDY
Chain pulling mechanism is sticking somewhere and the pulling force is not causing PEASD to operate	Identify the defect causing chain pulling force to be ineffective and attend to it.
Isolating cock of PEAV branch pipe may be closed or defective	Open isolating cock fully. If isolating cock is defective, replace.
PEASD or PEAV not	Replace the defective one or both

functioning properly. Also no hissing sound is heard for one or both the equipments	if the system is still inoperative
-------------------------------------------------------------------------------------	------------------------------------

10) Piston movement is not smooth rather sticky or jerky in application and release.

CAUSES	REMEDY
Piston rubber packing is running dry i.e. without grease or its lip turned backwards.	Open the cylinder cover. Clean and apply grease. Assemble it properly.
Piston return compression spring is deformed, creating trouble in motion	Check the spring. If it is deformed, otherwise change it.
8 Nos. Hex. Nut M-12 not equally tightened	Tighten the Hex nuts equally
Piston assembly with guide tube bent or damaged	Change the piston with guide tube if bent or damaged
Spring lost its design stiffness	Replace the spring

11) Regular hissing sound from PEAV is appearing during charging of the system or system is not charging appropriately.

CAUSES	REMEDY
Piston rod subassembly such as Rubber Vulcanized seat is defective	Change the piston rod

Scratches on bottom bush seat	Try to remove the scratches/aberrations by polishing with fine emery paper or gentle lapping
Defective compression spring on piston rod	Change the spring
Scratches on inner surface of the brush is obstructing the free movement of plunger	Remove scratches by polishing with fine emery paper to make free movement
'O' ring sealing the top cover is defective	Change the 'O' ring
'K' rings fitted external on the piece and/or 'K' ring fitted internal on position is/are defective	Check and change defective 'K' ring(s).

12) No hissing sound from PEAV specially on pulling the pressure rod of PEASD and does not show any brake pressure reduction effect.

CAUSES	REMEDY
'K' ring external on piston rod subassembly is defective	Change the 'K' ring
Nylock nut on the piston rod subassembly is loose	Tighten the nylock nut
Piston rod assembly including piston movement is jammed	Dismantle the assembly & ensure smooth movement
Drain choke of 4 mm clogged	Clean the drain choke

13) On resetting PEASD, hissing sound from PEAV not disappearing.

CAUSES	REMEDY
Piston robber assembly is not moving smoothly	Smoothen the movement of piston rod assembly
Causes mentioned at 11	Remedies mentioned at 11
Leakage observed from nipple adapter threads due to undersize threads or worn out/loose nipple	Change the nipple adapter. Use Teflon tape on threads to get tightening of nuts
Leakage observed at top cover joints due to loose hex head studs	Tighten the studs fully
Leakage observed at top cover joints due to defective 'O' ring	Change the 'O' ring

7.

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9. WHEELS DEFECTS

Wheel is an important part of rolling stock which contributes for safe running of the trains. The wheel provided in the rolling stock of railways has dual role of bearing the weight as well as guiding the vehicle. Hence the defects in the wheel can lead to derailment and accidents. The wheel defects are mainly observed on the profile which gets worn out in service and compared with the standard profile of the tyres.

Wheel defects and their condemning limits

Wheel defects	Standard	Condemning Limit
Sharp Flange	14.5 mm	Less than 5 mm
Thin Flange	28.5 mm	Less than 16mm
Less radius at root of flange	16 mm-IRS 14 mm-WWP	Less than 13 mm
Hollow Tyre	-----	5 mm or above
Deep Flange	28.5 mm	More than 35mm
Thin Tyre	-----	Since no tired wheel, dia of the wheel is the criteria.
Flat Tyre	-----	50 mm or more- Coaching 60 mm or more –Goods

- Less radius at Root of Flange:** When radius given at the root of flange is reduced to 13 mm is called less radius at root of flange. This defect can develop into other defects such as deep flange and hollow tyre.

- **Sharp Flange:** When the radius given at the tip of flange is worn out to 5mm, it is called sharp flange. This defect develops either due to running on the same curves for a long period or due to the defects on the rolling stock such as bent axle guard, weak springs, defective axle guides and excessive longitudinal clearance. The wheel is always pushed towards the rail and the flange starts wearing. The root of flange is first affected and then the inclination given on the flange disappears. Slowly the roundness given on the flange is reduced. Sharp flange can take wrong routes at a facing point provided the point itself is slightly defective such as a split, a worn out or damaged switch rail etc.
- **Deep Flange:** When the depth of the flange is increased to 35 mm for BG stock, it is called Deep flange. This happens due to the wear of the wheel tread at the root of the flange. A deep flange can cause damage to the permanent way by mounting over fish plate, fish bolts, check bolts etc. and also causes derailments especially at check blocks and check rails.
- **Hollow Tyre:** Due to wear on the wheel tread caused especially by wrong material composition in brake blocks, the inclination given on the wheel tread wears out and forms curve. Without this inclination on the tyre wheel will have more lateral play on a straight line causing rough riding. It will also find very difficult to negotiate curve.
- **Thin tyre:** When the thickness of the tyre is reduced to 25 mm for BG is called thin tyre. This happens due to wear and tear in ordinary condition. Wheel with thin tyre will not be

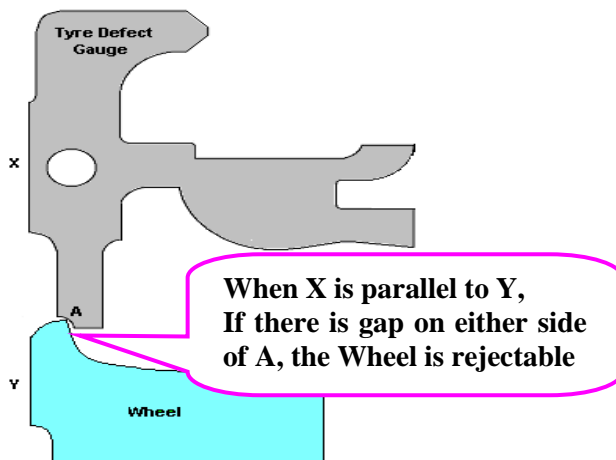
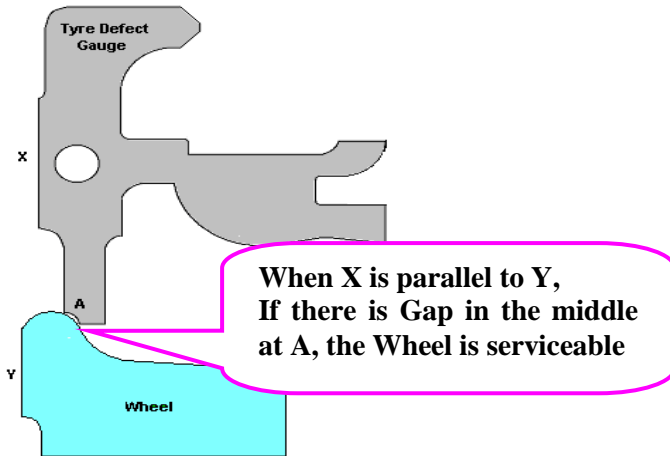
able to withstand the weight of the load. This also will cause low buffer heights.

- **Thin Flange:** When the thickness of flange is reduced to 16mm is called Thin Flange Thickness must be measured at a point 13 mm from the Tip.It leads to breakage of flange under the side thrust of the wheel on a curve.
- **Skidded Wheel:** This happens due to defective brakes or improper releasing of brakes. When a rolling stock is kept running with brakes binding the wheels do not revolve. Instead they slide over the rail surface. This cause heavy friction and wear on a particular spot on wheel tread. These worn out spots or patches will cause heavy noise on run and disturb the passengers. A skidded wheel not only damages the permanent way but also bearings.
- **Limits for flat tyres:** The limits for permissible maximum flat surfaces on tread for BG ICF coaches is 50 mm (reference Rly. Bd.'s Letter no. 83/M (N)/960/1/Vol I dated 15/18.3.99).

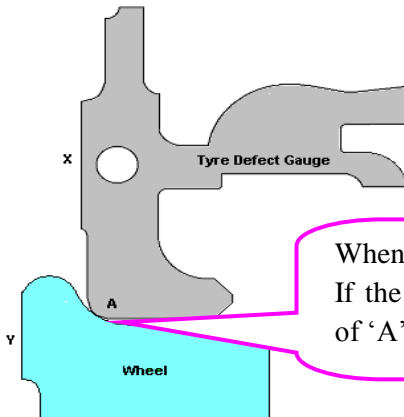
7.1 Application of Tyre defect gauge:

Wheel defects mentioned above, if suspected to have reached condemning limit during visual examination has to be ensured by applying tyre defect gauge (IRCA part IV, Plate No. 38 for BG coaches and Plate No.39 for MG coaches). The procedure for application of the gauge is depicted in the following pages.

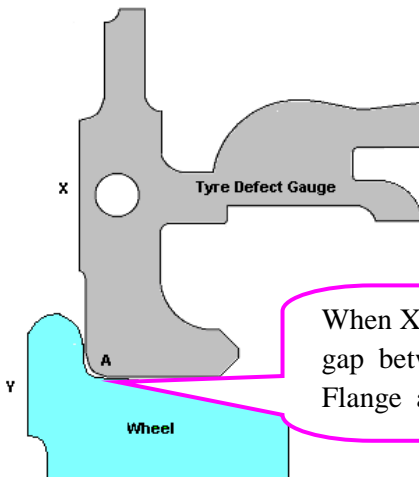
SHARP FLANGE:



LESS RADIUS AT ROOT OF FLANGE

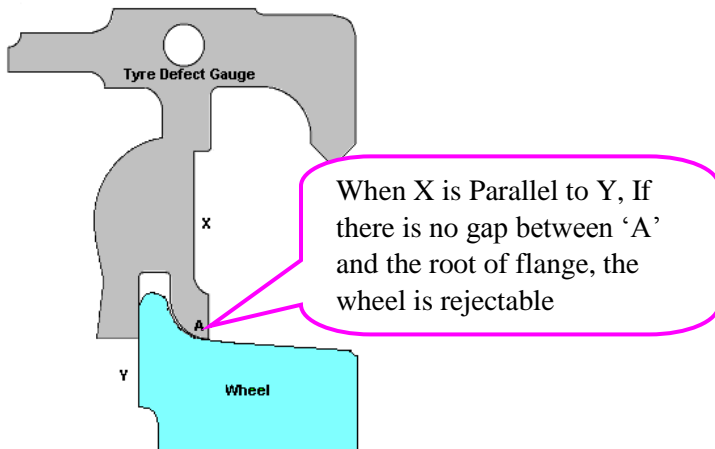
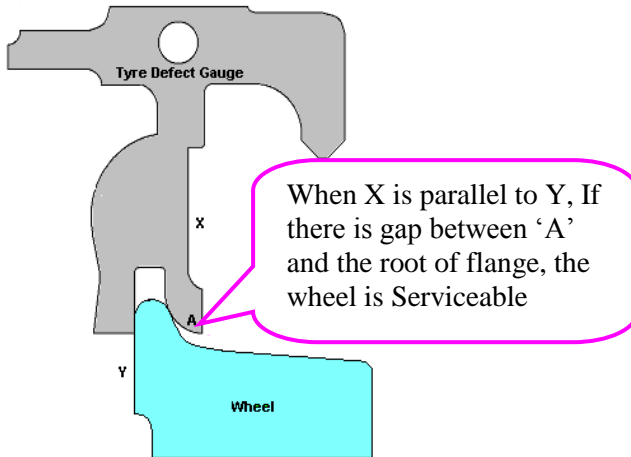


When X is parallel to Y,
If the gap is available at either side
of 'A', the wheel is serviceable.

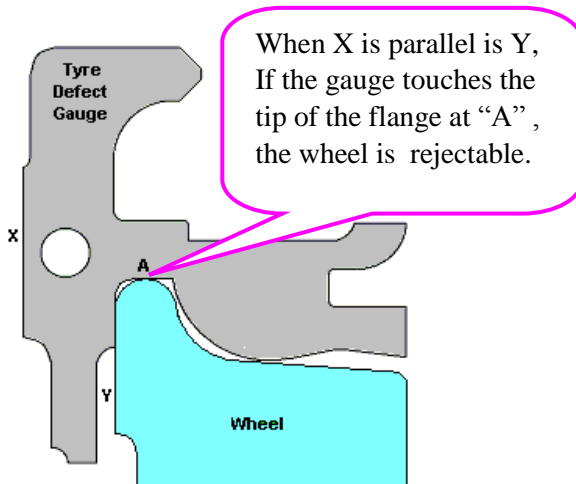
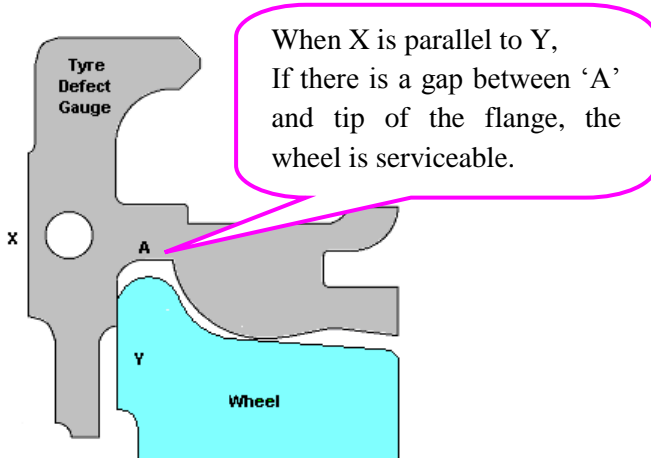


When X is parallel to Y , If there is a
gap between gauge and the Root of
Flange at A , the Wheel is Rejectable

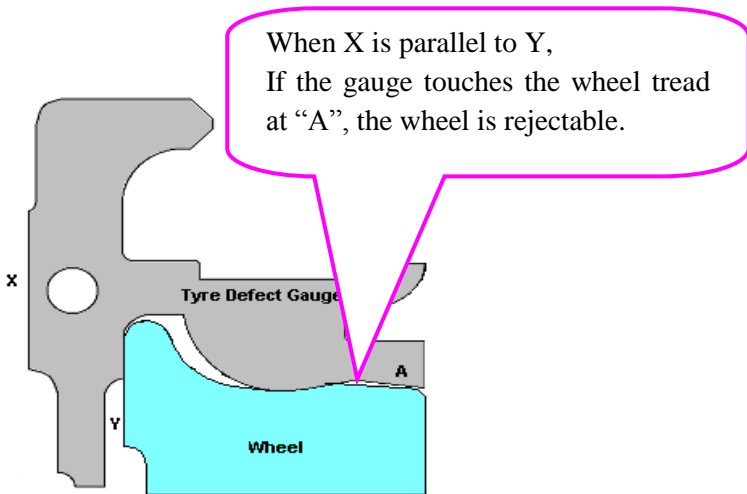
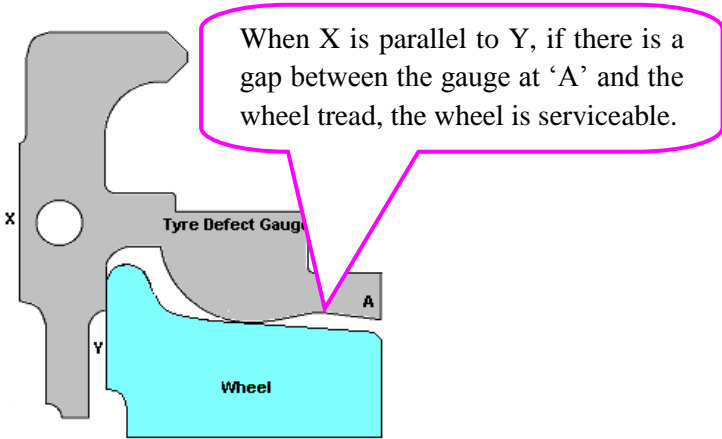
THIN FLANGE:



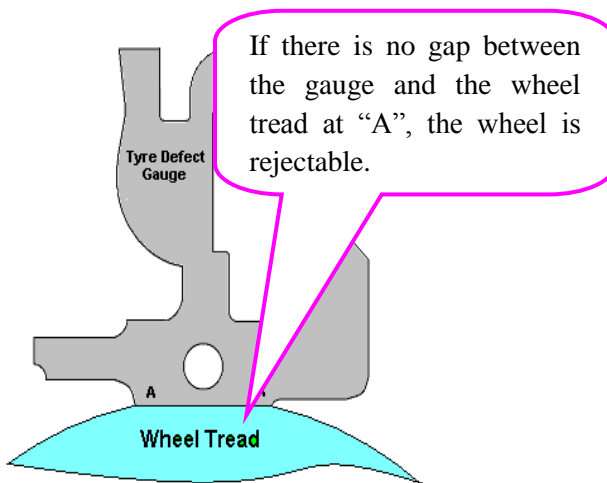
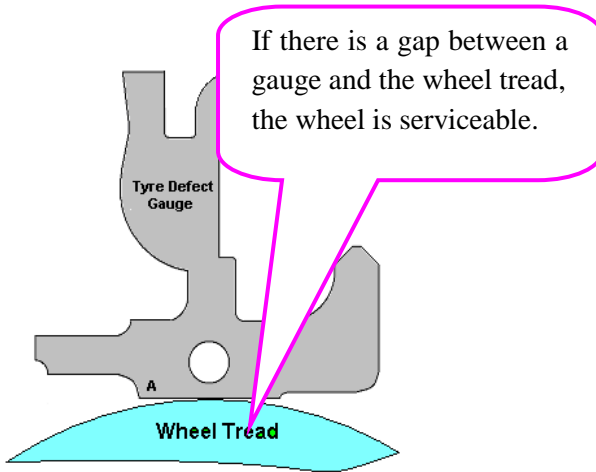
DEEP FLANGE:



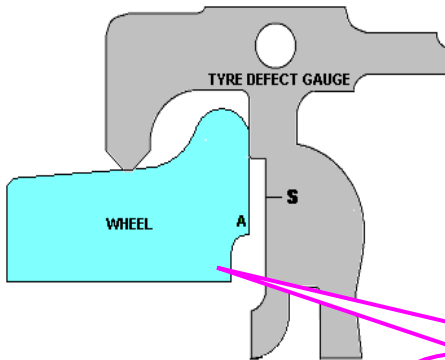
HOLLOW TYRE:



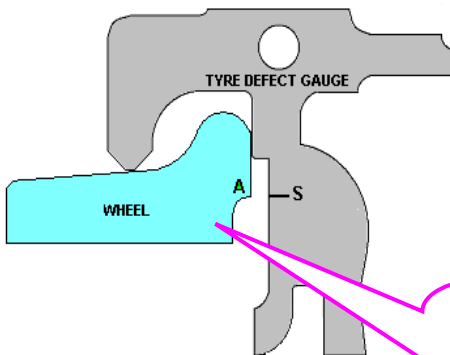
FLAT TYRE:



THIN TYRE:



If the mark 'S' on the gauge is above the mark 'A', the wheel is serviceable.



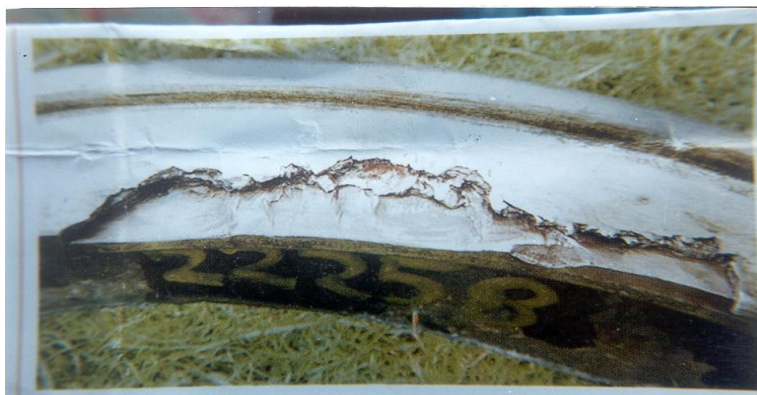
If the mark 'S' on the gauge coincides the wheel at 'A' the wheel is rejectable

7.2 RDSO Instructions on Wheel defects as per CMI – K 003

In addition to normal checks exercised on wheel condition during primary/secondary maintenance of coaches, a detailed inspection of wheels should be done during schedules or out of course attention. The wheels sets shall be inspected for the following conditions and action taken as indicated for each condition as per CMI – K 003.

7.2.1 Shattered Rim:

A wheel with a fracture on the tread or flange must be withdrawn from service. Shattered Rim is a rejectable defect. (This does not include wheels with localized pitting or flaking without presence of any rejectable condition).



7.2.2 Spread Rim:

If the rim widens out for a short distance on the front face, an internal defect may be present. Spreading of the rim is usually accompanied by a flattening of the tread, which may or may not

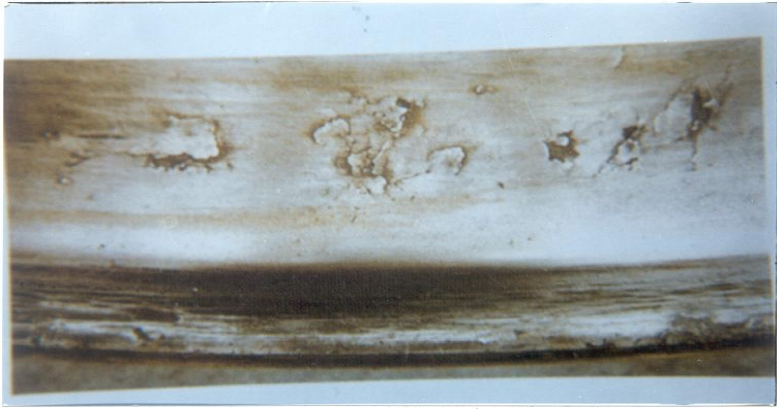
have cracks or shelling on the tread. Such wheels must be withdrawn from service.

(This condition should not be confused with a uniform curling over of the outer edge of the rim around the entire wheel, which is called rim flow. Rim flow is not a rejectable defect).



7.2.3 Shelled Tread:

Shelling can be identified by pieces of metal breaking out of the tread surface in several places more or less continuously around the rim. Shelling takes place when small pieces of metal break out between the fine thermal checks. These are generally associated with small skid marks or “chain sliding” Such wheels should be withdrawn from service and sent to workshops for re-profiling.



7.2.4 Thermal Cracks:

Thermal cracks appear on a wheel tread due to intense heating of the wheel arising out of severe brake binding. Such cracks occur on the tread and generally progress across the tread in a transverse & radial direction. Whenever such a crack becomes visible on the outer face of the rim or tread crack has reached the outer edge (non-gauge face) of the rim, the wheel should be withdrawn from service. If a crack becomes visible on the outer flange face, the wheel should be withdrawn from service. Such wheels should be sent to workshop for examination and subsequent rejection.

Wheels involved in brake binding during service, should be examined carefully during the maintenance to rule out the possibility of rejectable thermal cracks. Such wheels may be identified by presence of flats (even within acceptable limits) and severe discoloration or blue/ black heating marks on the tread.



7.2.5 Heat checks:

Fine superficial cracks visible on the tread on or adjacent to the braking surface are called heat checks, which are usually denser than the thermal cracks. Heat checks are caused on the tread due to heating and cooling cycles undergone by the wheel during normal braking. Such wheels need not be withdrawn but should be carefully distinguished from the rejectable thermal cracks.



7.2.6 Disc crack:

A crack on the disc due to material failure is called disc crack. The wheel should be withdrawn from service.



7.2.7 Loose axle:

While assembling wheel with axle proper interference should be maintained between wheel and axle. Due to improper selection of interference the wheel may shift outwards or it may come out completely. Loose axle is a rejectable defect.

Note: All wheel sets withdrawn from service for any of the conditions mentioned above must be sent to the associated workshops for detailed investigations and further disposal.

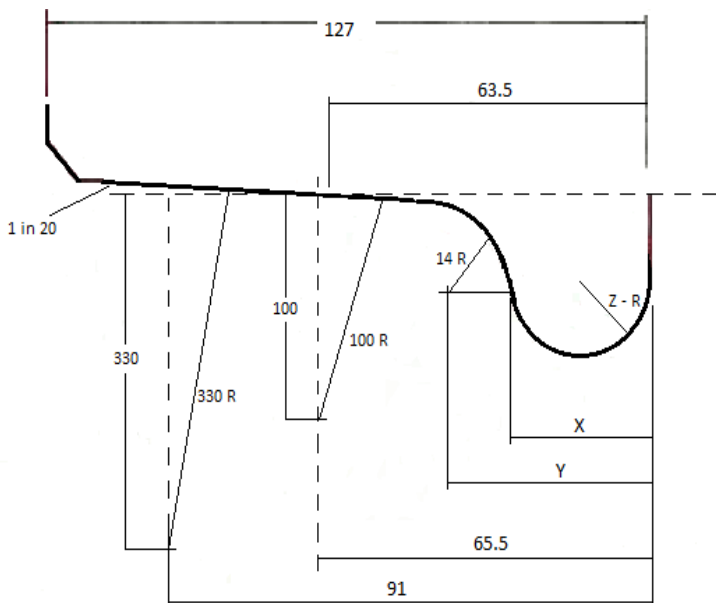
The date and station code of the maintenance depot where the wheels are changed should be stencilled on the end panels. An entry should also be made in the maintenance card of the coach.

No repairs, except wheel profiling of wheel sets is permitted to be done in the maintenance depot.

7.3 Worn Wheel Profile:

80 % of the track in Indian Railways is having rails which are already worn in service. Standard wheel profile running on these tracks tend to wear to a specific profile within short time itself, and further wear from this profile is very slow. Hence if the wheels are turned initially to this worn wheel profile, it will increase the wheel life by avoiding frequent re-profiling.

The worn wheel profile is made standard for all the wheels in Indian railways as the standard wheel profile is found uneconomical with lesser kilometers being run by the wheels within condemnation.



Step Sizes of Worn Wheel Profile:

The step sizes of worn wheel profile are given further to reduce the removal of material during tyre turning and increase the life of the wheel.

Flange Thickness (X)	Y	Z (Radius)
28 mm (27.84 mm)	42.23 mm	13.5 mm
27 mm (27 mm)	41.29 mm	13.0 mm
26 mm (26.16 mm)	40.34 mm	12.5 mm
25 mm (24.49 mm)	38.41 mm	11.5 mm
24 mm (23.65 mm)	37.44 mm	11.0 mm
23 mm (22.81 mm)	36.47 mm	10.5 mm
22 mm (21.97 mm)	35.49 mm	10.0 mm
21 mm (21.13 mm)	34.5 mm	9.5 mm
20 mm (20.29 mm)	33.5 mm	9.0 mm

10.

11.ENVIRONMENTAL FRIENDLY TOILETS

Indian Railways is running almost 10106 trains (approx: 40,000 passenger coaches), touching 7335 stations and handling about 1.9 crore passengers every day. An estimated two and a half million passengers use Indian Railway coach toilets daily, using a huge amount of water and creating aesthetic and hygiene related problems as the existing coach toilet systems discharge waste directly on to the tracks.

This leads to unacceptable hygiene conditions, particularly in the railway stations and damage the rails.



One of the key objectives of IR is to provide adequate passenger amenities in trains which include provision of clean and hygienic surroundings. Since majority of the existing toilets are discharging human waste directly onto the track, efforts are being made to introduce environment friendly toilet (EFT) systems.

Few EFT systems are given below:

- Controlled Discharge Toilet System
- Zero Discharge Toilet System
- Biological Toilets (Anaerobic / Aerobic)
- Vacuum Toilets.

Several types of toilet systems are in service and there is a need to work on incorporating knowledge from these to improve the designs. The adoption of a particular type of EFT in a train type mainly depends upon number of factors such as technology/product features and the type of train service.

Since the issue of EFTs on the trains is inviting greater attention in view of environmental and hygienic effect as well as passenger image building, high priority is accorded for this work.

However, the challenges are not-so-disciplined Indian toilet habits, requirements of long distance travel, separating non-degradable waste, maintenance practices in Indian Railways, Minimum peripheral such as air and electricity, retro fitment on coaches in service, wide scale proliferation of technology and cost effectiveness.

Controlled Discharge Toilets System:

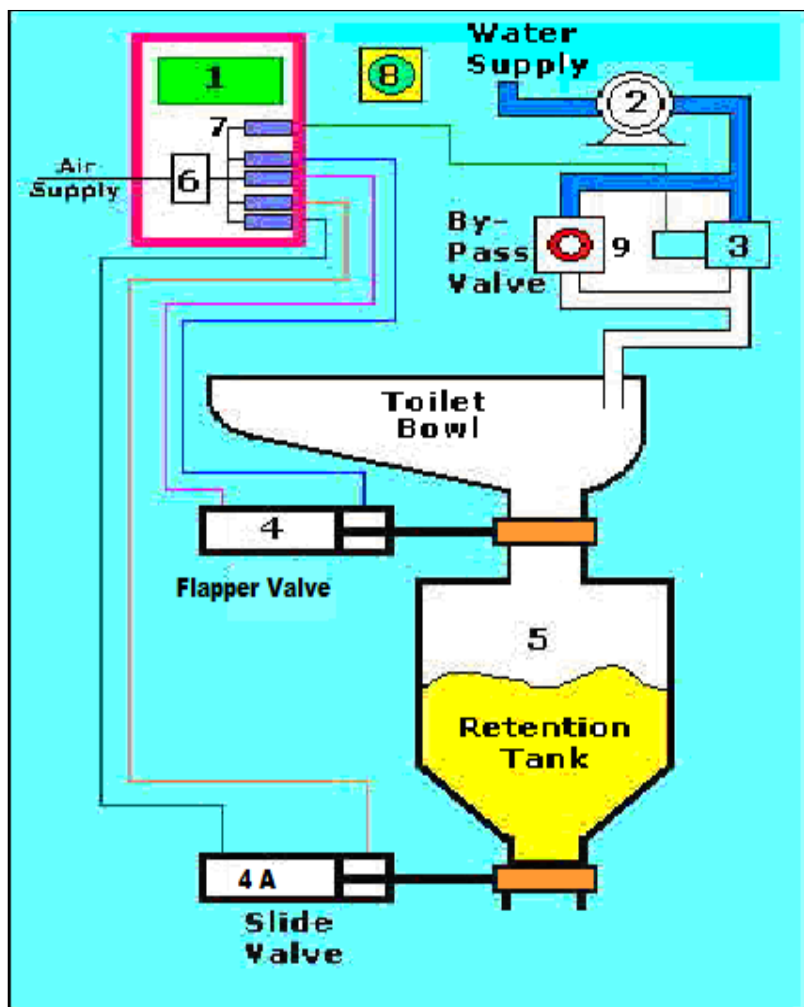
Controlled discharge toilets were the first to be experimented when LHB design stainless steel coaches were introduced for Rajdhani and Shatabdi trains in 2001-02. This system ensures that the waste from the toilet is retained in under-slung tanks while the train is waiting at a station or it is passing through city limits. The waste is finally discharge on the track when Train picks up 30 kmph speed + 15 cycles of flush or when the train is de-accelerating and approaching to 30 kmph.



Limitations:

CDTS does not fulfill the requirement of green toilet i.e. Zero-Defection on the ground. It requires both pneumatics and electrics for operation. It requires other electronic gadgets like PLC etc. and requires frequent maintenance

Working of Controlled Discharge Toilet System.



The system comprises the following:


1.	Control module	Having a programmable logic controller (PLC) used for counting the number of cycle as well as the speed sensing.
2.	Water pressuriser	A pressure pump used for pumping water with high pressure to clean the toilet bowl.
3.	Retention tank	A cylindrical tank with 40 Ltrs. capacity connected below the toilet bowl with two sliding valves each one at top & bottom.
4	Flapper Valve	The electro-pneumatically controlled flapper valve is provided on the top of the retention tank, designed to open and close in every flushing cycle with the cycle time of 15 Sec. (can be adjustable). Since it is a flapper valve, it will allow the waste to fall to the retention tank by opening due to the weight of waste itself, even if pneumatic system fails to work.
4A	Slide valve	Electro-pneumatically operated by the control module during flushing cycle and discharge. Bottom valve is designed to open and close after completion of 15 flushing cycles and also when the vehicle speed is above 30 KMPH.
5.	Water check valve	An electrically operated magnetic (solenoid) valve, used for opening and closing pressurised water during flushing cycle. It admits 2.5 Ltrs for Indian water closet and 1.5 Ltrs. for European water closet in 12 Sec.
6.	Bye-pass valve	A hand operated push cock which bye passes the water circuit during emergency situation i.e. in case of electricity failure and failure of CDTS.
7.	Pressure switch	A fail-safe system, which opens the top flapper valve of the retention tank in case of failure of air supply/ electric supply to use the toilet as an ordinary toilet.


Working:

Passenger after using the toilet presses the flush button (Soft press). Check valve of water pressuriser opens and pressurised water flows from the circuit to the toilet bowl and flushing takes place. Simultaneously top flapper valve opens and flushed water along with waste goes to the retention tank. After the flushing check valve of water pressuriser and top flapper closes.

At the end of every 15th cycle and if the speed of the vehicle is equal to or above 30 KMPH the bottom discharge valve will be opened and discharges take place. In the case of LHB coaches, the speed is sensed from the microprocessor provided for wheel slide protection. For conventional coaches individual speed sensors are provided in each bogie. Now a day's GPS based speed sensor is also under trial.

Problem	Cause	Remedy
1.No flush water	<ol style="list-style-type: none">1) Valve Y3 on the control panel is defective or non-operational.2) The control panel fails to transmit signals (the red light is not illuminated).3) An air hose may be bent.4) The shut-off cock on the water tank is closed.5) No water in the tank	<ol style="list-style-type: none">1) Activate valve Y3 on the control panel manually.2) Check the electric signals and connections.3) Check the air hoses (Activate Y3 manually).4) Open the cock.5) Fill the tank.

<p>2. Continuous water falling from nozzles</p>	<p>Some foreign particles in water can obstruct the flush valve operation.</p>	<p>Remove the flush valve and clean it with a soft cloth and again put it into the line.</p>
		
<p>3. Flapper valve not open during flushing.</p>	<ol style="list-style-type: none"> 1) The inlet valve fails to open. 2) Valve Y2 on the control panel is defective or non-operational. 3) The controller (PLC) fails to transmit signals. 4) An air hose may be bent. 5) If after checking the above 4 points, it is still not working. 	<ol style="list-style-type: none"> 1) Activate the push button “Inlet”(Green button) on the control panel . 2) Activate valve Y2 on the control panel manually. 3) Check the electrical signals and connections. 4) Check the air hoses (Activate Y2 manually). 5) Change the valve block Y2.

<p>4. Flapper wall making heavy noise/splashing water.</p>	<p>Adjustment of speed controller of its cylinder irregular</p>	<p>Adjust the speed controller as shown in picture with the help of a screw driver to control speed to avoid water splash/noise</p>
<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 20px;"> <p>Speed controller</p> </div> <div style="text-align: center;">  </div> </div>		
<p>5. The outlet valve fails to open/Close.</p>	<ol style="list-style-type: none"> 1) The outlet valve fails to open. 2) Valve Y1 on the control panel is defective or non operational. 3) The controller (PLC) fails to transmit signals. 4) An air hose may be bent. 5) If after checking the above points, it still not working 6) After doing all these it the 	<ol style="list-style-type: none"> 1) Activate the push button “outlet”(Back push button) on the control panel. 2) Activate valve Y1 on the control panel manually. 3) Check the electrical signals and connections. 4) Check the air hoses (Activate Y1 manually). 5) Change the valve blockY1.

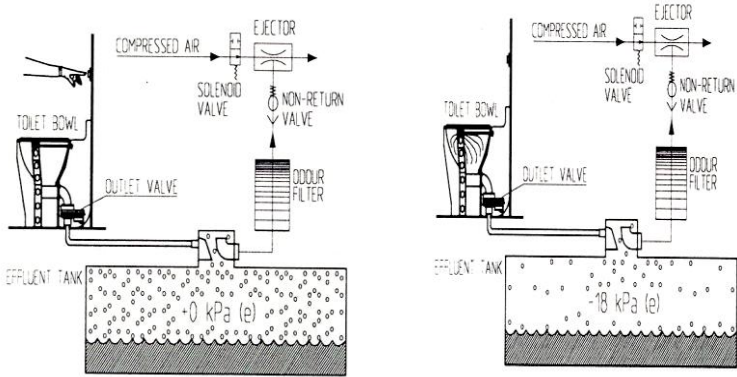
	problems still persist.	6) Refer to its maintenance schedule.
6.No activity by the Pressurizer	<ol style="list-style-type: none"> 1) The ball valve of Pressurizer closed 2) There is a failure signals in the controller. 3) Valve Y3 on the control panel is defective or non operational. 4) Water is leaking from the sides. 	<ol style="list-style-type: none"> 1) Open the ball valve. 2) Check the electric signals and connections. 3) Activate valve Y3 on the control panel manually. 4) Tight the nut bolts.
7. No water comes from wall protector	<ol style="list-style-type: none"> 1) The flush valve fails to open. 2) Valve Y3 on the control panel is defective or non-operational. 3) The controller (PLC) fails to transmit signals. 4) An air hose may be bent. 	<ol style="list-style-type: none"> 1) Activate valve Y3 on the control panel manually. 2) Activate valve Y3 on the control panel manually. 3) Check the electrical signals and connections. 4) Check the air hoses (Activate Y3 manually).

<p>8.The toilet basin is not evacuated</p>	<ol style="list-style-type: none"> 1) There is a blockage in the pipe between the basin and the intermediate tank. 2) The inlet valve fails to open. 3) Valve Y2 on the control panel is defective or non-operational. 4) The control panel fails to 5) transmit signals. 6) An air hose may be bent. 	<ol style="list-style-type: none"> 1) Open the inlet valve by activating 2) the push button and push or press the blockage into the intermediate tank. 3) Activate the push button “Inlet” (Green push button) on the control panel. 4) Activate valve Y2 manually. 5) Check the electric signals and connections. 6) Check the air hoses (Activate Y2 manually).
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Vacuum Toilet System

Based on the principle of direct transport from the toilet bowl to the tank aided by vacuum condition in the tank and pipeline. Water used per flush is 250ml only which is much less than other systems. Centralized tank that is fitted in this system retains the effluent and requires to be emptied. Effluent emptying facilities can be fixed or mobile type. In fixed type, evacuation pumps to be deployed at the terminating stations which transfer the

effluents to ground tanks or transferred to locations specified by municipal corporations. Mobile type units can be installed on trucks which can be used for collection at large stations and onward transportation to specified locations.

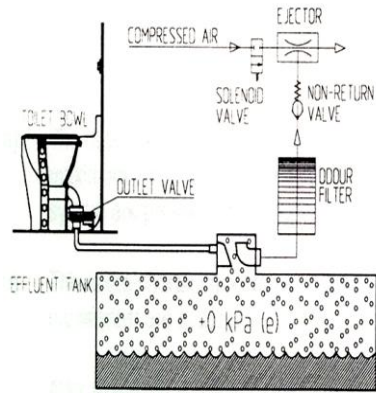
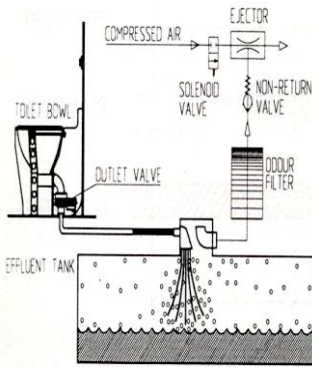


Flush Knob Pressed

Flush valve lamp comes on; Ejector starts and begins building up vacuum in the system. Odour filter blocks odour

Flushing Initiated

When vacuum level of -18kPa is reached, water pressurizer unit is activated, water valve opens and toilet bowl is flushed



Flushing Completed

The Ejector, Water valve and Water Pressuriser close at the same time as the outlet valve opens – contents of the bowl transported to tank

Cycle completed – System ready

The output valve closes and the system is in its stand-by position – ready for use

Limitations:

Does not work in the event of loco changeover/failure, due to non-availability of compressed air and does not work in stabled condition in platforms.

The system needs better monitoring as several indicator and alarm signals are outputted by the system.

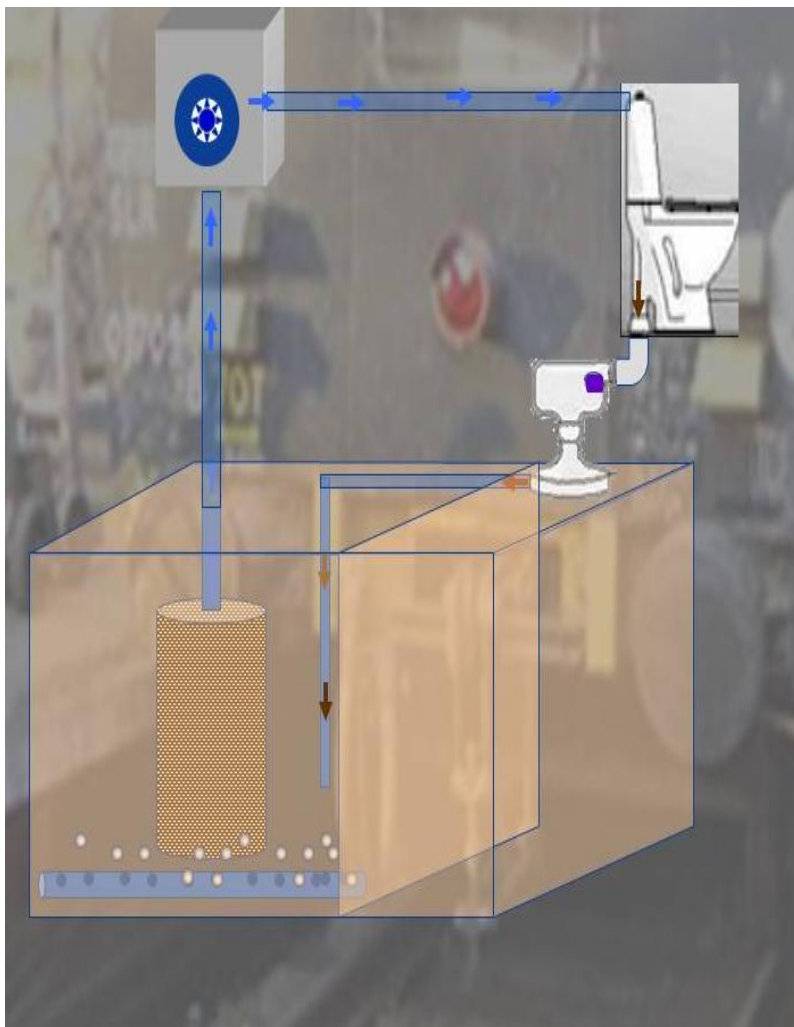
If required conditions are not met, the system stops the toilet. Elaborate infrastructure needs to be built up for disposal of effluents from the retention tank.



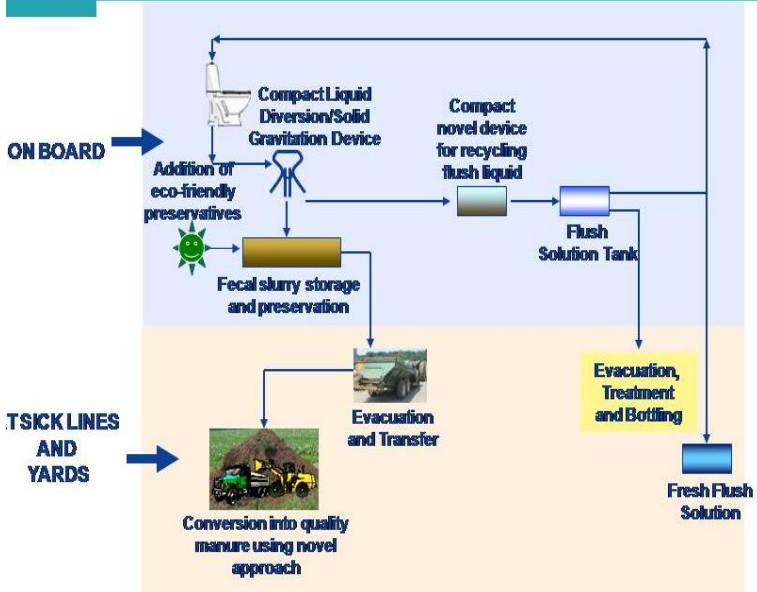
8.1 Zero Discharge Toilet System:

This toilet works on the principal of solid liquid separation with solid portion stored- evacuated- transferred and dump into pits for composting and liquid portion filtered, treated, recycled for flushing purpose. These toilets have been

developed by a consortium consisting of RDSO, IIT/Kanpur & URBANE Industries, Chennai under TMRS Projects.



ZDTS- Schematics Representation of System



Advantages of the system:

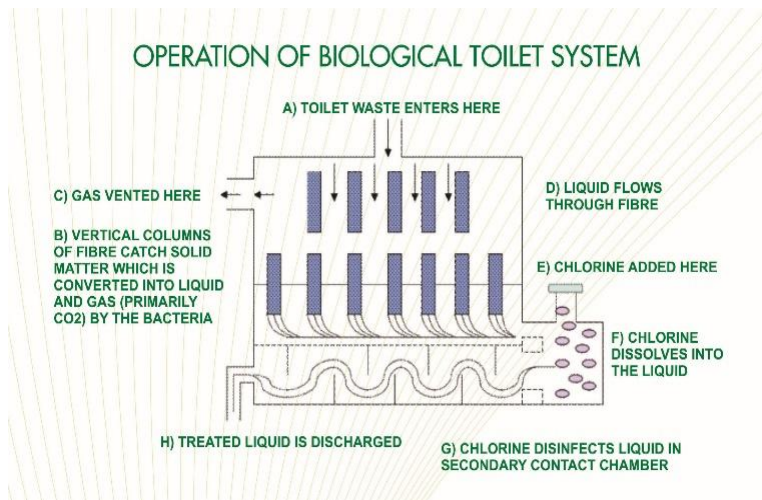
- There is no effluent discharge on track and has effective non-degradable waste segregation system.
- Water is recycled for flushing.
- It is completely Environment friendly as waste is converted to fertilizer.
- The design is robust.

Disadvantages:

- This needs evacuation frequently and extensive ground facilities like pits, transfer pumps etc for composting.
- It has higher operational cost.
- Quality of recycled water for flushing needs improvement as it has mild stink.
- Detention of rakes at pit lines is more.

Aerobic type biological Toilet:

Indian Railways has tried out bio digesters imported from M/s Microfore, USA where aerobic bacteria are used for decomposing the waste into gases and water. Liquid is discharged on the ground after chlorination. This system has been successful but periodic replenishment and high initial as well as maintenance cost are the stumbling blocks.



Limitations:

- The toilets has foul smell, there is lack of non-bio-degradable separation system.
- There is choking due to accommodation of non-bio-degradable.
- It requires periodic replenishment.

8.2 IR-DRDO Anaerobic biological toilet system:

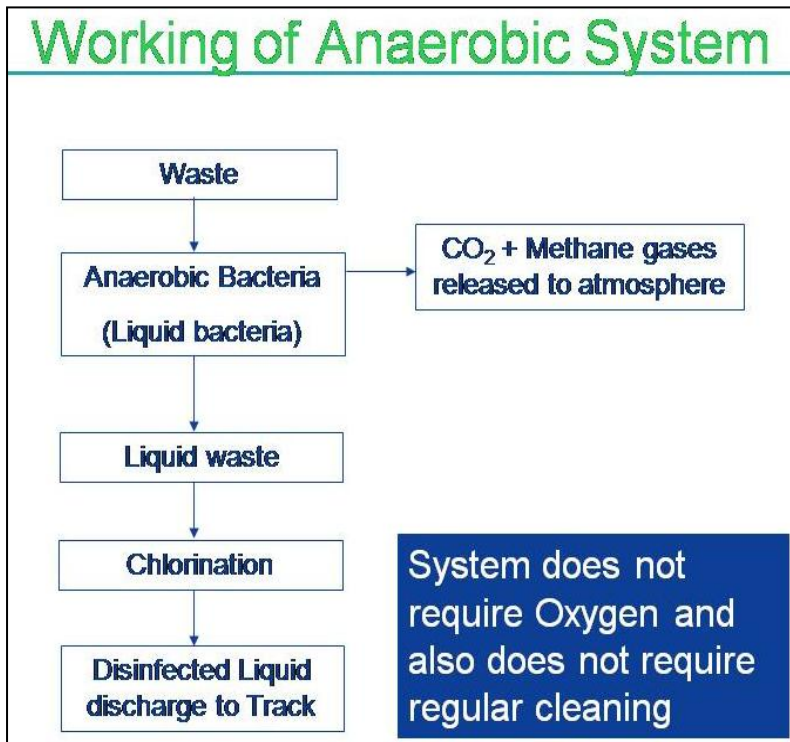
In this technology anaerobic bacteria is used for decomposition. DRDO developed these bacteria for use in high altitudes areas like Siachen Glacier where de-composition of waste is not possible by natural process. This bacterium once charged does not require replenishment for long time and system is maintenance free.

Difference between aerobic bacteria and anaerobic bacteria:

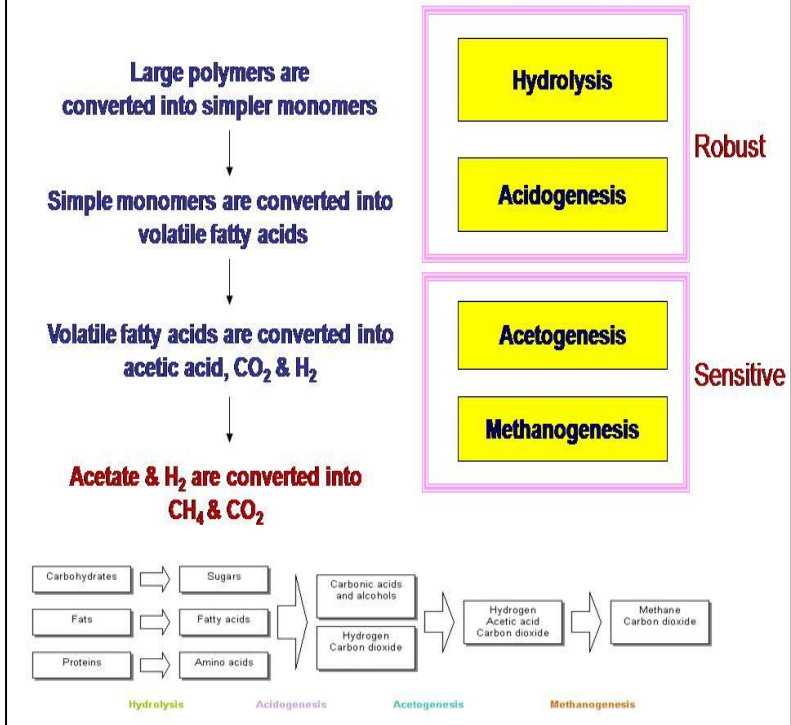
Aerobic Bio-degradation	Anaerobic Bio-degradation
Forced aeration/agitation is essential which is energy intensive	No aeration is required
Incomplete aeration (partial aerobic condition) leads to foul smell	Complete anaerobic condition
Not effective in pathogen inactivation	More than 99% pathogen inactivation
Cannot tolerate detergents/phenyl	Anaerobes can even degrade detergents/phenyle
Generates large amount of	Sludge generation is very less

sludge	
Repeated addition of bacteria/enzyme is required for process	One time bacterial inoculation is enough
Maintenance & recurring cost is high	Minimal maintenance & no recurring cost

Fecal matter: Having 80% of bacteria (both aerobic & anaerobic & reducing in nature), Water and Non-degradable waste.



STEPS IN ANAEROBIC DIGESTION



Anaerobic Bio digester provided under the toilet in the coaches:

- The size of the tank is 1150 x 720 x 540 mm, made up of stainless steel, under slung on mounting brackets in the coaches.

- The tank has 6 partition walls inside the tank (seven chambers).
- Poly grass mat for protection of bacteria inside the partition walls.
- Ball valve with handle for operation for making toilet direct discharge in case of chocking.

Total volume of tank – 400 ltrs

Effective volume of tank – 300 ltrs

Empty tank weight – 110 Kgs

Full tank weight – 410 Kgs

Height from Rail level – 225 mm



There are Seven chambers in the tank. First chamber has grill partition so that non-bio-degradable objects do not pass to further chambers. Fecal matter in slurry form goes from 1st chamber to 2nd chamber through a pipe (from bottom of first chamber). Slurry flows from 2nd chamber to 6th chamber through slits in the partitions. From 6th chamber to 7th chamber it flows through a pipe (from bottom of the 6th chamber). From 7th chamber to the chlorinator it flows through a pipe (from top of the 7th chamber). Finally chlorinated water is discharged to the ground. Nylon matting is provided on all walls for colonization of bacteria. Four variants and its Limitations:

SN	Design variants	Limitations
1	Varaint-1 Having PLC with electronics and pneumatics	Failure and theft of PLC. Non availability of electricity and air every time. High cost of AMOC. Frequent attention similar to CDTs. Leakage through flapper valve.
2	Varint-2 Provided with manual slider valve for removing the choke, without electronics and pneumatics	No problem in maintenance, except for opening in case of choking with foreign object. It is required to be opened by going between adjacent coaches. (Modifications are under trial with provision of opening arrangement from inside the toilet itself.)
3	Varaint-3 Provided with smaller dia opening to the	Being no fail safe mode, all foreign objects going to tank, thus tank is with full of garbage. Frequent choking problems.

	tank, no fail safe arrangement, without electronics & pneumatics	
4	Vraint-4 Provided with manual flapper with solid liquid separator.	Manual flapper leakage Solid liquid separator groove blockage thus not functions as desired.

SALIENT FEATURES:

- Bad smell in toilets from the tanks is not there.
- Fecal matter in the tank is not visible.
- Infestation of cockroaches & flies is nil in this system.
- Clogging of digester is not noticed.
- The effluent is free from odour and solid waste.
- There is reduction in pathogens by 99% and organic matter by 90%.
- No maintenance and adding of bacteria/ enzyme is required during service.
- Removal of solid waste is also eliminated.
- Use of phenyl/ cleaning agents is permitted up to 100ppm.
- Cleaner undergear components and end body, for hygienic working in maintenance lines.

Improvements in the designs:

The sliding valve is replaced with ball valve. In the case of the toilet getting choked, the failsafe valve cannot be made operational in the entire journey as ball valve cannot be operated from inside the toilet. Further, in case train is standing at a station toilet adjacent to platform cannot be made operational because of space constraint for operation of valve. Hence the valve is provided with arrangement to be opened with a foot pedal from inside the toilet itself in the case of choking during run, and it automatically closed on release of the foot.

One dust bin is provided inside the toilet which can be used for disposing the non bio degradable items, as the passengers have tendency to throw the objects into the lavatory pan and cause choking.

For awareness among the passengers, particularly Non AC passengers, Pictorial stickers are provided inside the toilet to educate passengers for Do's and Don'ts.

Brief about bacteria (Anaerobic bacteria):

The bacteria double its population within 6 to 8 hours. It dominates and decomposes fecal matter in to liquid and gases. It can be kept for 3-4 months at ambient temperature and can withstand sub zero temperature as well as upto 60 degree centigrade. The cold temperature would not affect the inside process because Anaerobic process is exothermic in nature hence in cold regions heat will be available inside the chamber because of chemical process.

Maintenance of Bio-toilet system:

- Inspect complete toilet system including under slung equipments visually.
- Check the toilet system for any deficiency.
- Clear the chocked chute in bio-toilets and preferably keep the system in direct discharge mode during cleaning the toilets.
- Toilets fitted with bio-digester should be preferably cleaned by pressurised water cleaning system so as to minimise the water usage.
- Charge the chlorination chamber with chlorine tablets as per the requirement.
- Collect the samples as per the schedule and sent for laboratory tests.
- Charge the bio-culture if required based on the test reports of the samples collected.

Guidelines for handling the bacteria:

- Wear gloves while handling bacterial culture.
- Store bacterial culture in container with lid which can be closed.
- During transportation, lids should be tightly closed and during storage, lids should be kept loose to facilitate escape of gas generated inside the container.
- Do not mix detergents/acids with bacteria at any stage during use.
- Clean/sanitize hands with detergents/soap after handling the bacteria.

Testing of Effluents of Bio-toilet:

Details	Set target	Sampling qty	Frequency of sampling	Remarks
pH value	6- 9	50 – 100 ml	90 days	To be tested in Laboratory /at site
Total Solids (TS)	< 750 mg/100 ml	25 ml	90 days	To be tested in laboratory
Total Dissolved Solids (TDS)	< 350 mg/100 ml	25 ml	90 days	-do-
Total Volatile Solids (TVS)	< 500 mg/100 ml	25 ml	90 days	-do-
Chemical Oxygen Demand (COD)	< 2000 mg O ₂ /100 litres	5 – 10 ml	90 days	Laboratory/DRDO/ Govt approved labs
Fecal Coli Forms count	> 99% reduction (less than 10 ⁸ /100 ml)	10 ml	90 days	Govt approved labs only

Storage of sample:

Determination	Container	Minimum sample (ml)	Sample type	Preservation	Maximum storage	
					Recommended	Regulatory
pH	Plastic or Glass	100	Composite	Analyze immediately	15 min	15 min
Total solids	Plastic or Glass	25 – 50	Composite	Refrigeration (4-7° C)	7 days	2 – 7 days
Total dissolved solids	Plastic or Glass	25 – 50	Composite	Refrigeration (4-7° C)	7 days	2 – 7 days
Volatile solids	Plastic or Glass	25 – 50	Composite	Refrigeration (4-7° C)	7 days	2 – 7 days
Chemical oxygen demand	Plastic or Glass	5- 50	Composite	Analyze immediately or add H ₂ SO ₄ to pH <2.0 and refrigerate	7 days	28 days
Total fecal coli forms count	Plastic or Glass	1 – 10	Composite	Add sodium thiosulphate and refrigerate (4-7° C)	1 day	1 day

Sample shall be collected on quarterly basis and sent for testing. Samples will be collected randomly from a lot of 5% coaches of the total coach holding but minimum one coach of each type at an interval of every three months during the trial period.

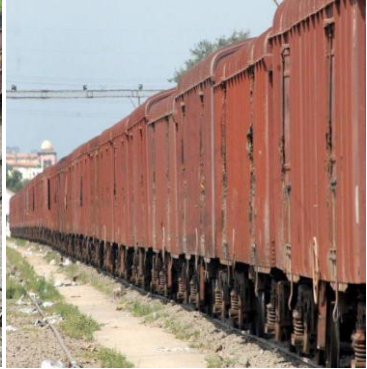
Sampling will start after coach has been in passenger service for 10 days or more and collect samples from the bio digester 30 minutes after the train becomes stationery/still. Open the sample port and let water drain for 2 minutes to remove settled solids particles and to ensure that sample is representative of the system

The samples should be collected and sealed in presence of Railway representative. At least one test every quarter shall be carried out in Govt lab. In case the samples do not meet requirement, test shall be repeated after taking necessary corrective actions within a fortnight.

Sample shall be collected in 2 liter plastic bottle by simply opening the knob provided in the sampling port. Date and time of sampling and coach No. must be mentioned on the bottle. Sample collected in the bottle shall be transported to lab at the earliest but not later than 24 hours after collecting of the sample.

During POH of the coach fitted with Bio toilet, the tank shall be removed from the coach and kept at safe place and refitted on the same coach after other attention on the coach. In case there is any damage or leakage the inoculums shall be drained and the tank repaired. After repairing and fitting on the coach it has to be refilled with required level of fresh culture (approx 120 liters) before dispatch of coach.

12.FREIGHT STOCK



Rolling stock used exclusively for transport of goods is termed as freight stock. Freight Stock are broadly classified either according to their under gear or according to utility.

Classification according to under gear:

- i) Four wheeler wagon
- ii) Bogie wagons

➤ **Four wheeler wagons:**

At present only Brake van is in service, other 4 wheeler wagons like tank wagon and CRT wagons are phased out.

➤ **Bogie wagons:**

There are four different types of bogies used in wagons.

Diamond frame bogie, Cast steel Bogie, UIC fabricated bogie, CASNUB Bogie

Classification according to utility:

Open wagons, Covered wagons, Flat wagons, Hopper wagons, Well wagons, Container wagons, Tank wagons, Brake vans

- **Open wagons:**

These are wagons are used for transportation of coal, ore, limestone's etc. which does not require protection from rain. The wagons are provided with flap doors for ease of loading/unloading of consignment.

- **Covered wagons:**

The consignments which required to be protected from rain etc; are transported in covered wagons. These wagons generally carry food grains, cement, fertilizers, fruits & vegetables etc.

- **Flat wagons:**

These wagons are without side walls and are generally used for carrying steel coils, billets, rails sleepers etc.

- **Hopper wagons:**

These are special wagons designed for Rapid discharge from bottom. These are used for transporting coal and ballast.

- **Well wagons:**

These wagons have well shaped under frame and are used for larger consignments like military tanks, heavy equipments etc.

- **Container wagons:**

These are special flat wagons designed for handling containers.

- **Tank wagons:**

These are wagons designed to carry liquid consignment like petroleum products, milk, edible oils, etc.

- **Brake vans:**

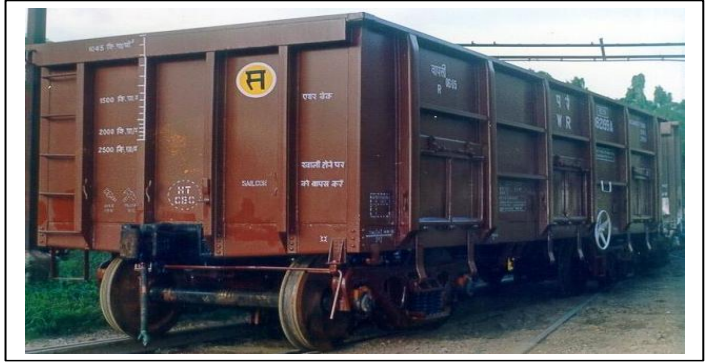
These are guards van used with freight trains as last vehicle.

9.1 OPEN WAGONS

- i. **BOY:** Designed in 1967 for heavy minerals. Axle Load - 22.9t. Cast Steel Bogie. It has no doors. Speed 65/75 Kmph.



- ii. **BOY EL:** Introduced in 2006 for operation at 25t Axle Load. Bogie -Casnub 22NLC. Differentiated from BOY by an Olive Green Band. Speed restricted to 50/65 Kmph.
- iii. **BOXN:** Designed in 1980 for coal. Axle Load - 20.32t. CASNUB Bogie, Speed 75/80 Kmph.



- iv. **BOXN M1:** In 2005 for increasing the CC up to CC+8+2t, suspension of BOXN is augmented by providing additional springs. A caption “Fitted with additional springs for Axle Load of 22.2t” in the centre of the wagon in golden yellow is printed to differentiate. Bogie side frame is also painted with Golden Yellow band. Speed 70/80 Kmph for CC+6+2t & 60/80 Kmph for CC+8+2t.
- v. **BOXN EL:** Introduced in 2006 for operation with 25t Axle Load. Bogie - Casnub22 NLC. Differentiated from BOXN by an Olive Green Band. Speed restricted to 50/65 Kmph.



- vi. **BOXN HS:** Designed in 2000. Variant of BOXN with Casnub 22HS bogie for increasing speed. Differentiated from BOXN by a Golden Yellow band. Speed 100/100 Kmph.



- vii. **BOXN HSM1:** In 2005 for operation up to CC+8+2 t, suspension of BOXNHS modified by providing two additional inner springs. Differentiated from BOXNHS by a caption “Fitted with additional springs for Axle Load 22.82t” in centre of the Golden Yellow band. Bogie side frame also provided with Golden Yellow band. Speed 75/90 Kmph for CC+6+2t and 60/90 Kmph for CC+8+2t.
- viii. **BOXN CR:** Designed in 1999. Material of body of BOXN changed to stainless steel (IRS: M 44). Other parameters are same as BOXN.
- ix. **BOXN R:** Designed in 2007. It is upgraded rehabilitated version of BOXN. Entire superstructure of MS replaced with Stainless steel (IRS: M 44). Height is 177 mm more than BOXN. Carrying capacity increased by 6t. Nine

stanchions provided, instead of 6 in BOXN. Axle Load - 22.9t.



- x. **BOXNHA:** This wagon was designed in 2001 for transportation of coal with an axle load of 22.1t. Bogie - IRF 108HS. Its height is more than BOXN. Speed at 20.32t and 22.1t Axle Load 100/100 Kmph and at 22.82t Axle Load 60/65 Kmph.
- xi. **BOXN LW:** Designed in 1988 to meet the requirement of higher pay to tare ratio. Axle Load - 20.32t. Casnub22HS bogie, Width is 50 mm more than BOXN. Stainless steel (IRS: M44) & corton steel (IRS: M41) used in body and under frame and Cold Rolled Formed (CRF) sections were used in design to reduce the tare weight of the wagons. Manufacturing of this wagon started in 2005. Speed 100/100 Kmph.
- xii. **BOXN LWM1:** In year 2008, design and Suspension of BOXNLW modified for operation up to CC+8+2t. Speed 60/65Kmph for both CC+6+2t and CC+8+2t.

- xiii. **BOXN HL:** Designed in year 2005, 250mm longer, 76mm higher & 50mm wider than BOXN. Axle Load - 22.9t. Casunub22HS Bogie. Stainless steel (IRS:M44) and CRF section used in body and under frame to reduce tare weight (20.6t). Has been provided with improved quality coupler and draft gears. PU painting is used. Initially red oxide colour specified, later on changed to phirozi blue. In red oxide colour wagons 'SS' written on side in a circle in phirozi blue colour for identification. Speed 75/100 Kmph.



- xiv. **BOST:** Designed in 2000 for long steel products. Axle Load - 20.32t. CASNUB 22HS Bogie. Speed 75/80 Kmph.
- xv. **BOST M1:** In 2006 for operation up to CC+6+2t, it is modified by providing additional springs. Differentiated from BOST by a caption "Fitted with additional springs for Axle Load 22.32t" in centre of the wagon in Golden Yellow. Speed 60/65 Kmph.



- xvi. BOST HS:** Designed in 2004. Variant of BOST with Casnub 22HS (Mod-1) bogie for increased speed. It is differentiated from BOST by a Golden Yellow Band. Speed 100/100 Kmph.
- xvii. BOST HS M1:** In 2007 for operation up to CC+6+2t. it is differentiated from BOSTHS by a caption “Fitted with additional spring for Axle Load 22.32t” in centre of the Golden Yellow Band. Speed 60/80 Kmph.
- xviii. BOST HS M 2:** Designed in 2006 for increasing speed. Axle load 22.32t. Variant of BOSTHS with CASNUB 22HS (Mod-II). Speed 60/100

9.2 COVERED WAGONS

- i. **BCN:** Designed in 1984 for transportation of bagged commodities. Axle Load 20.32t. present stock is mostly with CASNUB 22NLB, Speed 75/80 Kmph.

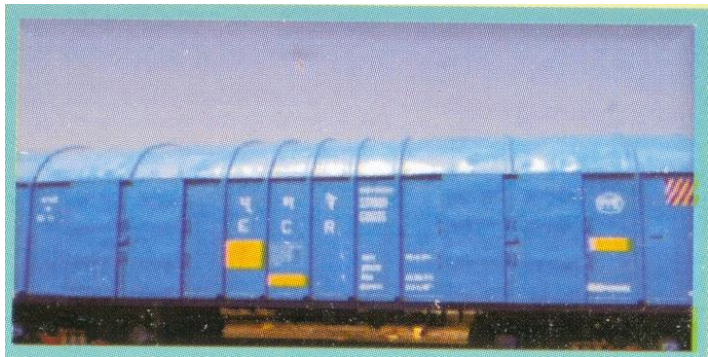


- ii. **BCN M 1:** Introduced in 2006 for operation up to CC+8+2t. It is differentiated from BCN by a caption “Fitted with additional springs for Axle Load 22.82t” in centre of the wagon in Golden yellow. Golden Yellow Band is provided on bogie side frame also. Speed 75/80 Kmph for CC+6+2t and 65/80 Kmph for CC+8+2t.
- iii. **BCN A:** Designed in 1990 by reducing the length of BCN wagon and increasing height, there by increasing the number of wagons in a rake to 44. Axle Load 20.32t. Bogie is CASNUB 22NLB, Speed 80/80 Kmph.



- iv. **BCNA M 1:** Introduced in 2006 for operation up to CC+8+2t. It is differentiated from BCNA by a caption “Fitted with additional springs for Axle Load 22.82 t” in centre of the wagon in Golden yellow. Golden Yellow Band is provided on bogie side frame also. Speed 75/80 Kmph for CC+6+2t and 65/80 Kmph for CC+8+2t.
- v. **BCNA HS:** Designed in 2001, variant of BCNA with CASNUB 22HS bogie for increased speed. It is differentiated from BCNA by a Golden yellow band. Speed 100/100 Kmph.
- vi. **BCNA HSM 1:** Introduced in 2006 for operation up to CC+8+2t. It is differentiated from BCNAHS by a caption “Fitted with additional springs for Axle Load 22.82t” in centre of the wagon in Golden yellow. Golden Yellow Band is provided on bogie side frame also. Speed 75/100 Kmph for CC+6+2t and 65/100 Kmph for CC+8+2t.
- vii. **BCN HL:** Designed in 2006 for bagged commodities. Axle Load 22.9t. Length is further reduced and both width

and height increased compared to BCNA. Hence number of wagons per rake increased to 58. Bogie is of CASNUB 22 HS type. Stainless steel (IRSM: M44) and CRF sections used in body and under frame construction to reduce the tare weight. Has been provided with improved quality coupler and draft gears. PU painting of Phiroziblue colour is used. Speed 65/65 Kmph.



- viii. **BCCN/BCCN A/BCCN B:** BCN variants for carrying bulk cement (not packed in bags). Loading is through ports at the top; unloading via chutes at the bottom.



- ix. NMG:** These are not narrow-gauge wagons, despite the classification code. The class code 'NMG' stands for 'New Modified Goods'. These are single-decker automobile carriers constructed out of old ICF and BEML passenger coaches. The design is not entirely uniform but generally all the windows and doors on the side walls are removed and the opening closed. End body is modified by providing doors to allow vehicles to be driven into it.



9.3 FLAT WAGONS

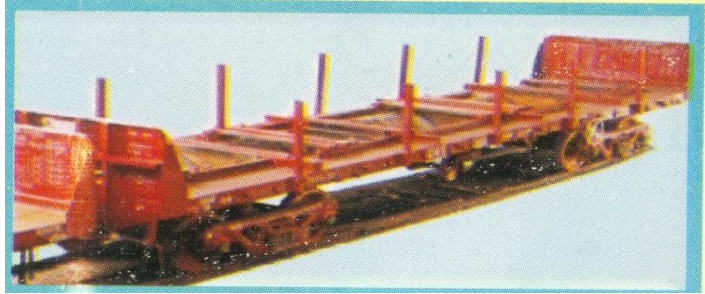
- i. **BRN:** Designed in 1992 for transportation of rails and heavy steel products. Axle Load 20.32t. provided with CASNUB 22 NLB, Speed 75/80 Kmph.



- ii. **BRN A:** Designed in 1994, improved version of BRN. The design is riveted cum welded construction. Higher pay to tare ratio, compared to BRN. Other parameters are same as BRN. Speed 75/80 Kmph.
- iii. **BRN AHS:** Designed in 2001. Variant of BRNA with CASNUB22HS bogies for increased speed. Speed 100/100 Kmph.



- iv. **BFNS:** Designed in 2002 especially for transportation of hot rolled/cold rolled coils, plates, sheets and billets etc. This is the first wagon designed in Indian Railways to carry point load. Provided with CASNUB 22HS bogie, Axle Load 20.32t. Speed 100/100 Kmph.



- v. **BRHNEHS:** This bogie rail wagon was designed in 2004 for use of Engineering department of various Zonal Railways for Track Relaying Train (TRT), specially for loading RCC sleepers. Axle Load 20.32t. provided with CASNUB 22HS Bogies. The design was provided with Transition CBC and air brake system. Speed 50/65 Kmph.



9.4 HOPPER WAGONS

- i. **BOBSN:** Designed in 1994 for transportation of iron ore, Axle Load 22.9t. Provided with modified CASNUB 22NLB bogie. It is provided with side discharge. Speed 75/75 Kmph.



- ii. **BOBSNM1:** In 2006 for operation at A/L 25t, suspension of BOBSN modified by providing 4 additional inner springs, Bogie renamed as Casnub22NLC. Speed 50/60.
- iii. **BOBR:** Designed in 1986 for transportation of Coal, it is provided with bottom discharge. Axle Load 20.32t. Provided with CASNUB 22NLB bogie, Speed 80/80 Kmph.



- iv. **BOBRM1:** Introduced in 2006 for operation up to CC+6+2t. It is differentiated from BOBR by caption “Fitted with additional springs for A/L 22.32t” in centre of wagon in Golden Yellow. Golden Yellow Band is provided on bogie side frame also. Speed 70/75 Kmph.
- v. **BOBRN:** Designed in year 1991 by reducing the length of BOBR wagon to increase the number of wagons in a rake to 58 (from 53 of BOBR). Axle Load 20.32t. provided with CASNUB NLB bogie. Speed 75/70 Kmph.
- vi. **BOBRNM1:** Introduced in 2006 for operation up to CC+6+2t, it is differentiated from BOBRN by a caption “Fitted with additional springs for A/L 22.32t” in centre of wagon in Golden Yellow. Golden Yellow Band is provided on bogie side frame also. Speed 70/80 Kmph.
- vii. **BOBRNHSM1:** Designed in 2006 for Axle load of 22.32t. Variant of BOBRN with modified CASNUB 22HS Bogie for increased speed. Instead of BOBRNHS this (BOBRNHSM1) was manufactured. Speed 60/100 Kmph.
- viii. **BOBRNEL:** Introduced in 2008 for operation at Axle Load of 25t. It is differentiated from BOBRN by an olive Green band. Speed restricted to 50/65 Kmph.
- ix. **BOBYN:** Designed in year 1996 for transportation of ballast for engineering department. It has chutes at side & bottom for discharging ballast on both sides and centre of rails. Provided with CASNUB 22NLB Bogie, Axle Load 20.32t. Speed 75/75 Kmph.



- x. **BCBFG:** Bogie covered Hopper Wagon for Food Grain. This wagon has been designed for transportation of food grain in bulk. It is provided with CASNUB-22HS Mod-I bogie, Non transition CBC, single pipe graduated release air brake system with automatic load sensing device. There are 2 Nos. gravity discharge gates at bottom for unloading. Axle Load 21.82t, speed 65/65 Kmph.



9.5 TANK WAGON

- i. **BTPN:** Bogie Tank Wagon. This wagon was designed in 1986 for transportation of petroleum products i.e. Kerosene, petrol, diesel and naphtha. Axle Load 20.32t. CASNUB 22 NLB bogie. Speed 80/80 Kmph.



- ii. **BTFLN:** Improved version of BTPN, designed to increase the pay load. This tank is without complete under frame; hence the tare weight is reduced from 27t to 23.53t. Pay load is increased from 54.28t to 57.75t increasing the pay/tare ratio from 2.0 to 2.45. the volume is also increased from 70.4 m³ to 76 m³. since the under frame is not available the brake system is also modified to Bogie mounted brake system, with rigging components only on bogies.

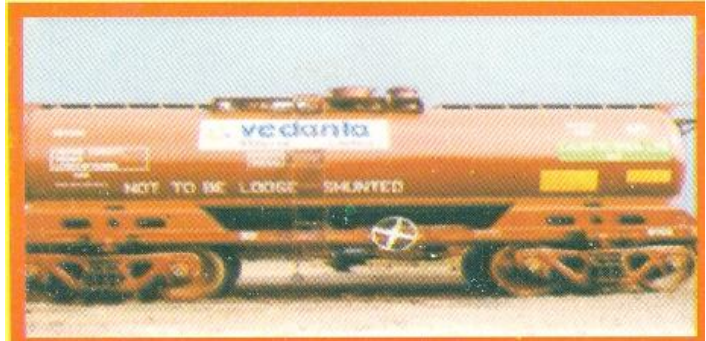


- iii. **BTPGLN:** This wagon is designed for transportation of LPG. Provided with Air brake and CASNUB 22NLB bogie, Axle Load is 20.32t. Speed 75/80 Kmph.



- iv. **BTALN:** Bogie Ammonia Tank Wagon. This tank wagon was designed in 1984 for transportation of anhydrous liquid ammonia. Provided with UIC Bogie, Axle Load is 20.32t. Speed 65/65 Kmph.

- v. **BTCS:** Bogie Caustic Soda Tank Wagon. This wagon was designed in 1980 for transportation of Caustic soda. Bogie CASNUB 22W. Axle Load 20.32t. Speed 65/65 Kmph.



- vi. **BTAP (Bogie Alumina Tank Wagon):** This wagon was designed in 1982 for transportation of Alumina powder. It is gravity loaded and has provision of fluidizing for evacuation. Present stock is fitted with CASNUB 22NLB bogie, Single pipe Air Brake System & non transition high tensile CBC. Axle Load 20.32t. Speed 65/65 Kmph.



9.6 BRAKE VAN

i. **BVZI: Bogie Brake Van**

This 8-wheeled brake van was designed in 2004 with ICF bogie to achieve comfort level(Ride Index) equivalent to loco for goods guard and capable of running at 100 Kmph. The brake van is 5 meter longer than BVZC brake van.



ii. **BVZC: 4 Wheeler Brake Van with Air Brake**

This 4-wheeled brake van is fitted with 9 plated laminated bearing springs. Wheel base of 5400 mm. Fitted with cylindrical roller bearing wheels. Auxiliary reservoir capacity is 75 ltrs. Brake cylinder dia 304mm/12 inches. Speed potential 100 kmph.



9.7 CONTAINER WAGONS

- i. **BFKN:** Bogie Container Flat Wagon. Broad gauge Bogie Container flat wagon type BFKN is modified version of BFKI wagons, which are in operation on IR from 1975 for transportation of containers (max pay load of 48t). Operating speed is 75 kmph. Modified BFKN (Air brake & enhanced pay load) wagons can carry payload of 61t. these wagons are fitted with indigenous designed Retractable Anchorage Locks (patented) to secure containers.



- ii. **BLCA/BLCB:** Bogie Low Platform Container Flat Wagon. Designed in 1994 for transportation of 20' & 40' long ISO containers with operation speed of 100 kmph. Lower height of under frame floor from R/L. has been achieved with introduction of hybrid design of bogie frame, bolster and use of smaller diameter wheel in LCCF 20(C) bogie, Axle Load 20.32t. Speed 100/100 Kmph. Provided with Automatic twist lock for securing of containers on the wagon.



- iii. **BLLA/BLLB:** Bogie Low Platform Longer Container Flat Wagon. Designed jointly by RDSO & RITES in 2001 for transportation of 22', 24' & 45' containers. There is provision for carrying 20' & 40' long ISO containers also. Except the under frame the bogies are all of BLC wagons. Axle Load is 20.32t. Speed 100/100 Kmph.

DOUBLE STACK CONTAINER OPERATION:

In March 2006 double stack container train operation started with restricted speed of 75kmph. This was for the first time in the world that double stack container train operation of flat wagon was done. Speed 75/75 Kmph.

- i. **BLCAM/BLCBM:** In the year 2007 bogie of BLC wagon was modified by providing upgraded side bearer, upgraded friction wedge & 2 additional inner springs for double stack container operation with Axle Load of 22t & 100kmph speed.
- ii. **BCACM:** In the year 2007, to meet the immediate requirement of auto car industry, design of existing container flat wagons (A type & B type) modified by provision of a suitable bi-level structure for transportation of auto cars. One rake can carry up to 270 auto cars. Two such rakes converted by Jagadhari Workshops are in operation.



SN	Particulars	Description
1.	Estimated tare weight	22.47T
2.	Payload	58.81T
3.	Gross load	81.28T
4.	Axle load	20.32T
5.	Ratio of pay load to tare weight	2.72
6.	Track load density (gross)	7.59T/m
7.	Floor area	20.87 sqm
8.	Volumetric capacity	56.29 cubic m
9.	Overall width	3200mm
10.	Inside width	2950mm
11.	Journal center	2260mm
12.	Length over center buffer faces (NT)	10713mm
13.	Length over headstock	9784mm
14.	Bogie center's	6524mm
15.	Wheel diameter on tread(new/condemning)	1000mm/906mm
16.	Wheel base	2000(+/- 5)mm
17.	Height of CBC from rail level	1105mm
18.	Distance between side bearers	1474mm
19.	Type of side bearers	Roller type
20.	Type of center pivot	IRS spherical
21.	Type of brake beam	Unit type fabricated brake beam
22.	Suspension details	Long travel helical spring suspension
23.	Type of roller bearing	Std.AAR CTRB suitable for 152.4 x276.4mm(6"x11" wide jaw)
24.	Type of bogie	CASNUB 22W
25.	'A' dimension	70(+2/-0)mm

9.8.1 DETAILED SAILENT FEATURES OF BOXN WAGON:-

1. No. of doors in BOXN wagon- 2 (on one side, at both ends)
2. DRAW & BUFFING GEAR:-
 - High capacity, high friction draft gear used
 - High tensile straight CBC used.
 - CBC coupler working capacity – 120 ton.
 - Proof load – 170 ton.
 - Hauling capacity in 1:10. In up gradient – 9000 ton.
3. BOGIE:-
 - CASNUB bogie used.
 - Axle load capacity 22.9 ton.
 - Secondary suspension, helical spring used.
 - Side frames are joined through spring plank & bolster.
 - UIC spherical type centre pivot fitted [except 22 W, 22 W(R)].
 - Metal bonded constant contact rubber pad side bearer used.
 - Fit for 90 kmph, 100 kmph for HS.
 - Maintenance cost is less.
 - Head stock with diagonal bar is removed.
4. BRAKE GEAR:-
 - Single pipe air brake system.
 - SAB, empty load device used.
 - Clearance between wheel & brake block is maintained through SAB.

- Pocket liner type brake beam.
- No. of brake beam – 4.
- No. of brake block – 8.

5. RUNNING GEAR:-

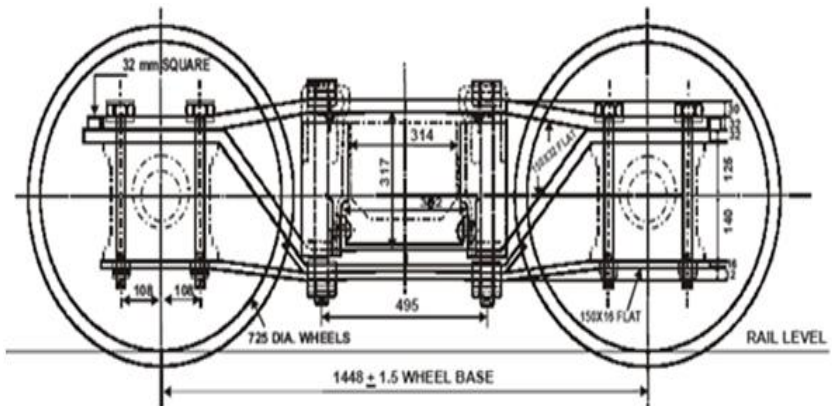
- Axle load – 22.9 ton.
- CTRB used.
- New wheel dia. – 1000 mm.
- Condemning dia. – 906 mm.
- Journal centre – 2260 mm.
- Dia. Of journal – 144.5 mm.

6. OTHER FEATURES:-

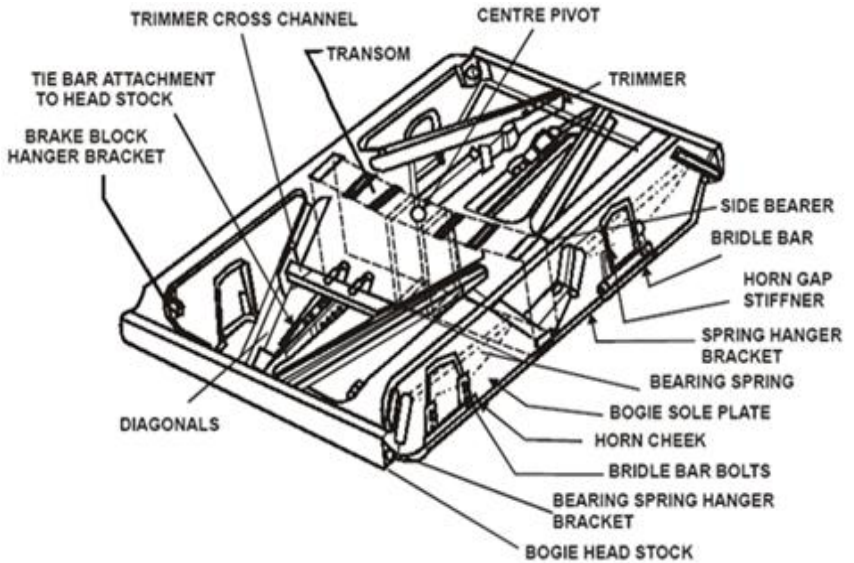
- Ratio of pay load to tare weight – 2.72
- Track loading density (gross) – 7.59 ton/m
- Volumetric capacity-56.29 cu meter
- Overall width- 3200 mm
- Length over center buffer face – 10713 mm
- Bogie center – 6524 mm
- Wheel base- 2000+/- 5 mm
- Height of CBC from rail level -1105 mm
- Distance between side bearers -1474 mm
- ‘A’ dimensions-70+2/-0 mm

BOGIE STOCK WAGON

- I) Diamond frame bogie - Used in BOB wagons
- II) Cast steel bogie – Used in BWT wagons
- III) UIC fabricated bogie – Used in VAC. Brake Bogie Stock
- IV) CASNUB Bogie – Used in Air Brake Bogie Stock



Diamond Frame Bogie Wagons



Isometric view of UIC Bogie

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

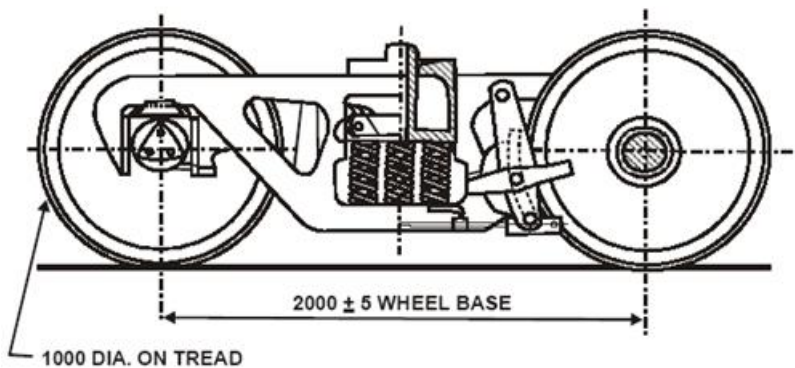
COMPARATIVE STUDY BETWEEN UIC AND CASNUB BOGIES

SN	UIC BOGIE	CASNUB BOGIE
1.	It is introduced in 1962.	It is introduced in 1972-73.
2.	It is a fabricated bogie.	It is a cast steel bogie.
3.	Weight: 5.5 to 6.0 T.	Weight: 5.35 to 5.45 T.
4.	It comprises sole bar, head stock, longitudinal bar, diagonals, etc.	There is a permanent departure of diagonals and head stock.
5.	It is designed to take axle load of 20.3T.	Except Casnub 22 HS bogie (20.3 T), all version of casnub are designed to take axle load of 22.9 T.
6.	It is utilized in vacuum brake stock i.e. BOXC, BCXC, BRHT.	It is utilized in air brake bogie stock i.e. BOXN, BCN, BRN.
7.	It comprises two no's of wheel set fitted with cylindrical roller bearing.	It comprises two no's of wheel set fitted with cartridge tapered roller bearing.
8.	Axle capacity of cylindrical roller bearing wheel set is 20.3 T.	Axle capacity of cartridge tapered roller bearing wheel set is 22.9T.
9.	Wheel diameter 1000mm (new) & 860mm (condemn).	Wheel diameter 1000mm (new) & 906mm(condemn).
10.	There is a provision of laminated leaf spring primary suspension.	There is a provision of helical spring in secondary suspension.
11.	There is a provision of bogie transom fitted with UIC bogie spherical type pivot.	There is a provision of floating bolster with UIC&IRS pivot.

12.	Bogie each fitted with 4 nos. of brake beam suspended with hangers..	There is a provision of 2 nos. of brake beam per bogie sliding in pocket type suspended with hanger.
13.	There is a provision of clasp type brake rigging arrangement	There is a provision of single block type brake rigging arrangement.
14.	There is a provision of metal plate side bearer arrangement.	There is a provision of metal bonded rubber pads side bearer arrangement
15.	There is a provision of total 36 types of pins.	Only 10 types of pins are used.
16.	There is a provision of 4 nos. vertical floating lever in brake rigging.	Only 2 nos. of vertical floating lever are provided.
17.	Crown packing of 10mm, 20mm, 35mm, and 45mm are used for adjustment of CBC height.	Packing plate of 12mm and 37mm are utilized for adjusting CBC height.

9.9 CASNUB BOGIE

CASNUB BOGIE means Cast Steel Bogie equipped with snubber spring . Bogie comprises of two cast steel side frames and a floating bolster. The bolster is supported on the side frame through two nests of spring, which also incorporate a load proportional friction damping .the side frames are connected by a fabricated mild steel spring plank to maintain the square ness of the bogie.



History:

- The CASNUB bogie was first tested in 1972 under BOI wagon and was found safe to run at test speed up to 110 kmph. The test result have been published in RDSO's mechanical engineering report no. M -265.

- In 1981 trials were again undertaken on these bogies under BOXN wagon to maintain the main line standard and its behaviour was well within safety limits up to 90 kmph speed and was designated as CASNUB 22W . These were modified as CASNUB 22W(M) mainly to take care of high wheel wear reported on earlier versions . Subsequently CANUUB 22 NL (Narrow jaw) and CASNUB 22 NLB (Narrow jaw with fish belly bolster) version were introduced.
- CASNUB 22 HS bogies have been developed for high speed operation with maximum permitted speed up to 100kmph.

SALIENT FEATURES OF CASNUB BOGIE:

SN	ITEMS	DESCREPTION
1	Gauge	1676 mm
2	Axle load	22.9 T
3	Wheel diameter	1000 mm new, 956 mm new for 22W (retrofitted)
4	Wheel base	2000 mm
5	Type of roller bearing	Slandered AAR cartridge bearing
6	DISTANCE between journal centers	2260 mm
7	Distance between side bearer	1474 mm

8	Type of side bearer	Roller type clearance for CASNUB 22 W.
a	Spring loaded constant contact for CASNUB 22 HS.	
b	Constant contact type (metal bonded rubber pads for others)	
c	P U pad (poly Urethane) for BOXN M1 & BOXNEL wagon	
9	Anti rotation feature	Anti rotation lugs have been provided between bogie bolster and side frame
10	Type of brake beam	Unit type cast steel brake beam suspended from side frames bracket CASNUB 22 W (M)
11	Center pivot	1) IRS spherical type for 22W only 2) Spherical type (UIC concept) for others
12	Suspension details	Long travel Helical Springs
13	Elastomeric Pad	Elastomeric Pad has been provided between adopters and side frames pedestal roof to reduce wheel flange wear.

BOGIE COMPONENTS

- Side frame with friction plates
- Spring plank
- Bolster with wear liners
- Friction Shoes
- Load bearing spring
- Center pivot top & bottom
- Bolster pivot pin
- Side bearer
- Wheel sets with bearing units
- Side frame key with Key bolt, nut, spring washer & split pin.
- Elastomeric pads.
- Bogie brake gear components.
- Packing piece of CBC height adjustment

Version of CASNUB Bogie:

CASNUB 22 W (MARK I)

- Introduced in 1972
- Weight 5.35 T
- Provision of adapter retainer bolt in outer jaw
- E M pad not provided
- Provision of wide jaw adapter
- Provision of floating bolster
- IRS pivot riveted and welded or casted
- Clearance roller type side bearer
- Sliding packet type brake beam

- Fitted with CTRB

CASNUB 22W RETROFITTED

- Introduced in 1990
- Weight 5.35 T
- Provision of adapter retainer bolt in outer jaw
- E M pad provided
- Provision of wide jaw adapter with 25.5 mm thickness
- Provision of floating bolster
- IRS pivot riveted and welded or casted
- Constant contact metal bonded rubber pad in side bearer
- Sliding packet type brake beam
- Fitted with CTRB

CASNUB 22 NL

- Introduced in 1989-90
- Weight 5.5 T
- Narrow jaw adapter provided
- Adapter retainer bolt not provided
- E M pad provided
- Provision of floating bolster
- IRS pivot riveted and welded
- Constant contact metal bonded rubber pad in side bearer
- Sliding packet type brake beam
- Fitted with CTRB

CASNUB 22 NLB

- Introduced in 1990-91
- Weight 5.4 T
- Narrow jaw adapter provided
- Adapter retainer bolt not provided
- E M pad provided
- Fish belly shaped bolster
- Weight reduced
- Spherical type centre pivot
- Constant contact type mental bonded rubber pads in side bearer
- Sliding pocket type bake beam
- Fitted with CTRB

CASNUB 22 HS

- Introduced in 1993
- Weight 5.4 T
- Narrow jaw adapter provided
- Adapter retainer bolt not provided
- E M pad provided
- Spherical type centre pivot
- Spring loaded side bearer
- Sliding pocket type bake beam
- Fitted with CTRB

These bogies are used in BOXN, BCN, BCNA, BRN, BTPN, BTPGLN, BOBR, BOBRN, BOBY, BOBYN, BFK

Detail of Load and Snubber Spring Arrangement

Axle load	No. Of spring required				
	Outer	Inner	Snubber	Per bogie	Per Wagon
22.90 ton HA	7	5	2	28 nos.	56 nos.
20.3 ton	6	4	2	24 nos.	48 nos.
16.2 ton	4	4	2	20 nos.	40 nos.
20.3 ton (H.S.Bogie)	7	6	2	30 nos.	60 nos.

Free Height of Outer, Inner and Snubber Springs in Bogies

Bogie	Spring	New in mm.	Condem in mm.	variation in mm
All Version except 22 HS	Outer	260	245	15
	Inner	262	247	15
	Snubber	294	279	15
Casnub HS	Outer	260	245	15
	Inner	243	228	15
	Snubber	293	278	15

(Mark-I) and (Mark-II) Casnub Bogies

SN	CASNUB 22 W (Mark-I)	CASNUB 22 W (Mark-II)
1	Introduced in 1972	Introduced in 1986
2	Weight 5.35 T	5.7 T
3	Side frame –straight and wide jaw opening ,there is provision of adopter retainer bolt and in outer jaw	Modified wide jaw opening and designed to accommodate Elastomeric pad . Camber is provided in side frame of 7 degree provision of adapter retainer bolt in outer jaw
4	There is no provision of Elastomeric pad	E M pad are provided
5	There is provision of wide jaw adapter of 48.5 MM thickness	There is provision of wide jaw adapter of 48.5 MM thickness
6	There is provision of floating bolster suitable for fitment of IRS pivot .Pivot may be welded and riveted with bolster or may be casted with bolster.	Bolster has been modified to suit fitment of spherical bottom pivot.
7	There is provision of clearance roller type side bearer	There is provision of constant contact metal bounded rubber pads in the side bearer .
8	There is provision of sliding pocket type brake beam	There is provision of hanger type brake beam which is suspended with hanger
9	Bogie is designed to take axle load of 22.9 T axle fitted with CTRB. Its new wheel diameter is 1000 MM and condemning 906 MM	Bogie is designed to take axle load of 22.9 T axle fitted with CTRB. Its new wheel diameter is 1000 MM & condemning 906 MM
10	Initially spring plank of structural steel was provided	Initially spring plank of structural steel was provided which was

	<p>which was later on changed to flanging quality steel. Initially its height was 60 mm and subsequently increased to 75 mm provided with 100 mm pitch hole at the centre which was later on closed and longer opening measuring 200 mm on either side of centre line provided.</p>	<p>later on changed to flanging quality steel. Initially its height was 60 mm & subsequently increased to 75 mm provided with 130 mm pitch hole at the centre which was later on closed and longer opening measuring 200 mm on either side of centre line provided.</p>
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CASNUB 22 (W) R Bogie: In 1990 CASNUB 22 (W) Bogies were provided with 46mm thick EM pad between pedestal crown and adopter to reduce the developing of false flange in wheel sets, for that the following modification were adopted in CASNUB 22 (W) Bogie.

- 1) Used of 46mm thick EM pad
- 2) Reduction in Height of adopter by 29.5mm
- 3) Used of New Wheel in dia. of 956mm
- 4) Position of retainer bolt is kept below by 32mm
- 5) Position of S.F.KEY is reversed on its location.
- 6) Provision of floating bolster
- 7) IRS pivot riveted and welded or casted
- 8) Constant contact metal bonded rubber pad in side bearer
- 9) Sliding packet type brake beam
- 10) Weight 5.35 T

CBC HEIGHT ADJUSTMENT IN CASNUB BOGIE FITTED

STOCK: As per Wheel Dia. WEAR 12 mm. and 37 mm. thick metal packing are utilized as under:-

Use of 12 mm. thick packing

S.N.	TYPES OF BOGIE	WHEEL DIA	LOCATION OF PACKING
1	Casnub 22 W	943 mm	Between Axle Box adopter and Pedestal Crown
2	Casnub 22 W (R)	910 mm	Between A/B Adopter EM Paid
3	Casnub 22 W (M) & Others	954 mm	Between A/B Adopter EM Paid

Use of 37 mm. thick packing

S.N.	TYPES OF BOGIE	WHEEL DIA	LOCATION OF PACKING
1	Casnub 22 W	924 mm	Between EM Pad & Pedestal Crown
2	Casnub 22 W (M) & Others	930 mm	

Note: 37 mm thick Packing is not utilized in Casnub 22 W (R) Bogie.

Adjustment of Brake Gear Pin in Bogie

Wheel Dia.	1000-982 mm	981-963 mm	962-944 mm	943-925 mm	924-906 mm
Hole to be used for Brake Gear Adjustment	‘A’	‘B’	‘C’	‘D’	‘E’

ROH of BOXN Wagon:

ROH of BOXN wagon is carried out at selected major sick line where all ROH facilities for BOXN wagon is available at a definite interval.

The First POH of BOXN wagon is carried out at a interval of 6 years/(72 months) & subsequent POH periodicity is reduced to 4 ½ years/(54 months) accordingly railway board/RDSO has decided to carry out 3 ROH after a interval of 18 months before first POH & 2 no. of ROH in between subsequent POH.

The complete wagon has been broken down into 5 major sub systems:

- 1) The body including under frame, super structure & brake rigging.
- 2) CASNUB bogie.
- 3) Air brake system.
- 4) Center buffer coupler
- 5) Wheel, axle and bearing.

Each sub system is further split into individual items and the particular work to be done in respect of each item is indicated under the different ROH schedules.

BODY

1. UNDER FRAME :-

Sole bar: Scrap the portion of sole bar at doorways, clean and apply primer paint followed by Top Coat

2. SIDE WALL :-

- SKIRTING: Check and patch if corroded thin apply primer and top coat on the patch.
- SIDE DOORS: Check damage and repair, clean and lubricate hinges.
- SIDE PILLARS: Check cracks at the base and repair.

3. UNDER GEAR:

- BRAKE LINKAGES: Check free movement on SWTR test.
- HAND BRAKE: Check proper working.

CASNUB BOGIE

1. BOLSTER:-

- POCKET SLOPE LINER: change liner if thickness less than 5mm.
- ROTATION STOP LUGS: Provide liner (thickness to suit) if dimensions less than 514mm.

- INNER COLOUMN GIB: Provide liner (thickness to suit) if dimensions more than 142mm.
- LAND SURFACE: Provide liner (thickness to suit) if dimensions less than 442mm.
- OUTER COLOUMN GIB: Renew by welding if dimension more than 241mm.

2. SIDE FRAME

- COLOUMN FRICTION LINER: Change liner if dimension more than 445mm.
- COLOUMN SIDE: Provide liner (thickness to suit) if dimension less than 209mm.
- ANTI ROTATION LUGS: Provide liner (thickness to suit) if dimension more than 526mm.
- KEY SEAT TO PEDESTAL 22 W: Provide liner (thickness to suit) if dimension more than 276mm.
- CROWN ROOF 22 W (M): Provide liner (thickness to suit) if dimension more than 321mm.
- CROWN ROOF 22 NL: Provide liner (thickness to suit) if dimension more than 326mm.
- PEDESTAL CROWN SIDES: Renew by welding if dimension less than 147mm.
- PEDESTAL JAW 22 W: Provide liner (thickness to suit) if dimension more than 275mm.
- PEDESTAL JAW 22 W (M): Provide liner (thickness to suit) if dimension more than 283mm.
- PEDESTAL JAW 22 NL-S: Provide liner (thickness to suit) if dimension more than 195mm.
- PEDESTAL JAW 22 NL-L: Provide liner (thickness to suit) if dimension more than 241mm.

- PEDESTAL SIDES 22 W: Provide liner (thickness to suit) if dimension more than 102mm.
- PEDESTAL SIDES 22 W (M): Provide liner (thickness to suit) if dimension more than 195mm.
- PEDESTAL SIDES 22 NL: Provide liner (thickness to suit) if dimension more than 78mm.

3. WEDGE:

- SLOPE SURFACE: Renew by welding if dimension less than 7mm.
- VERTICAL SURFACE: If vertical surface from the centre line of spigot less than 56mm, provide liner of 6mm thickness.

4. CENTRE PIVOT (BOTTOM)

- VERTICAL SIDE 22 W: Renew by welding if wear more than 4mm.
- VERTICAL SIDE 22 W (M): Renew by welding if wear more than 3mm.
- VERTICAL SIDE 22 W NL: Renew by welding if wear more than 3mm.
- SEAT 22 W: Renew by welding if wear more than 3mm.
- SEAT 22 W (M): Renew by welding if wear more than 3mm.
- SEAT 22 NL: Renew by welding if wear more than 3mm.

5. COIL SPRING:
 - OUTER: Group and use in sets. Replace if free height less than 245mm.
 - INNER: Group and use in sets. Replace if free height less than 247mm.
 - SNUBBER: Group and use in sets. Replace if free height less than 279mm.

6. BOGIE BRAKE GEAR:
 - PINS & BUSHES: Change if clearance is more than 1.5mm.

AIR BRAKE SYSTEM

1. DISTRIBUTER VALVE:
 - D.V.: Test on SWTR.
 - D.V. ISOLATING COCK: Examine operation.
 - D.V. RELEASE VALVE: Examine operation.
 - D.V. P4AG FILTER: Clean

2. BRAKE CYLINDER:
 - FILTERS OF ESCORTS AND RPIL MAKE: Clean.
 - BRAKE CYLINDER OF GREYSHAM AND WSF MAKE: Lubricate.

3. CUT OFF ANGLE COCK:
 - ANGLE COCK: Examine and lubricate.
 - RUBBER SEALS: Change.

4. DIRT COLLECTOR:
 - DIRT COLLECTOR: Clean
 - SEALING RING: Change

5. RESERVOIR:
 - AR & CR: Drain
 - SEALING RING: Change

6. HOSE COUPLING:
 - HOSE AND COUPLING: Examine
 - GASKET (MU WASHER) : Change

7. METAL PIPES AND JOINTS:
 - PIPE AND JOINTS: Examine leakage and repair.
 - SEALS (20MM & 32MM PIPE) : Change.

8. SLACK ADJUSTER:
 - SLACK ADJUSTER: Test functioning, repair if required.
 - A DIMENSION: Adjust.
 - M20 ANCHOR PIN NUT: Ensure securing by welding to pin.

9. AIR BRAKE SYSTEM:
 - BRAKE SYSTEM: Test on SWTR as per procedure.
 - BRAKE BLOCK: Ensure standard key split pin and all new brake block.

CENTRE BUFFER COUPLER

1. **CBC BODY:**
 - **COUPLER BODY:** Replace on condition.
 - **CBC CONTOUR:** Examine, replace if required.
 - **SHANK WEAR PLATE:** Replace on condition.

2. **KNUCKLE:**
 - **NOSE:** Replace if wear more than 4.3mm with H.T.E. knuckle. Knuckle with nose wear more than 4.3mm and less than 9.0mm can be used in yard replacement.
 - **KNUCKLE PIN:** Replace on condition.
 - **KNUCKLE STRETCH:** Examine, replace if required.

3. **STRIKER CASTING:**
 - **WEAR PLATE:** Replace
 - **STRIKER CASTING:** Replace on condition.

4. **COUPLER MECHANISM:**
 - **ANTI CREEP PROTECTION:** Examine and repair.
 - **LOCK LIFT ASSEMBLY:** Examine.
 - **OPERATING MECHANISM:** Examine.
 - **LOCK:** Examine.

5. **DRAFT GEAR:**
 - **SLACK:** Measure and take corrective action.

6. GENERAL:

- YOKE PIN SUPPORT: Replace on condition.
- BUFFER HEIGHT: Examine and correct if required.

WHEEL, AXLE AND BEARING

1. AXLE:

- ULTRASONIC TESTING: To be carried out at every ROH and reject if fails.
- DEEP NOTCHES DUE TO GRAGING OF PULL ROD: Reject if depth is more than 5mm.
- AXLE AND HOLES: Clean and lubricate in case end cover is opened.

2. WHEEL:

- TREAD PROFILE: check with tyre defect gauge.
- HEIGHT OF FLANGE: If height more than 31mm do not use in ROH.
- SMOOTH FLANGE: If flange not completely smooth in region 'A', then do not use in ROH.

3. BEARINGS:

- Cup: Rotate the bearing for unusual sound. Check cup for crack/chipping.
- SEAL: Check seal for external damage and dent.
- BACKING RING: Check backing ring for looseness and vent fitting on backing ring with vent hole (the vent fitting should be intact or the vent hole should be plugged).

- LOCKING PLATE: Use new locking plate whenever end cover is opened.
- AXLE END CAP SCREW: Clean and lubricate in case end cover is opened.
- LOAD ZONE CHANGE: Change load zone area of the cup while lowering bogie side frame.

4. ADAPTER:

- CROWN SURFACE: Replace if worn to relief depth.
- SIDE LUG: Replace/reverse and use.
- THRUST SHOULDER: Replace if depth exceeds 0.7mm.
- MACHINED RELIEF: Replace if depth exceeds 0.8mm.

SUMMARY ROH of AIR BRAKE WAGON WITH CASNUB BOGIE:-

BOXN wagons are to be given Routine Over-Haul (ROH) normally after every 18 month at the nominated sick line/wagon depot, where proper facilities are provided.

The ROH schedule is as follows:

- a) Lift the body, keep it on trestles & run out bogies.
- b) Strip bogie component for examination & repair as below:-
 - Strip spring & spring suspension arrangement including snubbing device. Check springs for free height & other defects. Replace where required.

- Examine bogie frame. Check frame alignment as per RDSO instruction.
 - Examine pivot for welding defects/cracks/abnormal depth due to wear. Replace where necessary & lubricate with graphite flakes to IS: 495 in dry condition.
- c) Strip brake gear levers & rods for examination of worn outs/ damaged parts.
- d) The equipment shall be given attention in accordance with the maintenance manual issued by respective air brake equipment manufacturer:-
- i. Cleaning of strainer discs.
 - ii. Lubrication of brake cylinders/ cleaning of its strainer.
 - iii. Check for easy operation of isolating cocks & anti pilferage device of distributor valve cut off angle cock, manual quick release valve & isolating cock.
 - iv. Draining of auxiliary reservoir.
 - v. Checking of hose coupling for serviceability.
 - vi. Cleaning of a strainer.
 - vii. Dirt collector to be cleaned.
 - viii. Leakage in pipe & joints to be checked.
 - ix. After carrying out above items of work the wagon shall be tested for proper function of air brake system with single car test device in accordance with the procedure indicated below:-
 - Connect the BP coupling of single car test rig to the corresponding coupling of the wagon to be tested. The couplings of the other end of the

wagon to be closed with dummy couplings heads. Fix pressure gauge on the brake cylinder.

- The single car test device should now be coupled to the main line of a compressor through a pipe.
- Carry out the preparation & testing in accordance with the procedure given in the manufacturer's maintenance manual & record the reading in the test Performa.

For passing the wagon, all the parameters shall be within specified limits.

- e) Clean horizontal levers, hand brakes & gears & lubricate.
- f) Examine head stock for damage, bend / cracks.
- g) Refit brake gears levers & rods, Lubricate pins & other equipment & apply graphite to horizontal levers of empty load box.
- h) Replace worn out brake blocks. Check wheel profile, turn the wheel as needed. UST of axle to be carried out & turning of wheel to worn wheel profile during ROH.
- i) All the wheels are to be checked ultrasonically & axle box cap bolts are to be tightened up by torque wrench with proper torque & in no case old locking plates are to be reused.
- j) CBC knuckles are to be checked by contour gauge, anti creep / articulated rotary operation of locking arrangement to be checked.
- k) Manual adjustment of brake gear to be done in accordance with wheel diameter. Modification works are to be attended as issued by RDSO from time to time.

9.10 BLC WAGONS

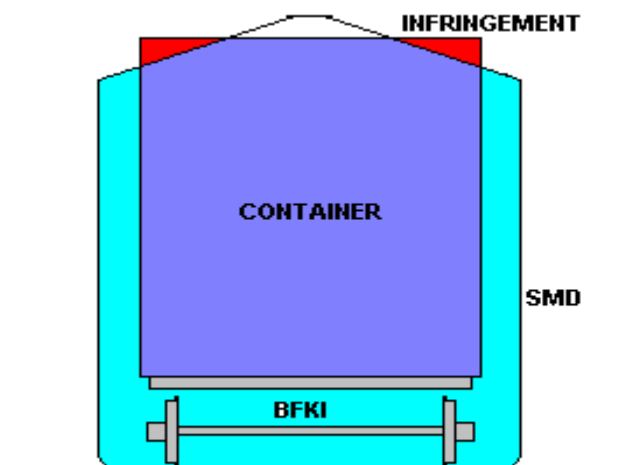
Bogie Low platform flat wagons for carrying ISO containers.



Different sizes of containers:

Description	Length	Breadth	Height
ISO Containers inland	20 feet	2438 mm	2593 mm (8'-6")
ISO containers international	20 feet	2438 mm	2896 mm(9'-6")
ISO containers for international	40 feet	2438 mm	2896 mm(9'-6")

BFKI wagons were used for movement of containers. When ISO containers, with more height than the inland containers is loaded on the BFKI wagons, the overall dimensions exceeds the Standard moving dimensions of X – class engine by 254 mm at the top side. And the load is to be moved as ODC with speed restrictions. This in turn affects the speedy movement of containers.



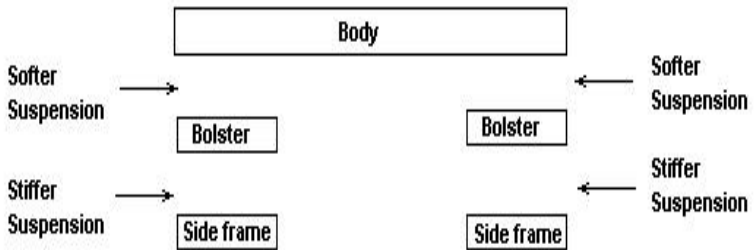
If the same containers are loaded on the specially made well wagons, the load can very well be moved as Non-ODC, but at either ends of the wagon 1.5 metres of length are necessary to accommodate the CBC couplers. Consequently the length of the wagon is increased by 3 metres (3000 mm). This will in turn reduce the number of wagons on a loop line from 42 for the existing BFKI wagons to 38 resulting in loss of earning capacity.

To overcome the above two shortcomings, the BLC wagons are developed with a intention to move the ISO containers as non-ODC load with high speed as well as with more number of wagons for a given length of formation.

These wagons are manufactured in multiple units with low floor height at the centre to accommodate the ISO containers and raised at ends to facilitate coupling of these unit with the Loco and brake van. The wagon which is having raised at one end is called A-Car and the wagon which is not having raised end is called B-Car. Each multiple unit of five wagons consists of two A-Cars at the ends and three B-Cars in the middle.

The special features of BLC wagons

- These wagons are designed to carry ISO containers with a height of 2896 mm as Non-ODC load. The floor height of these wagons from the rail level is decreased to 1009 mm from the standard of 1269 mm. These wagons are provided with with new hybrid design CASNUB LCCF20 (C) bogie frame and bolster in order to bring down the plat form height. The maximum wheel diameter is 840 mm and condemning is 780 mm.
- These wagons are provided with two stage vertical suspension for providing softer suspension under tare and stiffer suspension under load condition.
- The two stage vertical suspension is necessary to provide higher static deflection in empty condition, so that the spring off-loading in the empty condition lies within limits. Vertical suspension in loaded condition is stiffer on account of the constraint in the space between the bolster and the bogie frame.



The softer suspension is provided between the body and bolster and the stiffer suspension is provided between the bolster and bogie frame.

The spring loaded side bearers are used on these bogies. The spring loaded side bearers are designed to take 90% of load in tare condition.

Comparison of 22 NLB & container bogie type LCCF 20 (C)

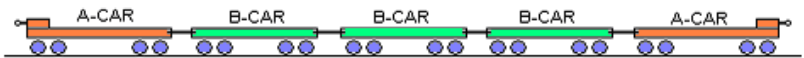
Description	22 NLB	LCCF 20 (C)
Centre pivot height from Rail level	932 mm	715 mm
Max height of side frame from Rail level	851 mm	786 mm
Bottom of side frame	165 mm	149 mm
Height of side bearer top	921 mm	772 mm
Wheel diameter	1000/906 mm	840/780 mm
Side frame design	Cast steel design for narrow jaw adapter	Cast steel design for wide jaw adapter
Bolster design	Separate center pivot	Integral center pivot
Side bearer	CC pad	Coil spring
Load bearing coil spring	12 outer, 8 inner spring	14 outer, 12 inner spring
Snubber springs	4 Nos, IS: 3195 Gr.60 Si 7	4 Nos, IS 3195 Gr.50 CrMoV4
Brake shoe	Conventional	Non metallic
Adapter	Narrow jaw	Wide jaw
Elastomeric pad	Similar	Similar
Side frame key	Similar	Similar
Spring plank	Similar	Similar



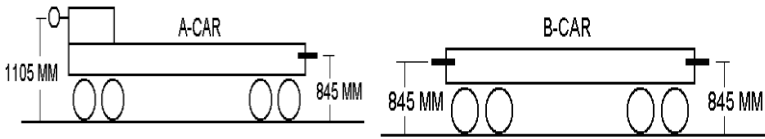
Centre pivot riveted
to Bolster

Centre pivot Integral
Flat type

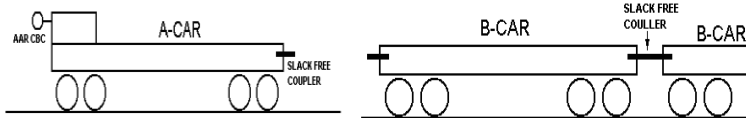
These wagons are formed in multiple units. Each multiple units consist of two A-CARS and three B-CARS.



The buffer height of Outer end of A-CAR is 1105mm and at the inner end is 845mm. Both the ends of B-CARS are having a buffer height of 845mm.

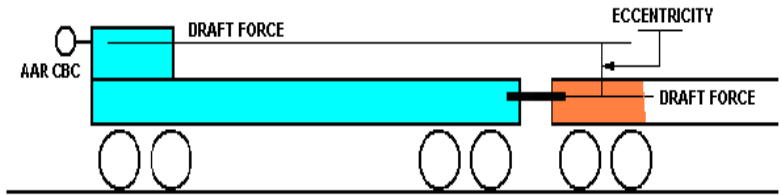


The outer end of A-CAR is provided with AAR CBC coupler and at the inner end is provided with Slack-less Couplers. Both the ends of B-Cars are provided with Slack less coupler.



We know that the buffer height of A-Car at raised end is 1105 mm and for the B-Car is 845 mm. Due to the difference in buffer heights between the raised end of A-Car and the B-Car, the draft force transmission not lies on the same line. Because of the eccentricity in the draft force line between these wagons, there is a possibility for off loading of wheel whenever the tractive force/buffing force is applied suddenly.

This sudden load is mainly caused by the excessive slack available in the standard AAR couplers. The shock loads acting on couplers can be prevented by reducing the slack between the two couplers.



To overcome the above shortcoming, the Slack less/free couplers are introduced for the BLC wagons at one end of A-Car and at both ends of B-Cars.

Description	AAR CBC	Slack free coupler
Draft Gear travel of first wagon	3 ¼ Inches	¾ Inches
Draft Gear travel of adjacent wagon	3 ¼ Inches	¾ Inches
Slack between the two knuckles	1 Inch	No Knuckles. Straight draw bar is provided
Total Slack	7 ½ Inches	1 ½ Inches

Different parts of Slack free couplers are Key stone Mini draft gear, Straight draw bar, Standard AAR yoke, Striker casting.

These wagons are provided with two-stage load sensing device, which admits a maximum pressure of 2.2 kg/cm² when the gross load is less than 40 tons, and 3.8 kg/cm² when the gross load exceeds 40 tons automatically.

These wagons are provided with automatic twist locks. These locks are designed to lock the containers with the wagons

with a force of 600 kgs. It unlocks the container from the wagon with a force of 1000 kgs.



Comparison between the BLC and BFKI type wagons.

SN	Features	BLC	BFKI
01	Wagon unit	Consists of 5 Wagons. (2 Nos of A-Car and 3 Nos of B-Cars.)	Single Wagon.
02	Platform height	1009 mm	1269 mm
03	Length of wagon over head stock	A-Car - 13625 mm B-Car - 12212 mm	13716 mm
04	Tare weight	A-Car - 19.25 tons B-Car - 18.50 tons	20.5 tons
05	Pay load	61 tons	48 tons

06	Wheel diameter	Max - 840 mm Cond - 780 mm	Max - 1000 mm Cond- 906 mm
07	Permissible speed	100 Kmph	75 Kmph
08	Coupler	CBC and Slack less draw bar	CBC
09	Empty load device	Two stage automatic Pneumatically operated	Manually operated.
10	Suspension	Two stage suspension	Single suspension
11	Lock for locking containers	Automatic Twist Lock	Manual Retractable Anchorage Locks
12	No. of wagons per Rake	45 Wagons	42 Wagons

Attentions to be paid for these wagons during the Examination

- All under gear items including brake gear, draw & buffing gear and running gear should be examined and kept in sound condition.
- Wheels must be tapped to detect Loose/Cracked wheel and profile checked visually and in the case of doubt to be checked with Tyre defect gauge for the rejectable defects.
- Maintain Control A dimension to $72 +0 / - 2$ mm. Ensure 100% brake power.
- The general conditions of under frame should be examined and repairs attended, Check all the automatic locks mounted on under frame for its proper working condition and inspect for any welding failure of mounting brackets. Side bearer assembly should be examined and repairs

attended. Check all the safety fittings, safety brackets etc, and defects if any should be attended. Check the hand brake for its proper functioning.

- Maintain a clearance of 21 mm within a tolerance of 1 mm between load sensing device and the stopper.

TANK WAGONS

Tank wagons form a special class of non-pooled rolling stock. They are classified according to the product carried by the tank and its design as follows:

- Tanks as pressure vessels, Tanks for corrosive liquids
- Tanks for petrol and other highly inflammable products
- Tanks for middle distillates of petroleum and others products.

The design of the under frame of 4 wheeled and 8 wheeled wagons is generally similar to that of other IRS wagons except that a pair of saddles is provided on the under frame at each end for mounting the barrel.

The barrel is cylindrical vessel generally fabricated out of low carbon structure steel to IS 2062 Fe 410 Cu W. The barrel is placed longitudinally on the under frame and secured by means of rivets to the saddle. The saddle is welded on under frame at each end.

Codes used for different types of tank wagons

SN	Type of wagon	Code for the wagon
1	Ammonia tank	TAL, BTAL, BTALN
2	Chlorine tank	LCT
3	Liquefied petroleum gas tank	TLGL, BTPGL, BTPGLN
4	Sulphuric acid tank	TSA & MBTSA
5	Petrol tank	TPR/A, MBTPX & MBTPZ
6	Oil tank	TORX
7	Heavy oil tank	TORX
8	Bitumen tank	TBT
9	Coal tar tank	TR
10	Petrol tank	TR & MBTP
11	Oil tank	TO
12	Oil tank	MBTOX
13	Caustic soda tank	TCS, BTCS
14	Hydrochloric acid tank	THA
15	Molasses tank	TM & MBTM

Various types of barrel mountings, safety fittings and their functions:

SN	Mounting/Fittings	Functions
1	Safety valve	The safety valve is provided to prevent building up of excess pressure inside the barrel. It is fitted on the barrel either on the diaphragm plate inside the dome or on a separate opening on the barrel. This is provided on tanks for highly inflammable liquids such as petrol, Aviation spirit etc.
2	Relief valve	It is a spring-loaded valve fitted on the barrel of tanks for corrosive liquids. Its main function is to release built up pressure, if it exceeds the working pressure limit.
3	Safety vent	This consists of frangible disc (lead or any approved material not affected by lading), which ruptures at specified pressure. It is an additional safety fitting to safeguard against the failure of the relief valve. When the built up pressure exceeds the working pressure of the relief valve and the latter fails to function for any reason the frangible disc of this safety vent ruptures to release the pressure.

4	Compressed air valve	It is provided on tank from which the contents are unloaded by compressed air. Its main function is to control the rate of discharge by controlling the rate of air admission.
5	Vapour extractor cock	Its function is to extract vapour from the tank while filling
6	Master valve	It is a gravity discharge valve fitted with a hand wheel in the dome for manual operation.
7	Bottom discharge valve	BG 4-Wheeler Bottom discharge valve are provided with single bottom discharge valve situated underneath the master valve while on BG/MG eight wheeler stock two bottom discharge valves are fitted, one on either side and connected with the master valve through a “T” pipe. The main function of the valve is to control the flow of the contents and also to serve as an additional safety stop in case the master valve fails or breaks. The bottom discharge valve openings are also provided with blank flanges to be used with 2 mm compressed asbestos fibre jointing material to serve as further check on accidental leakage of contents.

The periodicity of POH is given below:

SN	Type of wagons	For 1 st POH	For subsequent POH
1	4 wheeler tank wagons except those listed below	4 years	3-1/2 years
2	Tanks for liquid chlorine and hydro chloric acid	2 years	2 years
3	Tanks for liquid ammonia	2-1/2 years	2-1/2 years
4	Tanks for petroleum gas	4 years	4 years
5	BTPN	6 years	6 years

The codal life of tank wagons is 45 years.

Steam cleaning for pressure vessels, petroleum and other highly inflammable products:

Tanks as pressure vessels, tanks for petroleum, other highly inflammable products, vegetable oils, bitumen, coal tar and molasses are cleaned by steam. The tanks requiring steam cleaning should be placed as near the steam supply line as possible and protected against any movement. The berthing siding should be completely isolated from all other traffic. In case of pressure vessels, it should be ensured that all the gas has been discharged to the atmosphere.

After ensuring that the tank barrel is no longer under pressure, the following sequence should be followed:

Remove the manhole cover together with manhole housing, valves etc. and leave the tank exposed to atmosphere for 24 hours. Entry of staff in the tank barrel should be strictly prohibited and signs with suitable legends displayed at a reasonable distances away from the tanks to be steam cleaned. Insert pipe through manhole and steam the interior of barrel for 12 hours. In order that the tank barrel is thoroughly steamed from inside, the steam pipe should be provided with a “T” connection at its lower end and so directed as to blow steam towards both ends. Remove condensed steam collected in the tank barrel and keep the barrel exposed to atmosphere for another 24 hours.

The following are the tests that should be conducted to ensure the tanks are free from contamination gases of the contents.

AMMONIA TANK BARREL

Fill the tank barrel with water. Collect a specimen of the water in a clean glass bottle. Test the specimen of the water with red litmus paper. If the colour of the litmus paper turns into blue, it indicates that the barrel is still having the gases of ammonia and requires steam cleaning.

NESSLER’S TEST

Test the specimen of the water with a mixture of potassium mercuric iodide and potassium hydroxide. If the colour of the mixture turns into brown, it indicates that the barrel is still having the gases of ammonia and requires steam cleaning

CHLORINE TANK WAGONS

Fill the tank barrel with water. Collect a specimen of the water in a clean glass bottle. Test the specimen of the water with

red litmus paper. If there is any bleaching effect on the litmus paper, it indicates that the barrel is still having the gases of chlorine and requires steam cleaning.

LPG TANK WAGONS

Fill fresh water in a clean bottle. A string is to be attached to the bottom of the bottle. Lower the bottle through the manhole up to the bottom of the tank and tilt the bottle. Allow the water to flow out and let the gas get into the bottle. Wait for 5 minutes and lift the bottle and close the mouth immediately after withdrawing. Take it away from the tank. Bring a lighted matchstick near the mouth of the bottle after opening it. If there is no flame it is free from injurious gas. But in case it gives out a flame, the tank should again be steam cleaned again.

Procedure for steam cleaning of bitumen and molasses tank wagons:

Close the manhole cover and open bottom discharge valve. Pass steam through the air inlet valve for sufficient time till the bitumen melts and drains away through the water discharge valve. The bitumen should be collected in containers and not drained out on the floor. Open the manhole cover to see whether the tank is completely cleaned from inside. In case any residue is left behind the above procedure should be repeated. Remove heating arrangement i.e., heating pipe, internal pipe, etc, from the tank. Clean inside surface of the heating pipe by scrapping the carbon layer with wire brush or other suitable process. Blow in air under pressure from one end. The outer surface of the heating pipe should be cleaned with kerosene oil.

Procedure for cleaning of tanks for corrosive liquids:

HYDROCHLORIC ACID TANKS:

Open the manhole and the washout cover and start cleaning the barrel with water. Initially the water coming out of the washout opening will show excessive acidity, which will turn blue litmus paper into red. The washing should be continued till blue litmus paper shows no change. Then close the wash out cover, fill the tank with water. Collect a sample of the water in a bottle. Test the sample of water with blue litmus paper. If the colour is changing to red, it indicates that the tank is still having traces of acid and requires cleaning.

SULPHURIC ACID TANKS:

Wash the Sulphuric acid tank barrels with $\frac{1}{2}$ % to 1% solution of sodium phosphate commercial or half percent solution of soda ash so as to neutralize the sulphuric acid. The washing should be done as soon as it is received in workshops. Since concentrated sulphuric acid absorbs moisture when left open to moist air, the acid will be diluted with time. It is to be remembered that diluted sulphuric acid is highly corrosive and attacks the tank barrel more vigorously.

Collect a sample of water in a bottle. Test with blue litmus paper. If the colour of the paper changes into red, it indicates that tank is having still traces of acid and requires cleaning again. After cleaning allow the tank for drying.

Caution: As addition of water to sulphuric acid will produce intense heat, resulting in splashing of steam, the solution of

commercial sodium phosphate should be added or spread gradually and with care.

CAUSTIC SODA TANKS:

Wash the barrels with hot water. Freedom from alkalinity can be easily ascertained by litmus test (if red Litmus changes to blue, there are still traces of alkalinity). After it is free from alkalinity, water should be drained and barrel dried before inspection and repairs

Checks to be carried out by the C&W Engineers before the tank wagon is certified for loading

Master Valve: Leakage of master valve should be checked while keeping the bottom discharged valve in open.

Bottom discharge Valve: Proper functioning and fluid tightness of the bottom discharge Valve should be ensured.

Blank flange: The blank flange of the correct thickness made out of steel plate and with a gasket of proper material between the blank flange and bottom discharge valve flange should be tightened by six bolts and nuts.

Tank barrel: Tanks with cracks on barrels should be marked sick.

Leaky Tank barrels:

The leakage of tank barrels may be caused due to the following reasons. Mechanical injury to the valve face and /or valve seat as a result of foreign material, particularly nuts and bolts finding their way inside the tank wagon, valves seat not properly secured to the stool by proper interference fits and malfunctioning of master valve.

Precautions in the case of leakage from the loaded tank wagons:

CHLORINE & AMMONIA tanks;

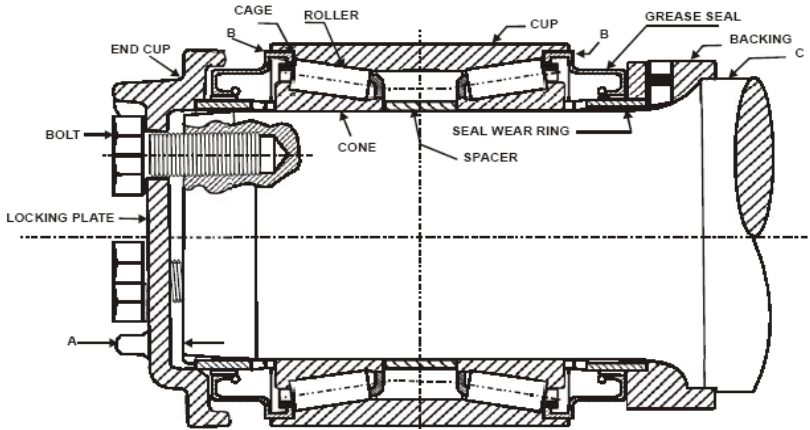
Chlorine and ammonia gases are poisonous and have a characteristic pungent odour, which gives warning of their presence in the atmosphere before dangerous concentrations are attained. In the case of chlorine, the greenish yellow colour of the gas makes it visible when high concentrations are present. In the case of ammonia, if sufficient concentration of the gas is present in the atmosphere, it will irritate the eyes and the respiratory system.

As such, in the event of leakage, all present in the vicinity should be warned to keep on the windward side of the tank.

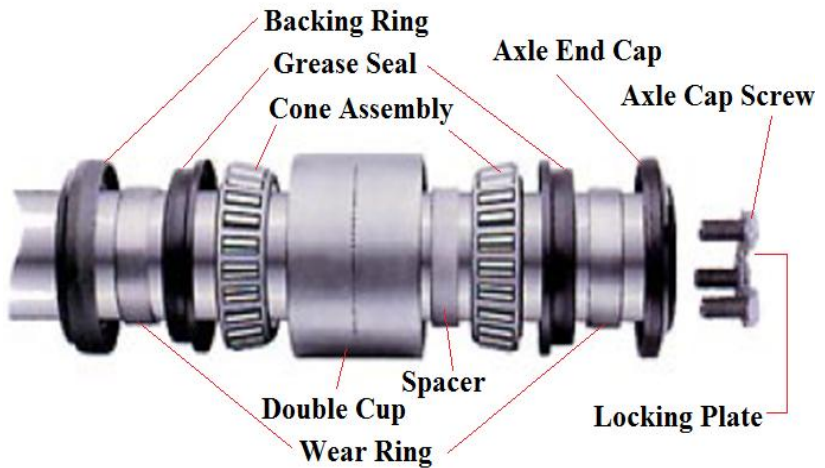
HIGHLY INFLAMMABLE GAS tanks;

All the flames or fires near it should be extinguished or removed. Smoking should not be allowed. Spectators should be kept away. Only battery operated torches or incandescent electric lights with gas proof sockets should be used. Oil lanterns or signal lamps used for signalling must be kept away. The steam engine available if any should be moved away from the site. The leaky tank wagon should be removed as quickly as possible to an open area, where the escaping gas will be less hazardous. Earth should be spread over any surface on which the LPG has leaked out in liquid form. Call the company concerned for further attention.

(CTRB) CARTRIDGE TAPERED ROLLER BEARING:



SN	Name of parts	No. Off
1.	Cone assembly.	2
2.	Cup(consisting 24 nos roller & cage)	1
3.	Spacer	1
4.	Wear ring	2
5.	Grease seal	2
6.	End cap	1
7.	Axle cap screw	3
8.	Locking plate	1
9.	Backing ring	1



Defects in CTRB:

- a) Double cup:
 - Stain discoloration, corrosion, pitting and rust.
 - Flaking/spilling.
 - Beveling.
 - Pitting.
 - Electric burns.
 - Cracks & fractures.
 - Decrease in outer diameter.
 - Increase in counter bore.

- b) Cone assembly:
 - Stain discoloration, corrosion, pitting and rust.
 - Flaking/spilling.
 - Smearing & peeling.

- Wear &tear of lage.
 - Pitting marks on roller surface.
 - The clearance between cage pocket & roller is more than 1.5mm.
 - The clearance between cage flange & inner ring is more than 2.3mm.
 - Internal diameter of cage more than 144.4879mm.
- c) Wear ring:
- Breakage in contact route of lip.
 - Scratches or cracks on out face.
- d) Grease seal:
- Hardened, cracked or cut seal lip.
- e) Backing ring:
- Pitting marks
 - Cracked fractured or heavy corrosion.
 - Loose wear ring in counter bore of locking ring.
 - Increase internal diameter i.e. more than 178.56mm.

AAR approved grease Qty/ Bearing – 455 +/-30 gms.

Lateral play fixture – 0 .51 to 0.66mm.

Torque for axle end cap – 40 Kgm.

Bearing mounting pressure – 55 +/-5 Ton.

Defects, their cause & remedial action:

SN	Damaged condition	Possible cause	Remedial measure
1.	Flaking	Entry of foreign particles, water & poor lubrication	Improve the sealing mechanism, use the lubricant with proper viscosity
2.	Peeling	Rough surface due to poor lubrication, entry of debris into lubricant	Use proper lubricant, Improve the sealing mechanism
3.	Scoring	Excessive load, shaft bending	Check the size of load, check the precision of shaft
4.	Smearing	High speed & light load, sudden acceleration/deceleration	Improved the preload, check bearing clearances
5.	Fracture	Impact during mounting, poor handling	Improved mounting methods, provide enough back up & support for bearing rib
6.	Cracks	Heat generation due to creep, excessive interference	Correct the interference, use & appropriate shaft shape
7.	Cage damage	Poor mounting, excessive rotation speed, shock & large	Check mounting method, check the rotation & load

		vibration	condition, reduce the vibration
8.	Denting	Debris caught in the surface, shock during transport or mounting	Wash the housing, improve the mounting & handling methods
9.	Pitting	Exposure to moisture in the atmosphere, poor lubrication	Filter lubricating oil, improve sealing method
10.	Wear	Progression from rust & electrical corrosion, sliding due to irregular motion of rolling elements	Improve the sealing methods, prevent misalignment
11.	Fretting	Vibration with small amplitude, in sufficient interference	Check the interference fit, apply a film of lubricant to the fitting surface
12.	False brinelling	Oscillation & vibration of a stationary bearing during transporting, oscillation motion with the small amplitude	Secured the shaft & housing during transporting, reduce vibration while preloading
13.	Creep	Insufficient interference or loose fit, insufficient sleeve tightening	Check the interference & prevent rotation, correct sleeve

			tightening, tighten the raceway ring side race, apply adhesive to the fitting surface
14.	Seizure	Excessive small internal clearance, poor precision of shaft & housing	Check precision of shaft & housing. Study preload, bearing clearances & fittings
15.	Electric corrosion	Electric potential difference between inner & outer rings	Design electric circuit which prevent current flow through the bearings, insulation of the bearing
16.	Rust & corrosion	Entry of corrosive gas & water, poor rust prevention treatment	Improve the sealing methods, anti-rust treatment for periods of long running
17.	Mounting flaws	Inclination of inner & outer rings during mounting or dismounting, shock load during mounting or dismounting	Use appropriate jig & tool, avoid a shock load by use of a press machine, center the relative mating parts during mountings
18.	Discoloration	Poor lubrication, oil stain due to reaction with lubricant	Improve lubrication methods.

CENTRE BUFFER COUPLER

CBC is combined unit of Draw and Buffing Gear, located at the centre of Body Head Stock.

- i. Used as Draw Gear.
- ii. Used to transmit buffing force.

ADVANTAGES OF CBC:

- Coupler and buffing gear are both located together at the centre of the wagon.
- Coupling action between wagon is automatic so that more safer for operation.
- Hauling capacity increased.
- Maintenance cost is less than conventional Draw gear.
- Hauling capacity of conventional draw gear is- 2200 T
- Hauling capacity of CBC -7000 T to 9000T.

TWO TYPES OF CBC ON THE BASIS OF OPERATION:

- i. Transition type CBC.
- ii. Straight type CBC.

MAIN COMPONENTS OF CBC

A. COUPLER BODY:

- i. Coupler head.
- ii. Coupler shank.
- iii. Coupler tail.
- iv. Coupler guard arm.
- v. Coupler lock chamber.
- vi. Coupler shank wears plate

- B. KNUCKLE:
 - i. Knuckle nose.
 - ii. Knuckles lock face.
 - iii. Knuckle front face.
 - iv. Knuckle thrower / Kicker.
 - v. Knuckle pin.

- C. STRIKER CASTING
- D. STRIKER CASTING WEAR PLATE
- E. LOCKING PIECE
- F. ROTARY LEVER ASSEMBLY
 - i. lever hook.
 - ii. lever contraction.
 - iii. toggle.

- G. CBC OPERATING HANDLE

- H. CBC OPERATING HANDLE BRACKET

- I. CBC OPERATING HANDLE WEAR PIECE

- J. YOKE PIN SUPPORT PLATE

- K. YOKE SUPPORT PLATE

- L. TRANSITION COUPLING
 - i. Clevis.
 - ii. Clevis pin.

- M. FRONT FOLLOWER

- N. BACK STOPPER

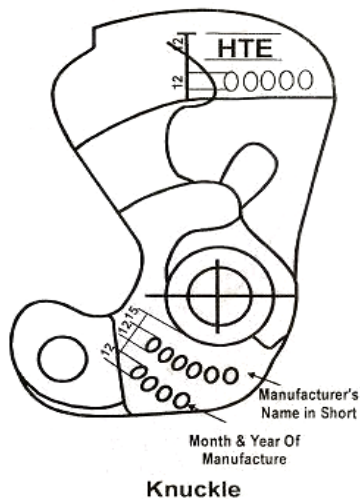
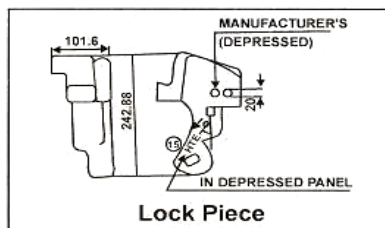
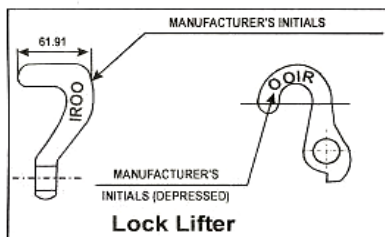
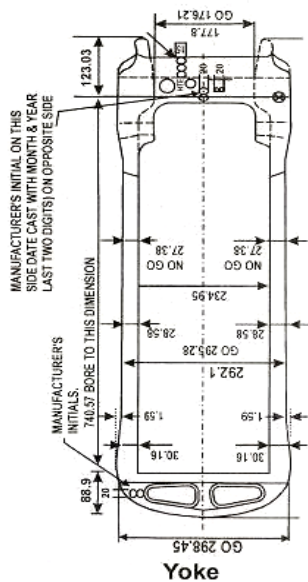
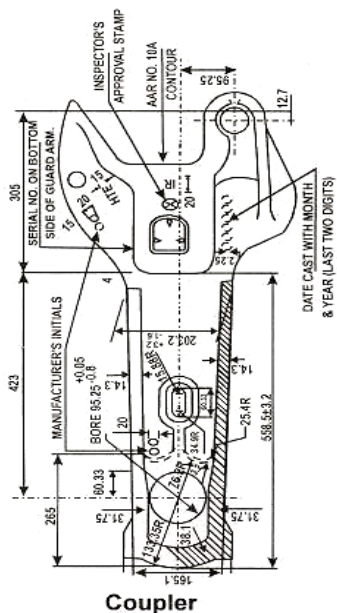
- O. YOKE, YOKE PIN

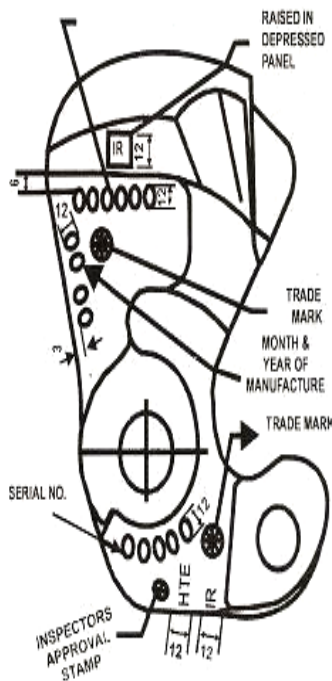
P. DRAFT GEAR

- i. HR-40 [All vacuum brake bogie goods stock]
- ii. MK-50[Air brake bogie goods stock]
- iii. RF-361[-----do-----]
- iv. SL-76 [-----do-----]

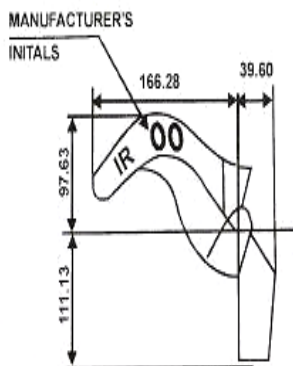
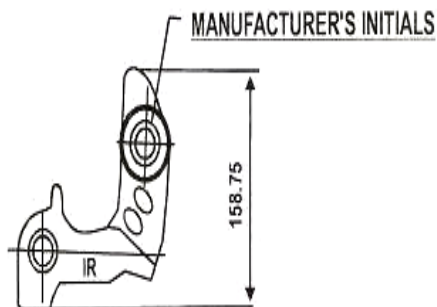
Q. BEARING PIECE: Size 16 x 16 x 270- mm (Modified)
with 16x16x210-mm

MARKING ON CBC (MANUFACTURERS INITIAL)





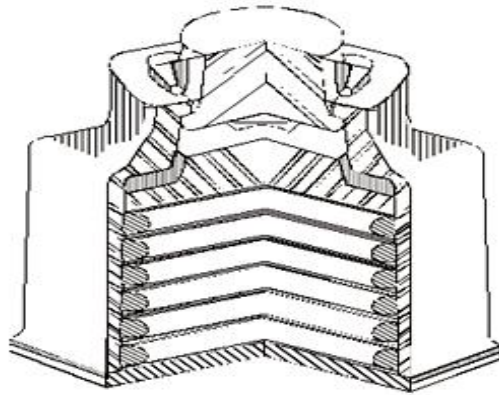
Marking of Parts



S.No.	Manufacturer's Name	In Short
1	Burn Standard Company Ltd.	BURN
2	Bhartia Electric Steel Company Ltd.	BESCO
3	Bhilai Engineering Corporation Ltd.	BECO
4	Hindustan Development Corp. Ltd.	HDC
5	Mukand Ltd.	MUKUND
6	Orient Steel Industries Ltd.	Orient
7	Sri Ranga Alloys Ltd.	Ranga
8	Titagarh Industries Ltd.	TITA
9	Texmaco Ltd.	TEXMA
10	Datre Corporation Ltd.	DCL
11	Raneka Industries Ltd.	RIL
12	Braithwate & Co. Ltd.	BWT

Types of CBC

- i. Standard AAR coupler: HT(high tension)
- ii. Alliance II coupler(Now only in 4 wheeler Tank Wagon)



RF - 361 DRAFT GEAR

1. STANDARD AAR(NHT) COUPLER:

- Broad gauge goods stock
- Used in vacuum brake bogie stock and brake van
- Working capacity-86T.
- Full proof load-132T.
- Braking capacity-251T.
- Hauling capacity in 1:100 up gradient-6500T-7000T.
- Draft gear utilized-HR-40.1.
- Buffing capacity-6200 Kg.
- Long case buffer used with transition CBC.

2. STANDARD AAR (HT) COUPLER:

- Upgraded version of standard AAR coupler.
- Used in air brake broad gauge goods stock.
- Buffer not used since it is a straight CBC type.
- Black color paint.
- Working capacity-120T.
- Full proof load-170T.
- Braking capacity-295T.
- Hauling capacity in 1:100 up gradient-9000T.
- High capacity friction draft gear is used.

TRAIN PARTING

When a train after formation, during run, shunting operation or while starting/ stopping divides itself into two or more parts, is termed as train parting. This is termed as “J” Class Accident In such cases the driver should keep the front portion moving as far as possible until rear portion has stopped to avoid any possibility of collision between the two parts of the train and cause of derailment. Guard should immediately try to stop the rear portion of the train by applying the hand brakes to avoid collision with front portion. Then driver & guard shall act accordingly to provision of G & SR to clear the block section in case of train parting occurred in the block section.

THE REASON OF TRAIN PARTING

Incidence of train parting is an accident as per accident manual. The train parting takes place mainly due to following reasons:-

- a) **Operational reason:** Operational reason such as bad engineman ship by driver Brake binding due to emergency application of the brakes etc also contributes to the train parting. Bad driving technique such as fast notching up of locomotive, sudden application of brakes, bad driving on gradient, improper road knowledge etc. can also contribute to train parting.
- b) **Due to defective signal:** Train parting mostly taking on up gradient followed with down gradient, the most important location where the cases are more is near the home signal which means driver while started from home signal after stopping are not ensuring releasing of brake in shock load on knuckles.
- c) **Poor Maintenance of P Way Track:** Analysis of section wise occurrence of train parting on railway indicates that bad section can be identified and driver should be counselled for pre drive techniques such as poor rail joints, mud accumulated track create uneven height with CBC coupler resulted train parted due to vertical slipping of knuckle.
- d) **Improper maintenance of rolling stock:** Train parting takes place in goods train due to following improper maintenance of rolling stock.

Causes & their remedial action for AAR CBC:

SN	Defects	Causes	Remedial Action
1	Excessive wear of knuckle nose.	Improper maintenance.	CBC Knuckle nose wear gauge No.- 2 must be apply at any schedule of maintenance.
2	Expansion of guard arm.	Ineffective anti-creep mechanism.	During ROH & other repairs it should be checked by CBC gauge No.- 2.
3	Excessive CBC drooping.	Excessive wear on shank wear plate/ missing of shank wear plate.	It should be replaced in sick line & yard examination
4	Cracks on Coupler Body.	Defective material/ Weak draft gear.	It should be replaced during POH & ROH
5	Bent operating levers.	Excessive projection of operating handle more than 75°.	It should be checked and replaced by examining staff in sick line and yard.
6	Dropping of Yoke pin support plate.	Loose & deficient rivets.	It should be secured properly by rivets
7	Improper/ Partial locking of knuckles	Locking piece dislogged.	Ensure proper locking of knuckles by examining staff
8	Breakage of front & rear stoppers.	Dead or weak draft gear.	Check the damaged draft gear.

9	Deficiency of lock lifting components	Defective and bent operating gear.	Ensure that all the components lock lift assembly is intact.
10	Excessive wear on the lock and knuckle at locking face.	Ineffective anti creep mechanism.	During ROH & other repairs it should be checked by CBC gauge No.- 2.
11	Stretched knuckle.	Defective or sudden draw and buffing forces.	During ROH & other repairs it should be checked by CBC gauge No.- 1.
12	Dropping of the operating lever on run.	Improper securing of bearing piece.	It should be ensured at every attention by examining staff.
13	Breakage of the operating lever support bracket	Bent/ Damaged operating lever and loose riveting of support plate.	Ensure proper riveting & bent lever to be replaced.
14	Excessive wear of the yoke pin support plate.	Yoke pin hole elongated.	Check any excessive rubbing marks on the bottom of the yoke.
15	Breakage/ Perished rubber pads in draft gear.	Excessive play in draft gear.	Proper attention during POH & ensure proper fitment of rubber pads & check for damaged draft gear by examining staff.
16	Failure of anti-creep mechanism.	Excessive wear of CBC components.	Ensure all the components of CBC body/ lock lift assembly are intact.

Defects of CBC which leads to Train Parting.

- CBC back stoppers plate broken and / or its rivet missing.
 - Draft support plate rivet loose.
 - CBC yoke cracked / broken.
 - CBC yoke pin support plate rivet loose.
 - Lock seat worn out or lug broken.
 - Excessive wear on lock piece.
 - Articulated lock lift assembly missing. CBC Drooping due to CBC shank wear plate excessively worn out.
 - Excessive wear on knuckle nose.
 - Cracked knuckle.
 - Wear in anti creep device.
- A. Anti rotation lug not available or non standard. (Standard size 270 X 16 X 16mm).
- B. CBC operating handle bearing piece slot more wear and tear (Standard size 17.5 X 17.5 mm).
- C. Wear in lock lifter assembly.
- D. CBC operating handle non standard i.e. bent portion length more than 400 mm.
- E. Failure on A/C of Commercial Department
- Over-Loading (Beyond carrying capacity) :If any particular wagon is over-loaded beyond its carrying capacity will lead to difference in buffer height between two wagons (more than 75 mm), it may cause disengagement of knuckle in locked condition i.e. vertical slipping of knuckles.

- Un-Even Loading: Due to un-even loading of any particular wagon it may lead to uneven CBC height on either end of the wagon & may cause in train parting.

F. Miscellaneous

- i) Due to handling of operating handle by miscreant
- ii) Grassing of operating handle with platform while running.

ACTION TO BE TAKEN BY THE FIELD STAFF: -

1. Parting of train takes place due to breakage of CBC or screw coupling during running of train. This is a dangerous situation for safety of trains therefore precaution to be taken by crew as mentioned below
 - a) To keep away front portion of train running

On noticing that train has parted, the driver of the train must try to take the front portion of the train as much ahead as possible. This may be done till the rear portion of the train comes to stop. This will avoid any chance of the collision in between both the portion of parted train. For taking ahead the front portion driver may take notches with the permissible amount of traction current.

- i) To stop rear portion of the train

After noticing the train parting, Guard of the train will apply hand brakes to stop the rear portion of the train as soon as possible.

- ii) Exchange of signal

After noticing, Driver may confirm the train parting as follows

1. Experiencing sudden drop of air pressure
2. Looking back and finding out that the train is parted in two portions.
 - i) **Re coupling of both portion of the train after stoppage of both portion of train guard of the train should secure the rear portion of load by applying the hand brakes properly. After bringing both portions together the following step to be taken.**
 - Intimation to section controller about parting of train
 - After coupling of both CBC's there should be no gap (lock should proper engage)
 - Connection of air hoses and preparation of pressure
 - Conduct continuity test.
 - Start the train to reach up to next station
 - Repeat the case to station master/SCOR in following details
 - Engine Number
 - Train load
 - Driver's & Guard's Name.
 - Location of wagon evolved in train parting.
 - BPC issuing station and date.
 - Kilometer on track.
 - Condition of gradient.
 - Train parting and load coupling time
 - Wagon particulars.
 - Probable cause of train parting etc.

ii) Clearing of load in two Portion

After parting of train if it is not possible to clear the load in one hook due to damage of CBC or its component, the parted load to be cleared in two portions. Front portion should be cleared by the driver up to next incoming station & rear portion can be attached and cleared with another engine after attaching with rear most wagons.

9.11 SAB AND LOAD EMPTY BOX

SAB (SVENSKA AKTIE BOLAGOT BROMS Regulator)

This is a mechanical device provided in the brake rigging, and forms part of the pull rod, for automatic adjustment of the clearance between the brake blocks and wheels in the brake rigging. This automatically operates to shorten or lengthen the length of the pull rod, to adjust the excess or less slack in the brake rigging or brake block clearance. This helps to maintain the clearance between the brake block and the wheels to a pre-determined constant value always, thereby maintaining the piston stroke of the brake cylinder constant. This, in turn, always maintains constant brake power for the wagon or coach on the run.

Types of SAB

- i. DRV 450
- ii. DRV 600

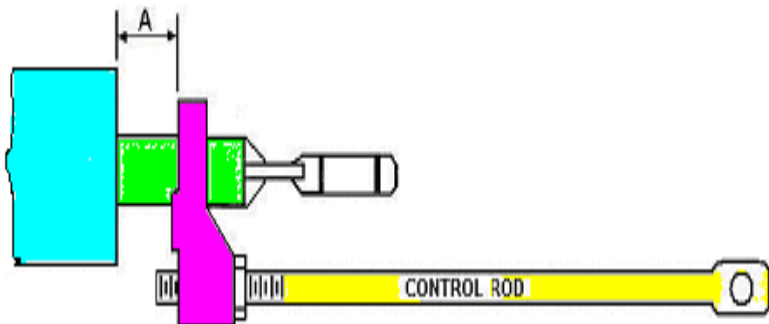
Code	Expansion	Remarks
D	Double acting	It increases or decreases the length of the pull rod automatically to maintain a constant piston stroke/clearance.
R	Rapid	It is fast in adjusting the piston stroke/clearance. It takes a maximum of only two brake applications and release for adjusting the piston stroke/clearance.
V	Verificative	It always verifies the piston stroke/clearance with control A dimension for the purpose of automatic adjustment of piston stroke/clearance.
450/ 600		This is the capacity of SAB up to which the length of the SAB pull rod can be increased or decreased. It is 450 mm for Coaching stock and 600 mm for Goods stock.

Main parts of the SAB

1. Adjuster Spindle
2. Leader Nut
3. Adjuster Nut
4. Traction sleeve
5. Barrel
6. Adjuster Tube
7. Barrel Spring
8. Clutch spring
9. Take up Spring
10. Pay out Spring
11. Adjuster Ear
12. Control Rod Head
13. Control rod

Control "A" Dimension

This is the distance between the slack adjuster barrel and the control rod head, measured when the brake is in fully released condition.



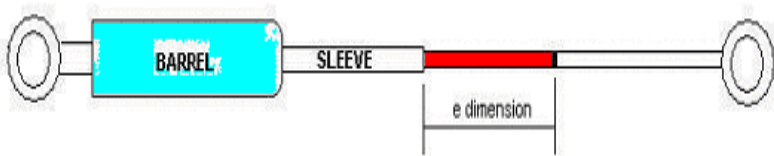
This is called as ‘Control Dimension’, because this is the pre-determined dimension, according to which the slack adjuster pays-out /takes-up the slack in the brake rigging.

The control rod ‘A’ dimension for Different Rolling stock is given below.

a) Coaching stock	16+ 2/ -0mm for 13 T Bogie stock 22+ 2/ -0 mm for 16.25 T bogie stock 22+ 4/-0 mm for Air Brake Stock (HS)
b) Goods Stock	50 mm for VB Stock 70 mm for Air brake stock 27 mm for BOBRN

‘e’ Dimension

This is the distance between the end of the protective sleeve of the screw and the grooved mark on the screw rod when the brake is fully released



This indicates the total capacity of the slack adjuster available for the adjustment of the brake rigging clearance. This dimension will be 375 ± 25 mm for coaching stock and 555 ± 20 mm for goods stock. It will decrease as wear takes place on brake

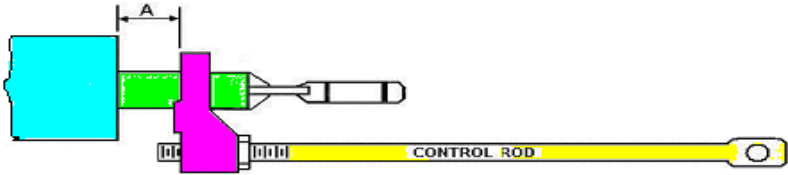
blocks, wheels, brake gear pins and bushes due to brake applications. And it will be the maximum when all Brake blocks, brake gear pins and bushes are new and all the wheels are at maximum diameter.

As the 'e' dimension decreases and reaches to the minimum due to the wear on the wheel tread, which cannot be made up (worn out brake blocks, brake gear pins and bushes can be replaced with new ones), manual adjustment shall be done according to the worn out wheel diameter, on the adjusting link of the bogie. This will ensure that sufficient capacity of 'e' dimension will be again made available for subsequent adjustments.

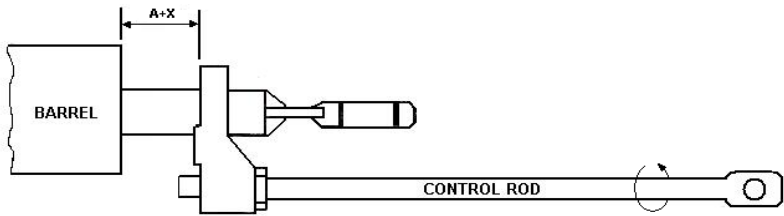
Functioning of the SAB:

The SAB is working based on the principle of LIMITING FRICTION. Due to this Limiting friction, the nuts that are provided inside the SAB get rotated automatically, whenever the excessive forces offered due to the incorrect slack acting on them. The rotation of these nuts on the screw rod causes the screw rod to move inward or outward for increasing or decreasing the length of pull rod till the correct adjustment of piston stroke and clearance is obtained.

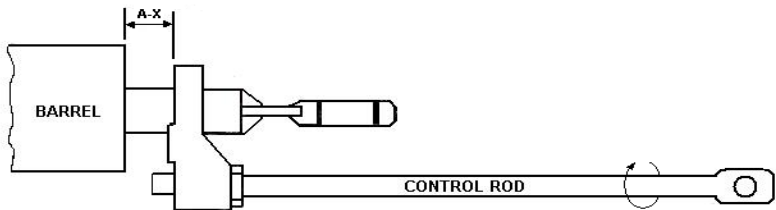
Adjustment of control 'A' dimension. Assemble the slack adjuster (SAB brake regulator) on the bogie brake rigging. Ensure that the hand brake and brake cylinders and the rigging are in fully released condition and in proper working order. Apply and release the brakes few times and again ensure that the brake rigging is in fully released condition. Check the 'A' dimension, if found correct, secure the pins correctly.



If found more, disconnect the control rod from its bracket and lengthen it by rotating anti-clockwise.



If found less, shorten its length by rotating it clock-wise.



One full rotation of the control rod will alter the 'A' dimension by 2 mm. Fix the control rod in its bracket and apply and release the brakes few times, check 'A' dimension, adjust it if required and test. Secure the pin when correct.

'A' Dimension to be correctly set to maintain the correct piston stroke and in turn the correct brake power. Rotating the

SAB or slack adjuster barrel will not alter the 'A' dimension. Once set correctly shall not alter it during service.

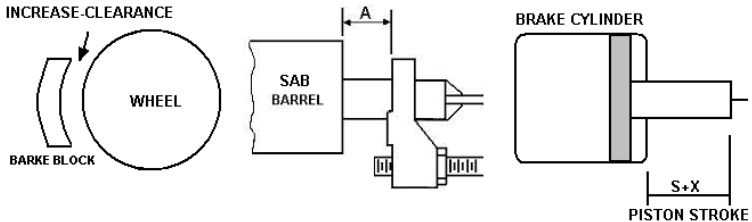
Take –Up and Pay-Out Test of SAB

For testing the slack adjuster, it need not be removed from the bogie brake rigging. It can be tested as it is on the bogie, during pit-line examination as follows.

Make few brake applications and release and note the piston stroke.

Take-up test:

Rotate the barrel anticlockwise 2 or 3 times, to increase the brake block clearances. Apply the brake and release.

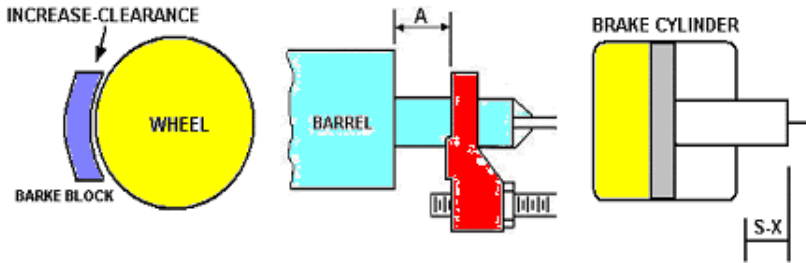


Note the higher piston stroke, at first application.

Apply and release the brakes. The stroke will be normal (equal to the original piston stroke) after 3 or 4 applications. This shows take up is satisfactory, If not slack adjuster is defective

Pay-out test:

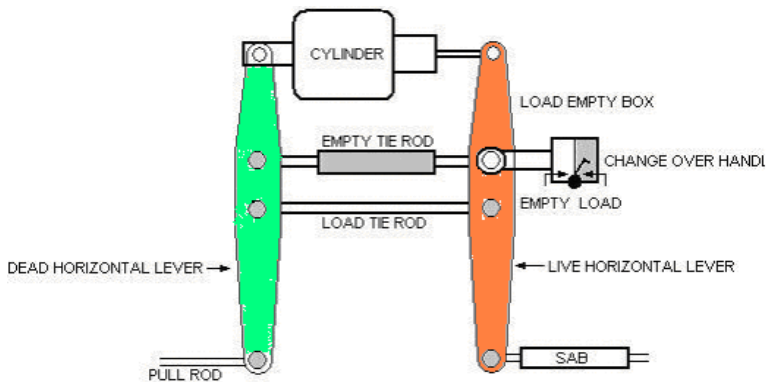
Rotate the barrel 2 or 3 times clockwise to decrease the brake block clearance. Apply the brake and release.



Note the short piston stroke at the first application. The stroke will be normal (equal to the original piston stroke) after 3 or 4 applications. This shows Pay-out is satisfactory. If not the slack adjuster (SAB) is defective.

Empty-Load Device

It is a mechanical device, which enables to provide two different leverage ratios to the brake rigging of the wagon for the empty and the loaded conditions



SCHEMATIC DIAGRAM OF LOAD EMPTY DEVICE

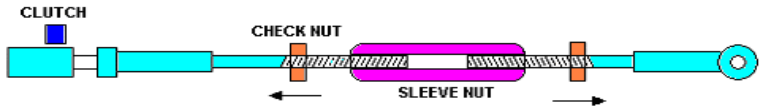
The braking force required to stop a train within the permissible stopping distance depends on the load of the train. As the load increases, more brake power is required, and as the load decreases, less brake power is required to stop the train. So the brake power should be increased or decreased according to the requirement by changing the brake leverage ratio. To enable this, the 'EMPTY-LOAD BOX' device is provided on wagons, in between the brake cylinder and the brake blocks in the brake rigging. The position of the change over lever of the E/L Box is to be set to ensure correct brake power according to the gross weight, as given below.

Less than 42.5 tonnes	–	in empty position
42.5 tonnes & above	-	in loaded position Brake

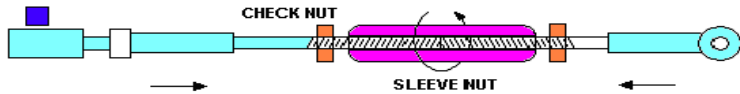
The LOAD-EMPTY device consists of two horizontal levers (one live and the other dead) and are connected by means of empty and load tie rods. When the handle is kept in empty position, the empty tie rod is connected with the system and in turn provides low leverage ratio, thereby gives lesser brake force. When the handle is kept in load position, the load tie rod is connected with the system and in turn provides higher leverage ratio, there by gives higher brake force as required.

Resetting of Empty/Load box:

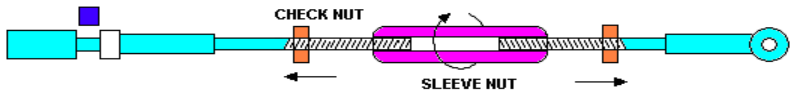
Release brake rigging completely, including the release of hand brake fully. Ensure horizontal levers can move freely. Keep change over lever in 'load' position. Shift lock nuts and washers of sleeve nut as far as possible.



Rotate sleeve nut and tighten empty tie rod fully.



Then rotate sleeve nut slowly in reverse direction to lengthen empty tie-rod. Stop rotating as soon as the end of the “live horizontal lever” starts moving.



Carry out test

Tighten lock – nuts and bend lock washers.

Testing the Load-Empty device for its effective functioning

Keep the change over lever in ‘empty’ position, a clear click sound should be heard. Apply the brake and tap the empty tie rod pins, it should be tight. Tap the load tie rod pins, they should be loose. If tight, the adjustment is wrong, and indicates the sleeve nut might have been tampered with.

Release the brake and keep the change over lever in load position and apply brake. Tap the load tie rod pins, they should be tight. Tap the empty tie rod pins, they should be loose. If not adjust the empty tie rod as given above.

10. ODC:- OVER DIAMENSIONAL CONSIGNMENT

10.1 Introduction:-

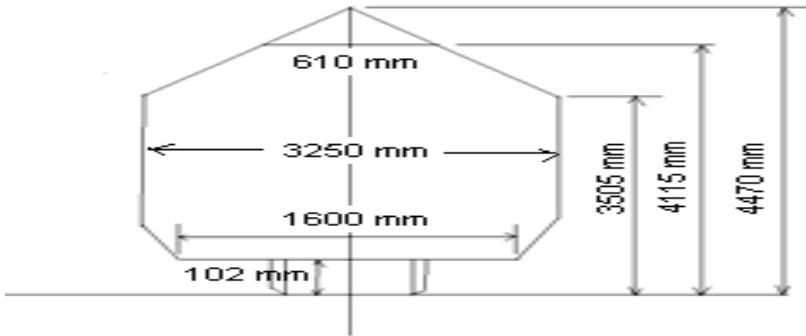
The transport of Over dimensional consignment has increased considerably in recent years; it has therefore become necessary to give wide publicity to the procedure in vogue on the railway for arranging movement of such consignment. This circular should be read in condition with the railway boards instructions issued from time to time & should be understood by all the staff responsible for movement of oversize consignment.



2. Maximum Moving Dimensions:-

- i) Overall height at top centre : 4115 mm
- ii) Overall height of OHE from rail level : 4470 mm
- iii) Overall height at the side : 3505 mm
- iv) Overall width of eight wheeler : 3250 mm
- v) Overall width at maximum level at top center : 610 mm

- vi) Floor height : 102 mm
 vii) Overall width at bottom : 1600 mm



3. Definition:- An ODC is found which, when consignment is loaded on ordinary open wagon, would infringe the maximum moving dimension of the gauge over which is to be moved.

4. TYPES OF CLEARANCES:- There are two types of clearances:-

- i) Net clearance
- ii) Gross clearance

Net Clearance:- The maximum clearance between consignment & fixed structure on running condition will be known as “Net Clearance”.

Gross Clearance:- The net clearance between consignment & fixed structure in stationary condition is known as “Gross Clearance”.

NOTE: Net Clearance is less than Gross Clearance.

10.2 CLASSIFICATION OF ODC:- The ODC has been classified in following three categories:-

- i. class ODC
- ii. class ODC
- iii. class ODC

i. Class ODC (Permitted Out of Gauge):

The consignment load which infringes the maximum moving dimension, but do not infringe any fixed structure en-route by net clearance of 150 mm & above & gross clearance 230 mm & above.

- i) Speed restriction : 40 kmph
- ii) Movement : During day & night
- iii) Escorting : Not required

ii. B- Class ODC (Exceptional Out of Gauge) :

The load which infringe the maximum moving dimension, but do not infringe any fixed structure en-route by net clearance of more than 75 mm & less than 150 mm & gross clearance of more than 150 mm & less than 230 mm.

- i) Speed restriction : 40 kmph
- ii) Movement : During day & night
- iii) Escorting : During Night
- iv) Escorting Staff : PWI, TI & CWI

iii. C- Class ODC:- (Extra ordinary Out of Gauge)

The load which infringe the maximum moving dimension, but do not infringe any fixed structure by a net clearance of less than 75 mm & gross clearance by less than 150 mm.

- i) Speed Restriction : 15 kmph
- ii) Movement : During day only
- ii) Escorting : required
- iii) Escorting Staff : JE (P-way), TI, JE (OHE)

Note: On the basis of gross clearance C-Class ODC is further divided in two categories

- a. If net clearance is more than zero but less than 75mm –speed-15 kmph only in day and must be escorted by TXR,PWI,LI,TI etc.
- b. If net clearance is zero–speed-dead slow, only in day and must be escorted by TXR,PWI,LI,TI etc.

5. Special Instruction For The Movement Of Electric Section:-

- a) AC Traction –

SN	Gap Between Contact Wire & ODC	Speed	Power
1.	390 mm & above	40 kmph	ON
2.	Less than 390 mm & till 340 mm	15 kmph	ON
3.	Less than 340 mm & till 100 mm	15 kmph	OFF

b) DC Traction –

SN	Gap Between Contact Wire & ODC	Speed	Power
1.	245 mm & above	40 kmph	ON
2.	Between 245mm & 170 mm	15 kmph	ON
3.	Between 170 mm & 75 mm	15 kmph	OFF

Note: If Clearance is between OHE wire & consignment is less than 100mm in AC traction area and less than 75mm in DC traction areas movement of ODC is not possible.

6. Procedure For Varification In Ce's Office:-

The following particulars shall be furnished in duplicate by the COM's office to the Chief Engineer's office in respect of nay over sized consignment.

- i) Length of consignment
- ii) Height of consignment at top center & side
- iii) Width of the consignment at top & bottom
- iv) Weight of consignment
- v) Booking station
- vi) Destination station
- vii) The route by which the consignment is to be booked

In case of old consignment a sketch showing end & front elevation with the complete dimension Length, width, Height & Weight shall be sent along with the application in duplicate.

- i) Each division will send up to date rolling diagrams showing the moving dimension on the division by 30th September of every year to the Chief Engineer's

Office. Clearance of OHE structure (height of contact wire, horizontal distance of OHE, columns etc.) shall be submitted by the traction branch of the division to the chief engineer's office. Thereafter CE's office must be advised to receive the diagram whenever the clearances etc. are affected to rising of track, construction of new structure & alternation of existing structure etc.

- ii) Construction organization shall submit to CE's office roll diagram showing supposed clearance before taking any work likely to affect the moving dimension.
- iii) While under taking any construction work, such as extension of existing platform, construction of new platform, shelters, road over bridge etc. Whether by open line or construction branch, it must be ensured that the clearance as shown in the Chief Bridge Engineer.

7. Sanctioning By Chief Engineer's Office:-

After verifying the particulars of the consignment vis-à-vis the moving dimension, sectional movement of the consignment will be communicated by the chief engineer's office to the COM's office. Such cases which are not within the powers of the chief engineer's office shall be submitted to CRS for sanction by the chief bridge engineer & as soon as he sanction for the movement is received from the CRS, the same shall be communicated to the COP by the chief engineer's office.

In each case section will specify the speed restrictions to be observed, the track & structures to be avoided, lowering of

track, lifting of over head electrical equipment, shutting off of power etc. as necessary. COM's office will convey the sanction to the divisions & the division concerned shall be issue message to all concerned official by wire & in case the movement over a particular division is through locations where restrictive unavoidable structures or over head equipment are located, in addition will send conformation copies & obtain acknowledgment.

If acknowledgement is not received in time from any of the concerned officials it shall be the duty of the divisional control office to obtain in on telephone & recode it in the control diary to ensure that the concerned staffs are aware of the condition of movement & their respective duties.

11. FREIGHT TRAIN EXAMINATION

Introduction: The efficient working of freight stock is closely linked to the standard of yard maintenance. Several factors are responsible for good and quality examination/repairs in the yard. The method of examination is described as under.

New Pattern of Freight Train Examination: It is based on the Revised JPO issued by Railway board letter No. 94/M(N)/951/57 Vol-2 dated 25.10.04, letter NO-2005/M(N)/951/13 Dated 07.04.05 and even no dated 25.04.2006 and 5.11.07.

Following are the main feature of new pattern examination of freights trains.

- i. Word CRT has been deleted as the stock has been phased out.
- ii. The freight train can only be subjected to examine for intensive End to End, Premium End to End and Close Circuit rakes.
- iii. The practice of safe to run examination of freight trains per se may be discontinued.
- iv. En route rolling-in-Examination freight trains may be discontinued. How ever rolling in examination as part of intensive examination will continue.
- v. Post loading examination by TXR Staff may be discontinued for all type of stock (except loading of steel consignment). This check is to be carried out by Guard and Driver as per standard proforma issued by Railway Board. The post loading check must be carried out by TXR Staff and securing of steel bundles with lashing chains may be ensured.

- vi. After Tippling the rake will be offered for post Tippling examination, in case less than three rakes are day, the check may be carried out by guard and driver as per standard proforma issued by railway board. In cases 3 or more trains are being tippling, post tippling check will be done by Skelton TXR staff. After tippling the rakes should be subjected post tippling check either by TXR Staff or by GUARD & Driver in case of non provision of TXR Staff in siding.
- vii. It should be ensured that unexamined lead (after unloading before next TXR Point) of freight trains running end to end pattern or invalid BPC in case of premier & cc rakes does not exceed 400 kilometer .
- viii. Since multiple loading and unloading are permitted in CC & Premium Rakes .movement of CC rakes & premium rakes will be monitored through FOIS by Traffic Department with C & W control.
- ix. In case of mechanized loading an unloading (i.e. BOXN wagon examination by TXR will be desirable.
- x. In case of clearance of stable load instruction contained in Board letter No. 2000/safety (A&R) /19/35/ dated 31.7.01 should be followed.
- xi. The CC rakes shall be offered for PME in empty condition at the cc base depot where the cc base depot where the cc rake was originally formed.
- xii. ROH and POH wagons from CC rake will be marked and detach at base Depot.
- xiii. The rake integrity of CC rake as listed in the BPC should be maintained .However up to 4 wagon (10 FWU) may be replaced by good examined wagons in the entire Run

between the two PME.(05 BLC or one mark in case of BLC rakes allowed for attended or replaced).

Premium Rakes: This new type of examination for air brake stock (i.e. BOXN, BOXNHS, BCN, BCNHS, and BOBRN etc) introduced in Indian railway w.e.f. April 06 as per instructions issued by railway board.

The salient features of such types of examination are under:

- i. Premium rake will be form out of air brake stock (i.e. BOXN, BOXNHS, BCN, BCNHS & BOBRN etc.)only.
- ii. Such rakes will be given intensive examination in empty condition at nominated examination yard only.
- iii. Premium examination point must be upgraded to “A” category yard on top priority.
- iv. Stipulation to form rake out of Off POH /ROH wagons as in case of CC rakes are not applied in case of premium rakes.
- v. Similar types of wagon are taken to form premium rakes, mixed wagons not allowed for such rake.
- vi. The rakes will be turned out with minimum 95% brake power and BPC will be issued on Green Book only.
- vii. The validity of BPC to be issued for 12 days including date of issue. However grace period of 3 days is given when rake is loaded condition and on 15 days rake must be unloaded and must be offered for C &W examination.
- viii. The rake is handed over to Operating Department for multiple loading and unloading within 12 days.
- ix. After each loading and unloading , the rake must be offered for Guard and Driver check before commencement of journey as per proforma issued by Railway Board and

observation will be recorded on the relevant column of the BPC.

- x. Movement of premium rakes will be monitored through FOIS by Traffic Department with Mechanical Department.
- xi. If the rakes stabled in yard more than 24 hours, the rakes must be offered for C&W examination otherwise BPC will be treated as invalid.
- xii. Man hours are decided as 75 for Premium End to End (PEE) examination.
- xiii. The integrity of rake will be maintained. However 4(10 FWS) wagons may be replaced by examined wagons en route.

Advantage of Premium Rake: Following are the advantages of introducing premium rake examination:

- i. Wagon turn round is reduced and loading cycle is increased by 3 times.
- ii. Rakes are available for maximum to Traffic Department.
- iii. During the year 2007-08 a profit of 2000 crore is made to Railway by increasing 40 million ton loading on premium rake pattern.
- iv. Overall average yard detention of Indian Railway is reduced from 15 hrs to 11.15 hrs.
- v. Due to introduction of premium rakes the availability of rake for end to end examination over IR decreased from 400 rakes per day to 150 rakes per day due to this overall expenditure on examination reduced.

Disadvantage of Premium Rake: Since the examination of premium rake are being also attended in yard which is yet upgraded to 'A' category, Following are the disadvantages:-

- i. Man hours for Examination of premium rakes are not specified and are being examined on end to end pattern.
- ii. Reject able Items for attending examination and repair of such rake are also not specified.
- iii. The rake is permitted for multiple loading and unloading on the basis of GDR check. It is experienced in N. C. RAILAY that GDR check is not effective and derailment of 3 premium rakes during 2006-07 as 2007-08 were occurred due to lack of GDR check which is not safe practice and not safe to rolling stock.
- iv. Grace period of 3 days is permitted when rakes are in loaded condition (i.e. in rare cases) and must be reached to unloading point within 15 days and on 15th days rake must be offered for C&W examination .

But it is experienced in NC Railway that Traffic Department is taking advantage of grace period, the premium rakes are received after loading on 12thg day from the issue of BPC and thus rakes are running on invalid BPC. Such information is being sent to Railway Board in PCDO and operating department is requested to minimize such practice to safe running of rolling stock.

Close Circuit Rakes: CC rake are being formed in term of Railway Board's letter No.94/M(N)/951/57 Vol- II dated 25.10.2004 and letter No. 87/M(N)/951/31 dated 22.08.1989. and

time to time instruction issued by Railway Board. Following are the main feature of CC rakes:-

- i. CC rakes will run on predefined path and under completion of day / km mention on BPC the rake should be examined at nominated base depot only.
- ii. Off POH/ROH wagon should be preferred during formation of CC rakes.
- iii. Examination should be conducted in day light only (morning to sun set).
- iv. The examination should be conducted on nominated line by CRSE & CFTM of the Railway.
- v. All reject able items must be attended during examination of such rake.
- vi. The air brake wagons of same types of stocks are formed in CC rake .Mixed wagon can not be allowed.
- vii. For examination of CC rake, 100 man hrs is to be taken.
- viii. After examination BPC with 100 % brake power is issued on prescribed yellow color certificate.
- ix. The examination of CC rakes is carried out where the minimum infrastructure facility for examination as standardized by CAMTECH is available.
- x. There are 3 types of CC rakes be examined and validity of BPC being issued over Indian railway.
 - 4500 kms/20 days whichever is earlier (examined at “A” ,”B” and “C” Cat. yard)
 - 6000kms /30 days whichever is earlier (examined in “A” cat. yard)
 - 7500 kms/35 days whichever is the earliest (being examined at Special “A” cat. yard)

- xi. The rakes are handed over to Traffic Department for multiple loading/unloading within the validity of BPC and GDR check.
- xii. Listed wagons on BPC are allowed to run .En route if detachment or attachment by 4 or more wagons (10FWU) is done without examination by TXR, BPC should be treated as invalid (In case of BLC 5 wagons/ one unit)
- xiii. Movement of CC rakes will be monitored through FOIS by Traffic Department with Mechanical Department.
- xiv. If the rake is instable in yard more than 24 hrs in yard, the rake must be offered C&W examination and if not, BPC should be treated as invalid.
- xv. The km runs must be endorsed by Driver and Guard on BPC in relevant column.

Further, zonal Railways shall maintain detailed record w.r.t. en route detachments. Brake power and detachment during examination of these rakes and give monthly feed back to board on their performance.

Railway must ensure that infrastructural facilities at all the above points are upgraded to 'A' category.

11.1 POST LOADING AND POST TIPLING EXAMINATION:

Vide Rly Bd's letter no. 2005/M(N)/951/13 dated 08.02.2006. Post Loading examination by TXR staff was discontinued. Post loading check by Guard and Driver was introduced. In the para (iv) of Rly Bd's above letter dated 08.02.06. It was stipulated that:

After tipping the rake will be subjected to post tipping examination. In the case less than 3 rakes are being tipped per day, the check may be carried out by Guard & Driver as per proforma enclosed. In case 3 or more trains are being tipped, post tipping check will be done by skilled TXR staff.

The same has been reviewed vide Rly Bd's letter No. 98/ M (N)/951/12/pt.1 dated 17.05.07, relevant paras are reproduced as follows:

1. Board has reviewed the subject matter and has decided to revise the instructions contained in para (iv) of aforesaid letter dated 08.02.06 on post tipping checks on freight trains as under:
 - a) After tipping rake should be subjected to post – tipping checks either by TXR staff or by Guards and Drivers in case of non provision of TXR staff in the siding.
 - b) As local condition may vary from siding to siding, based on recommendations of CME & COM, GMs may decide whether the post tipping check on a particular point will be entrusted to TXR staff or

Guard and Driver. While deciding the matter one way or other, the following may be kept in mind:

- Recovery of necessary charges from the owner of such sidings in case any defects damages are noticed.
 - Post tripping check by Guards and Drivers should be done as per format enclosed with the above mentioned letter of Railway Board.
2. Rules regarding starting of trains from non-TXR points after examination by Guard and Drivers should be strictly enforced.
 3. All other provisions of Board's letter no.2005/ M(N)/ 951/13 dated 08.02.2006. It is to be followed.

GDR CHECK: GDR check has been defined as , required to be done only for rakes , which are to be offered to TXR examination, where due after completion of loading and unloading cycle and are required to move another 250-300 kms (now 400 kms stretch) before hitting the TXR points. The GDR check by guard and loco pilot should invariably ensure the following:-

- 1) Adequacy of Air pressure/vacuum pressure in motive power and brake van.
- 2) Ensure Air pressure / vacuum continuity from loco to last vehicle.
- 3) Success of brake feel test.
- 4) Adequacy of brake power by counting operative/ non – operative pistons.
- 5) Shall ensure by visual examination that there are no loose fitting in the under gear including brake blocks, safety brackets , track area, brake gear pins etc. which may danger the safe running of train. This examination shall be one by

walking along the length of the train by loco pilot on one side and by Guard on other side.

- 6) Guard and loco pilot shall jointly prepare a memo in triplicate indicating the brake power deficiency, if any .They shall append their signature on the same and both of them shall retain a copy of the same and third copy shall be handed over to station master on duty.
- 7) In case of premium end to end rakes the observation by the guard and loco pilot will be recorded under the relevant para of the BPC.

The GDR check should not lead to a false sense of adequacy of brake power in the psyche of the loco pilot. So apart from adequacy of air pressure per vacuum in the locomotive and the last vehicle, the loco pilot should have the confidence on the adequacy of the brake power only after conducting the brake feel test and this aspects of sufficiency of brake power of the train should not be diluted by other visual examination by Guard and Loco Pilot.

Since premium rake s allowed for multiple loading and unloading up to 12 days based on the GDR check, there is an urgent need to bring improvement in quality of GDR checks by imparting suitable training to all goods Drivers and Guards. Some of the areas that need to be specifically covered in such training are as follows:

- i) Significance of post loading and post tripling examination.
- ii) Items to be checked: critical assemblies and components: procedure for checking.

- iii) Type of BPC s: validity of BPC: action to be taken in the case of invalid BPC.
- iv) Type of tippers / pay loaders: nature of the damage caused to the freight stock during loading per tipping operation.
- v) How to check brake power of air and vacuum brake train? How to check continuity of air pressure/ vacuum in trains?
- vi) How to check condition of couplers, hoses and other under gear components .
- vii) Types of the angle cocks: open / close position of different type of the Angle cocks.
- viii) Empty / load device: principle of working /correct position of empty / load device handle.
- ix) Types of the bogies suspension arrangement, brake gear components, common defect of spring, brake pull load, brake beam, safety bracket, brake block etc. And action to be taken in each defect.
- x) Type of hand brake, procedure of release/application of various types of hand brakes / defect of hand brake.
- xi) Type of doors and their locking in various type of wagons, door opening mechanism of BOBRN wagons.
- xii) Action to be taken for various defect in freight stocks / train.

Post Loading/ Post Tipling Checks by the Guard and the Driver

Items	To Be Checked By Guard And Drivers
1.	All CBCs and Air House are properly coupled and locked
2.	All the Angle Cocks are in open condition.
3.	The last Angle Cock is in closed condition
4.	Empty/Loads device handle is in proper position
5.	There is no loose fitting/hanging parts like spring push-pull road, Brake Beam, Safety brackets, Brake blocks etc. which may endanger safe running of the train.
6.	Hand Brakes are released.
7.	Doors of wagons are closed and locked / secured.
8.	Check continuity of the air pressure/vacuum before starting.

Proforma for joint check by the Driver and the Guard

1.	Date	:
2.	Train No. and loco number	:
3.	From.....	To
4.	BPC No.; Date & Station of Issue		
5.	Loaded at	Or	Tiplled at
6.	Time of Locomotive Attachment	:
7.	Total Load	:

(Signature of Driver)

(Signature of Guard)

Driver's Name.....

Guard's Name.....

(This memo should be prepared in three copies, one copy to be kept with Driver , one with the Guard and one will be given by the Guard to the Station Master / Yard Master.)

Examination of Container Trains (In each case of invalid BPC): (Ref: Railway Board's letter No. 2007/M (N)/ 951/67 Dated 19/20. 11.2008);

- i) **Para 2.9(a)- In empty Condition (container off loaded from wagons):** Rake shall be offered at the nearest TXR point for intensive examination, where after examination its BPC will be revalidated for a period of 7 days, with endorsement on BPC by TXR that rake is safe to run up to its base depot. During this period of 7 days, one loading/unloading shall be permitted in the direction of CC base depot. The revalidation of BPC in above manner is permitted only once and rake shall be back to its CC base depot within 6 days period. Else the rake shall lose its CC character and will become normal end-to-end rake Re-conversion of such end-to-end rakes to CC shall be permitted only after personal approval of CME & COM of the concerned Zonal Railway.
- ii) **Para 2.9(b)- In loaded Condition (container loaded on the wagons):** Rake shall be offered at the nearest TXR

point for safe to run examination and endorsement on BPC by TXR that train is safe to run up to its destination. After unloading of consignment at destination, such potential unsafe rake shall be offered at the nearest TXR point for safe to run examination and endorsement by TXR on BPC that the train is safe to run in unloaded condition up to its CC base depot examination with containers loaded on wagon, shall be done only in case of extreme urgency with prior approval of CME & COM of the concern Zonal Railway.

- iii) **Para 2.10 of the same Railway Board's letter dated 19/20.11.2008:** Container rakes detained for more than 24 hours at TXR point, shall be subjected to safe to run examination and endorsement on BPC by TXR that rake is safe to run for the remaining validity period of BPC.

JPO for Close Circuit Pattern of Examination, Maintenance and Operation of BTPN Wagons (Ref: EDME/ Frt./Railway Board's Letter No.-2008/M(N)/951/13 CC Rakes dated 05.02.2010)

- i) After successful trial for one month Close Circuit Examination of BTPN wagons shall be taken up at BAAD Depot in Agra Division on trial basis for one year as detailed below:

SN	Base	No. of Rakes	Circuit	Validity of BPC
		30		6000 kms or 30 days whichever is earlier

--	--	--	--	--

- ii) CC examinations will be done only on the examination lines in the Yard having proper facilities of material handling, pucca pathway, welding, lighting etc. the CC examination will be done on the lines where there is no OHE.
- iii) If there is no CC examination line without OHE, CC examination and maintenance of under gear parts of wagons should be carried out in the CC examination Yard and maintenance of barrel portion of the wagon (i.e. barrel mounting and valves) may be done in gantry before loading of the product.

- iv) The existing rakes (ordinary/ non CC/ Premium) shall be thoroughly examined before the rake is declared CC by a supervisor not below the rank of SSE/C&W.
- v) The rake shall be offered for examination in day time only, till the lighting facility is developed.
- vi) Due to acute position of staff at BAAD Sr. DME/ C&W/ AGC may move 8 staff from BAAD sick line to yard for three days a week. On these days , CC examination may be carried out @ one rake per day . This will be done till additional staff is posted at BAAD depot.
- vii) All wagons released from ROH shall be utilized for making CC rakes and Off ROH wagons waiting for formation of CC rakes shall not be considered under ineffective.
- viii) During CC examination, proper attention to the safety fitting ,pipes valves etc shall be given and their maintenance records will be maintained separately.
- ix) Monitoring of CC rakes shall be done through FOIS and also by Sr.DME(C & W) and Sr.DOM of AGC division jointly.
- x) Proper computerized record keeping and documentation at CC base depot BAAD to be ensured to be monitor condition of CC rake.
- xi) The BPC will incorporate the name of CC depot as BAAD depot and will be valid over NCR,NE,WR,NR&WCR with a validity of 6000 kms or 30 days whichever is earlier.
- xii) Rake operating on zonal railways not mention on the BPC will loss their CC character and will be treated as per instruction prevailing for normal end to end rake.

- xiii) All rakes will be returned to BAAD depot , nominated CC base report as per validity of BPC.
- xiv) After each loading /unloading, the rake will be examined by Guard and Driver before commencement of journey and observation will be recorded under relevant column of the BPC.
- xv) Rake integrity as listed in the BPC should be maintained, however up to 4 wagons may be replaced by duly examined wagons in the entire running between two PMEs.
- xvi) ROH/POH wagons from CC rake will be marked end detached at base depots only.
- xvii) In case CC rake is not made available for examination at base depot and offered for examination at some other depot. It will become non CC rake and it will follow normal intensive examination pattern.
- xviii) Railway shall ensure that other requirements as stipulated by RDSO from time to time & IRCA for carrying and handling of hazardous material in the tank wagon shall be met.
- xix) Besides special conditions mention here in above , with respect to maintenance and operation of this special CC rakes, all other general instructions issued by railway board from time to time, regularly maintenance of 6000 kms CC rake shall be observed.
- xx) After completion of 1 year of trail period, division should submit performance report with detail of detachment (with reasons), poor brake power cases and detachment during examination etc. for review.

Items to Be Examined/Checked During Premium/Cc Rake Examining In Yard (Brief):

Rolling In examination must be done before block of rake to detect Hot Box, flat tyre and other unusual.

1. Complete inspection of running gears, break gears & spring gears including tapping and gauging of wheels. The wheel dia should be within limit.

DISCRIPTION	LIMIT	
	New	Condemn
Wheel dia used on BOX/UIC bogie)	1000 mm	860 mm
Wheel dia used on BOXN/CASNUB bogie)	1000 mm	906 mm
Wheel dia used on BLC Wagon	840 mm	780 mm

2. Ensure fitness of all safety fittings, straps & safety loops, safety brackets etc.
3. Replacement of cast iron & composite brake blocks. Brake blocks should be replaced on reaching condemning thickness. After fitment of brake block and key on brake head fitment of split pin should be ensured. The limit of brake block thickness is as under :

DISCRIPTION	LIMIT
Brake block condemning limits	10 mm
Yard leaving thickness of brake block except BOY	20mm

4. Correct functioning and positioning of empty load device.
5. Checking and proper securing of doors of the wagons.
6. Look for abnormal and/or unequal buffer height/CBC height, wear plates, knuckle, etc to the extent it is possible to detect by visual examination. Incase of doubt , the buffer height / CBC height should be measured and maintained as given below :

DISCRIPTION	LIMITS
Buffer height from rail level	Max 1105 mm (Empty)
	Min 1030 mm (loaded)

7. The Bogies, complete side frames and bolsters to be visually examined for cracks and missing parts. Bolster springs , Snubbers, spigots, center pivots fastening, roller side bearer in case of CASNUB 22 bogie to be checked for defects , if any. Following nominal clearances may also be observed;

DISCRIPTION	22W 22W RETRO	22W(M)	22NL NLB	22HS
Lateral clearance between Side frame and bolster	18mm	18mm	18mm	25mm
Lateral clearance between Side Frame and axle box/adopter	25mm	25mm	16mm	
Longitudinal clearance between side frame and axle box/adopter	2mm	10mm	9mm	9mm
Longitudinal clearance between side frame and bolster	6mm	6mm	6mm	6mm
Clearance between anti rotation lug and bolster	4mm	4mm	4mm	4mm

8. Hand brake Wheel should be checked for their proper working in ON & OFF position.

9. Visual examination of under frame members, body, door mechanism, CBC wear or deficiency of parts to be marked and their operation to be checked.
10. Examination of any loose or hanging component.
11. Abnormal behavior of any vehicle indicates if unsafe working condition.
12. The condition of side bearer pads Rubber bonded metal pad (RBMP), E M Pad must be examined and it should be within limit as given below.

DISCRIPTION	Normal dimension	Dimension after permanent set (condemning size)
Elastomeric pad	46mm	42mm
Side bearer rubber pad	114mm	109mm

13. A rake of air brake wagons should be tested with rake test rig from one end of rake. Leakages through air house pipe, MU Washers, cut off angle cock to be arrested and air pressure in BP gauge should be maintained as given below:

No. of Wagons	On BP Gauge of rake test rig	On last Wagon
Up to 56 wagons	5.0 Kg/cm ²	4.8 Kg/cm ²
More than 56 wagons	5.0 Kg/cm ²	4.7 Kg/cm ²

14. During the testing following parameters are to be checked and maintained as given below:

a) **“A” Dimension:**

Description	Limit
A' dimension of slack adjuster BOX/UIC bogie Wagon	50mm +2/-0
A' dimension of air brake stock fitted with CASNUB bogie except BOBRN wagons	70mm +2/-0
A' dimension of BOBRN	27mm +2/-0

b) **Piston stroke:**

Type of wagons	Piston Stroke	
	Empty	Loaded
BOXN,BCN/BCNA,BRN.BTPGLN	85mm+/- 10mm	130mm+/- 10
BTPN	87mm+/- 10	117mm+/-

15. **Brake Power Certificate (B.P.C.):** This is a certificate jointly signed by guard, driver and C&W supervisor prepared in triplicate by C&W supervisor after ensuring vehicle attached in train is fit to run and required amount of vacuum/ pressure is maintain in engine and brake van/ last vehicle. It contains train no., engine no., and loads, break up of load, brake power of the train, amount of vacuum/ pressure in engine and brake van and first and last two vehicles number respectively.

BPC to be issued on prescribed color performed as under:-

Premium rake	– Green color - 95%
CC rake	– Yellow color - 100%
End to End vacuum rake	– Pink color - 85%
End to End air brake	– Green color - 85 %

**Brake Power Certificate For Air Brake (Boxn/Bcn) Primum
End To End Rake**

ISSUED BY: (EXAM Point/Div/Rly.) _____yard /Railway

INTSTRUCTIONS

A. GUARDS AND DRIVERS

Before starting the train , guard and driver should ensure:

- (i) Continuity of air pressure from first to last vehicle of the train.
- (ii) Validity of BPC, if found invalid inform the section controller immediately and take necessary instructions from carriage control.
- (iii) Driver and Guard should correctly log the dates and kilometres earned.

B. STATION STAFF

They should be vigilant for averting any theft or tampering with this rake. Any incident of theft/ tampering to be

reported to section controller / TXR controller and entry of attention done be made in space provided.

THIS CERTIFICATE IS VALID FOR 12 DAYS (WITH A GRACE LIMIT OF 3 DAYS), PROVIDED.

1. More than 4 wagons have not been detached / attached from the rake.
2. The rake is not stopped for more than 24 hours in any train examination yard.

Note: 3 days additional grace period is given for loaded trains only. Loading of train on or after 12th day will make BPC invalid.

B. TO BE FILLED AT THE ORIGINATING EXAMINATION POINT BY RAKE EXAMINING STAFF

TRAIN No.

LOAD & STOCK

BPC No.

ENGINE No.

BPC ISSUED DATE

BPC VALID UP TO

STATION

DATE OF LOADING

AIR PRESSURE ON DEP: ON LOCO kg/cm²

ON BK. VAN kg/cm²

TOTAL No. OF CYLINDERS

No. OF OPERATIVE CYLINDERS

BRAKE POWER %

LIST OF WAGONS IN ORDER:

S. N.	Wagon No.	S. N	Wagon No.	S. N	Wagon No.	S. N	Wagon No.
		16.		31.		46.	
2		17		32		47	

()
DRIVER'S NAME & SIGN.

()
GUARD'S NAME & SIGN.

()
JE/SE (C&W) NAME & SIGN.

B. DISTANCE TRAVELLED (TO BE FILLED BY DRIVERS)

SN.	Date	Loco no.	Train no.	Driver's name/hq	From	To	Kms	Cum kms	Driver's sign.

PARTICULARS OF WAGONS DETACHED ENROUTE:

- 1.
- 2.
- 3.

C. ENROUTE PROBLEMS NOTICED & ATTENTION GIVEN:

Date	Loco no.	Dr's name	Dr's h.q.	Problems & action taken		Sign. Of Dr/ Staff	Of Stn.
				Stn.	Nature		

D. BRAKE CONTINUITY/ VALIDATION AT LOADING POINTS.

S. No.	Station	Rly .	Date	Pr. Ready at	Abnormality observed	Sign.

E. GDR CHECK LIST :

S.N	ITEMS TO BE CHECKED BY GUARD AND DRIVER
1.	Rake integrity is not disturbed by more than 10 FWUs. Only intensively examined wagons given fitness by train examining staff may be attached.
2.	All CBC's and Air hose are properly coupled and locked.
3.	All the angle cocks are in open condition.
4.	The last angle cock is in closed condition.
5.	Empty /load device handle is in proper position.
6.	There is no loose fitting/hanging parts like push pull rod, brake beam, safety bracket, brake blocks etc. which may endanger safe running of train.
7.	Hand brakes are released.
8.	Doors of wagons are closed properly and locked/secured.
9.	Any other abnormality noticed and action taken.
10	Guards and drivers shall prepare a memo jointly on a plain sheet triplicate indicating the brake power and deficiency, if any
11.	Continuity of the brake pipe pressure is confirmed through VHF/ Whistle code before starting the train.

BRAKE POWER CERTIFICATE FOR AIR BRAKE (GOODS) CLOSE CIRCUIT RAKES

ISSUED BY: (Intensive Exam. Point/ Divn./Rly.)

NOMINATED CLOSE CIRCUITS

DATE

BPC NO.

INSTRUCTIONS

A. GUARDS AND DRIVERS:

1. Before starting the train, guard and driver should ensure:-
 - (i).Continuity of air pressure from first to last vehicle of the train.
 - (ii). Validity of BPC. If BPC is invalid, inform the control office & take necessary instructions from Carriage Controller/ Sr. DME.
2. Driver and Guard should correctly log the kilometers earned.

B. STATION STAFF:

1. They should be vigilant for averting any theft or tempering with this rake. Any incident of theft/ tempering to be reported to TXR Control and entry made in the space provided.

THIS CERTIFICATE IS VALID FOR 6000 km.

1. Provided the kilometrage has been logged in correctly and continuously, if not BPC will be deemed to be valid for 30+5 days only from the date of issue of BPC.
2. Provided the rake integrity is not changed and only listed wagons are included.
3. Provided the rake is not stabled for more than 24 hours in train examination Yard.
4. Provided the rake is running in pre-defined close circuit as mentioned above.

Train No.

Engine No.

Load & Stock

Total No. of Bk. Cylinders

No. of Operating Cylinders

Brake Power %

Air pressure on dep: On Loco g/cm²

On BK. Van kg/cm²

Engine on Train

Air pressure ready at

LIST OF WAGONS IN ORDER:

S. N.	Wagon No.	S. N	Wagon No.	S. N	Wagon No.	S. N	Wagon No.
1		16		31		46	
2		17		32		47	

()
DRIVER'S NAME & SIGN.

()
GUARD'S NAME & SIGN.

()
JE/SE (C&W) NAME & SIGN.

D. DISTANCE TRAVELLED (TO BE FILLED BY DRIVERS)

S.no.	Date	Loco no.	Train no.	Driver's name/hq	From	To	Kms	Cum kms	Driver's sign.

PARTICULARS OF WAGONS DETACHED ENROUTE:

- 1.
- 2.
- 3.
- 4.
- 5.

E. BRAKE CONTINUITY/ VALIDATION AT LOADING POINTS (OR THEIR NEAREST EXAMINATION POINTS) BY TRAIN EXAMINING STAFF.

S. No.	Station	Rly.	Date	Loco no.	Pr. Ready at	Abnormality observed	Sign.

F. ENROUTE PROBLEMS NOTICED & ATTENTION GIVEN:

Date	Loco no.	Dr's name	Dr's h.q.	Problems & action taken		Sign. Of Dr/ Stn. Staff
				Stn.	Nature	

INTENSIVE BRAKE POWER CERTIFICATE FOR AIR BRAKE (GOODS) (END TO END RUNNING)

No

ISSUED BY : (Intensive exam. Point /divn./Rly.)
No.

Destination :

Date BPC No.

Train No Loco No.

Load & Stock

Total No of cylinders

No. of operating cylinders

Brake Power %

Vacuum on departure on loco

On Bk. Van

INSTRUCTIONS

A. GUARDS AND DRIVERS

Before starting the train guards and drivers should ensure:-

- (i) No driver should move the loaded train from the loading point unless the destination is clearly mentioned of the brake power certificate.
- (ii) Continuity first to last vehicle of the train.
- (iii) If BPC is invalid, inform the control office & take necessary instructions from C&W controller.

THIS CERTIFICATE IS VALID

Provided the destination is mentioned on the BPC of the loaded train

Provided the composition of the rake is not changed by 4 or more wagons

Provided the rake is not stabled for more than 24 hours

B. LIST OF WAGONS IN ORDER

S.no	Wagon No	S.No.	Wagon No.	S.No.	Wagon NO.	S.No.	Wagon NO.
1.		19.		37.		55.	
2.		20.		38.		56.	
3.		21.		39.		57.	

C. ENROUTE PROBLEMS NOTICED AT STATION GIVEN

Date	Loco No	Drivers Name/HQ	Problems and action taken	Sign. Of Driver

D. NOTES :

1. The incoming driver shall handover the brake power certificate to relieving driver . If he is leaving the train without relief . It shall be deposited with nominated authority who will give it to the outgoing driver.
2. The outgoing driver and guard will satisfy themselves from the listed wagon numbers that the brake power certificate pertains to their train.

()
DRIVER'S NAME & SIGN.

()
GUARD'S NAME & SIGN.

()
JE/SE (C&W) NAME & SIGN.

Details of intensive examination:

1. Rolling in examination including axle box feeling
2. Intensive examination and repairs:

Intensive examination and repairs:

- A Inspection and repairs of running gear fittings.
- B Inspection and repairs of brake gear and spring gears.
- C Inspection and repairs of draw and buffing gear.
- D Checking and making good the deficiency of safety fittings, safety brackets, safety loops etc.
- E Replacement of brake blocks.
- F Correct functioning and positioning of Empty Load Box Device.
- G Checking and proper securing of doors of covered wagons.
- H Checking of CBC and knuckle.
- I Meticulous check of BC, DV, AR.CR and other pipe joints.
- J After brakes are released, the wheel profile should be examined.
- K Where a reject able defect cannot be attended on the train in the yard, wagon shall be damaged labeled for attention in the sick line.

Difference between STR and intensive examination:

S.N.	STR / Revalidation	Intensive
1	Validity of BPC is given up to next TXR examination point and it is endorsed on the same BPC, No fresh BPC is issued.	The rake is examined in empty condition intensively and fresh BPC is issued as per required Brake power % as 85% or 95% or 100 %in case of EE or PEE or CC respectively.
2	Only safety “S” marks defects are examined and attended to.	All reject able, chargeable and “S” marks defects are examined and repairs if required.
3	This type of examination is being carried out for air brake stock only.	All type of stock offered by traffic given intensive examination
4	C&W staff with a least facilities may examined the load for STR.	All minimum infrastructural facilities as per CAMTECH are required to examine and repairs the fitting during examination.
5	It may be carried out at any traffic line	It is done only on nominated yard as well as selected line where infrastructural facilities are available.
6	10 man hours are required to carry out safe to run.	The man hours required as 40 for Vacuum brake stock EE, 56 for airbrake EE and 100 man hours for CC rake,75 per PEE.

Difference between CC and premium rake examination:

S.N.	CC rake	Premium rake
1	CC rake can only examine at base depot (A,B or C cat. yard).	Base depot is not nominated and can only be examined in “A” cat. Yard and nominated yard.
2	100 % brake power is ensured and BPC is issued on yellow color certificate.	95% brake power is ensured and BPC is issued on green color certificate.
3	It is run on predefined (closed circuit) path only.	It may be run over any route of Indian railway.
4	100 man hours is specified to attend CC examination of standard rake (58 BOXN+ 1 BVZC)	Man hours are not decided. (Proposed 75 man hours)
5	CC rake is preferred to form out of off POH/ROH wagons	Stipulation of off POH/ROH wagons is not applied to premium rakes.
6	Validity of BPC is 4500 km/20 days, 6000kms/30 days or 7500 km/35 days	Validity of BPC is 12 days and a 3 days grace period is allowed for the rake in loaded.(kilometer is not decided)
7	Items (reject table & chargeable) are specified to examine, repair & maintenance.	Items (reject able & chargeable) are not specified for examination and its repair.(Only being examined on EE pattern)

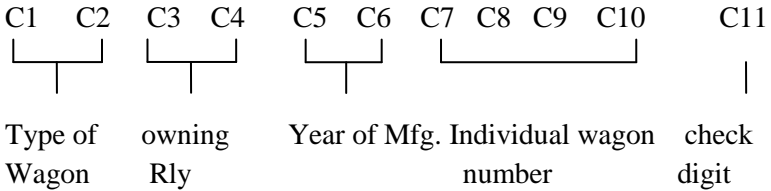
STEPS OF INTENSIVE EXAMINATION:

- a. Rolling in examination including axle box feeling.
- b. Intensive examination of originating train including repairs, detachment of damaged/sick wagons, brake testing etc.
- c. Issue of Intensive Brake Power Certificate after ensuring brake continuity of the formed load.

12. NEW WAGON NUMBERING SYSTEM

The new wagon numbering system is being done as per railway board's instruction issued vide letter vide letter Number. 2000/M(N)/60/2/wagon census dated 4th July 2003.

As per new scheme, the wagon number shall consist of 11 digits. First two digit will indicate types of wagon, next two digits will indicate owning railway, next two digits will indicate year of manufacture, and next four digits will indicate individual wagon number and the last digit will be a check digit. Brief is as under:



Check digit is calculated as under:

$$1. \text{Add all the character in the even number (S 1)} = C2+C4+C6+C8+C10$$

$$2. \text{Multiply S1 by 3} = 3 S1$$

$$3. \text{Add all the character in the odd number (S2)} = C1+C3+C5+C7+C9$$

(Except check digit)

$$4. \text{Add } 3S1 + S2 = S4$$

5.Round this total up to next multiple of 10.

Check digit is the number required to be added to roundup to the next multiple of 10. If the total in S4 is already a multiple of 10, then the check digit will be Zero.

For example let a Wagon has its number as 12030345679

$$S1 = 2+3+3+5+7=20$$

$$3S1 = 20 \times 3 = 60$$

$$S2 = 1+0+0+4+6 = 11$$

Now $3S1+S2$ i.e. $S4=60+11$

$$\text{Or} = 71$$

The next multiple of 10 will 80, to made round figure 80, more 9 is required to be added , hence 9 will be check digit.

The type of wagon and individual railway has unique code issued by railway board.

12.1 ACCIDENT

Any unusual / occurrence in railway which dose or may affect the railway working its engine rolling stock P-Way or its passenger or railway employee or delay to a train is termed as “Railway Accident”.

Classification of Accident:-

Accidents are classified into 16 parts which are following:

- 1) A’ class : Collision : Collisions are of 3 types –
 - Head on collision.

- Side on collision.
- End on collision.

Collision involving a train carrying passenger, resulting in loss of human life & damage to railway property of exceeding Rs. 25 lakhs.

2) 'B' class: Fire In Train

Fire in a train carrying passenger resulting loss of human life & damage to railway property exceeding Rs. 25 lakhs.

3) 'C' class: Level crossing

The road surface meet with railway track on same level is known as 'Level Crossing'. The most causes of accident on turns account as an unmanned level crossing resulting into loss of human life.

4) 'D' class: Derailment

Derailment is of two types – 1) sudden, 2) Gradually.

Derailment of trains carrying passengers resulting in loss of human life.

5) 'E' class : Natural Calamity

Train running over any obstruction including (land slide, flood, & earthquake) fined structure other than resulting in loss of human life or damage in railway property.

6) 'F' class : Averted Collision

Averted collision between trains at least one of which carrying passengers & obstruction.

7) 'G' class : Breach of Block Rules

Train carrying passengers, entering a block section without any authority or entering a wrong line a station.

8) 'H' class : Driver Passing Danger Signal

Train carrying passengers running past a stop signal at danger without proper authority.

9) 'J' class : Rolling Stock Failure

Failure in rolling stock such as failure of tyres, wheels, axles. Etc. on passenger carrying train.

10) 'K' class : Failure of Permanent Way

Buckling of track, weld failure, rail fracture.

11) 'L' class : Failure of Electrical Equipment

Snapping or any damage to OHE wire requiring switching of OHE for more than 3 minutes.

12) 'M' class : Failure of S & T

Failure of block instrument, interlocking, signal, station communication for more than 15 minutes.

13) 'N' class : Train Wrecking

Attempted wrecking of or sabotage to train carrying passengers.

14) 'P' class : Causalities

Person falling out of a running train resulting loss of human life or grievous hurt.

15) 'Q' class : Other Incidents

Murder or suicide in a train, robbery, attempted robbery or attempted theft in railway premises, & blockage to train services due to agitation.

16) 'R' class : Miscellaneous

- i) Train running over cattle
- ii) Floods, breaches & landslides etc., were resulting interruption of an important through line of communication more than the threshold value.

☞ Most serious class 'A'

☞ Least serious class 'R'

☞ I & O is not included

Role of Supervisor at accident site: As per accidental manual following duties would be performed by C & W supervisors at accident site.

- ❖ Protect the site of accident to restrict further movement on that line or yard as the case may be.
- ❖ Ensure that the necessary message regarding the details of the accident and casualties have been relayed to the SS/SM, control and civil authorities.
- ❖ Make first-aid arrangements for the injured persons, if any.
- ❖ Examine and make a note of all evidence which may prove useful in ascertaining the cause of accident.
- ❖ Try to save life and alleviate sufferings. Ensure everything possible is done provide secure to the injured and help to all other passengers.

- ❖ To relay the prima-facie cause of the accident with the expected time of restoration.
- ❖ Seize and freeze all records as laid down in accident manual.
- ❖ Arrange to take photographs from different angles to assist in reconstructing the scene of the accident.
- ❖ Co-ordinate with train crew, station staff and control office for providing relief to the injured and restoration of traffic.
- ❖ Record the statement of the concerned staff available at site for ascertaining the cause of the accident.
- ❖ Take written evidences of as many witnesses as possible in case passenger train is involved. Their names/addresses should be recorded (witnesses should not be from Railways).
- ❖ Ensure relaying the progress report to control after every one hour.
- ❖ Obtain clearance from civil/police before starting restoration in case of sabotage/doubt of sabotage.
- ❖ When a senior officer arrives at the spot, relevant records should be handed over to him and he must be briefed about the situation.
- ❖ If the accident is within station limits, note down the condition of points, fixed signals, position of levers, position of block instrument and SM control.
- ❖ Scrutinize as early as possible the train signal register, reply books, PN book and other relevant records pertaining to the train movement.
- ❖ Make a rough sketch showing the position of derailed vehicles, marks on sleepers etc.
- ❖ To give fit certificate to the accident involve train up to the next examination point towards direction of movement.

Following operating features must be checked while investigating into a derailment:

- ❖ Speed of the train just before the accident.
- ❖ Uneven load/ shifted load – load in all the vehicles must be checked to get an idea of loading and lashing/securing of loads.
- ❖ Application of brakes.
- ❖ Brake power of the train and location of vehicles without brake power.
- ❖ Whether all hand brakes are in released condition.
- ❖ Sudden reversal of points.
- ❖ S&T failure reported before the accident – how and when was it set right?
- ❖ The position of loose components wherever found.
- ❖ Whether the engineering staff was on work.

Wheel marks, points of mount, flange travel mark on the rail, point of drop and other damages to sleepers, rails and other fitting.

12.2 DERAILMENT

Definition: -Derailment means off loading of wheel/wheels causing detention to rolling stock/p.way.

Classification: Derailment classified in ‘D’ class accident. It is further classified as –

- D-1- Derailment of a train carrying passenger resulting loss of human life/Hurt or damage to railway property of the value exceeding Rs.25,00,000/- or interruption of communication for at least 24 hrs.

D-2- Derailment of a train not carrying passenger resulting loss of human life/Hurt or damage to railway property of the value exceeding Rs.25,00,000/- or interruption of communication for at least 24 hrs.

D-3- Derailment of a train not falling under D-1

D-4 - Derailment of a train not falling under D-2

(The loss of the property is more than the threshold value.)

D-5 - Derailment of a train not carrying passenger, not falling either D-2 or D-4

D-6 Other derailments occurring in shunting, marshalling in yard, loco yard and siding but not involving a train.

Categories: There are two broad categories of derailment

I) Sudden derailment – Instant dismounting of wheel from rail

II) Gradual Derailment – Gradual climbing of flange on the rail.

Sudden derailment – When derailing forces are high on a wheel it may suddenly jump off from the rail table and the rolling stock derails. In this case no flange mounting marks are available on the rail table. However the wheel drop marks can be seen on ballast or sleepers.

The possible causes for sudden derailment are –

- (i) Sudden shifting of load
- (ii) Improper loaded vehicle

Gradual Derailment: The forces acting on the rail & wheel contact are

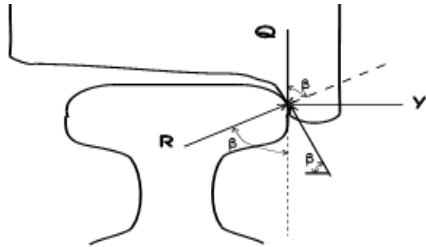
- (i) The weight of the vehicle transmitted by the wheel on the rail which keeps the vehicle on the track
- (ii) When the wheels of the vehicle roll parallel to the rail there is no angularity, when there is positive angularity the conditions creates the chance of derailment.

Derailment Mechanism: Nadal has derived the formulae as follows –

$$Y = R \sin \beta - \mu R \cos \beta$$

$$Q = R \cos \beta + \mu R \sin \beta$$

$$\text{So, } Y/Q \leq \tan \beta - \mu / 1 + \mu \tan \beta$$



FORCES AT RAIL-WHEEL CONTACT

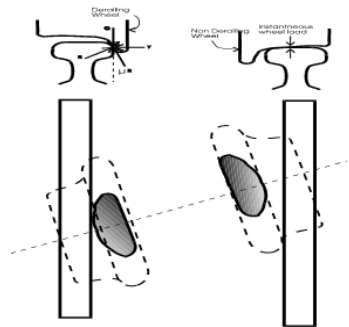
Cause of Derailment: The cause of derailment can be largely classified into following two major categories –

- (i) Equipment failure
- (ii) Human failure

Apart from the above cattle run over, sudden falling of boulders, trees etc. on the track, sinking of track also may be the cause of derailment of rolling stock which do not require thorough investigation.

Derailment occurred due to one or more of the following factors –

- (a) Operational factors
- (b) Track
- (c) Rolling stock
- (d) S&T
- (e) Others



(a) Operational factors:-

Speed – (I) The exceed speed of train creates more lateral forces on the flange there by creating the chances of derailment.

Loading – Excess loading may leads to derailment of a vehicle as the wheel may float off due to excess loading.

Wrong marshalling – Empty stock if marshaled in between two loaded wagon may cause the derailment

Operating –

- i) Improper setting of point during shunting operation
- ii) Undetected obstruction between toe of switch and stock rail
- iii) Improper train operation i.e. sudden application of brake causing bunching and off loading of wheel

12.3 Track Investigation:

(1) If point of mount is known.-the track length should be taken for measurement:- 45 m. In rear side of the point of mount & 45 m in front side of the point of mount.

(2) If point of mount is unknown/ disputed.- 90 m. In rear side of the point of mount & 45 m in front side of the point of mount.

Point of mount :- The first wheel flange climb marks found on rail table is known as point of mount.

If there is more than one point of marks found on rail table

The rear most 1st point of mount mark will be treated as actual point of mount. no any point of mount is found in case of sudden derailment.

Point of drop:- The wheel flange drop marks shown on rail table is known as point of drop.

In case of gradual derailment, the point of mount & point of drop both are found on rail table .but in case of sudden derailment only point of drop is found.

Track parameters which to be recorded

- 1) **Track gauge**:-The distance between two running rails is known as track gauge. the track gauge should be measured 13mm below from the top of the rail.

Track gauge should be :-

(i) on straight track - 1676 ± 6 mm.
(ii) up to 5 degree curve - 1676 ± 15 - 6 mm.

(iii) above 5 degree curve - $1676 + 20$ - 0 mm.

- 2) **Cross level** :- The variation in top level of the both rails on same point on straight track is known as cross

level..cross level is always measured on left rail in reference to right rail as per direction of the train.

Permitted cross level is - 13mm/station.

- 3) **Twist:** The variation in two continuous cross levels is known as twist. or

The algebraic variation in two continuous cross levels is known as twist. It is always measured in mm/m.

For example. ---- if cross level on station is +5mm and on station 2nd is 5mm,

Then twist will be:-

Twist = $(+5) - (-5)/ 3$ or $(+5) + (5)/3 = 10/3$ or 3.3mm/m.

The allowed twist:-

On straight and circular curve - 2.8 mm /m.

On transition curve - 1.0 mm/ m.

A class track (160 KMPH) – 1.37 to 1.41 mm./M

B class track (130 KMPH) – 1.41 to 1.78 mm/M

C class track (100 KMPH) – 1.78 to 2.41 mm/M

D class track (Main Line) – 1.78 to 2.41 mm/M

E class track (Branch line) –2.41 to 2.78 mm/M

- 4) **Cant or super elevation:** To maintain the centre of gravity or to neutralize the effect of centrifugal force, the

outer rail on curve is lifted in respect to inner rail, is known as cant. Or

The lifting of outer rail in reference to inner rail on curve on same point is known as cant or super elevation.

Cant is always measured on outer rail in mm.

The max. Cant allowed in Indian Rly B.G. Is – 165mm.

For A & B class track – 165 mm.

For C, D & E class track – 140 mm

Variation in cant is possible due to :- Cant deficiency or Cant excess.

Max. Cant deficiency permitted – 75mm (gen).

100mm (in spl. case).

Max. Cant excess permitted – 75 mm .

Causes of variation in cant

(1) Due to poor maintenance of track by Engg. Deptt. (excess or low cant)

(2) Due to poor engine man ship by the driver. (Excess or low speed)

The equilibrium cant

$$E = \frac{GV^2}{127R}$$

Where G = 1676+74 mm (gauge + width of the rail)

V = speed in Kmph

R = radius in mtr

5) **VERSINE**

The perpendicular distance drawn at the centre of chord from the mid point of arc is known as versine. Versine is always measured on outer rail in mm.

If the versine is measured on 11.8 mtrs chord basis, the allowed variation in versine is only 10mm. Or if the versine is measured on 20 mtrs chord basis, the allowed variation in versine is only 29 mm. The versine measured on 11.8 mtrs chord in cm, is tells directly the degree of curve.

$$\text{Versine } V = 125 \frac{C^2}{R}$$

Where C = length of chord in mtr.

R = radius in mtr.

Rail defect

6) **HOGGING**:- bending of rail ends at rail joints is known as hogged rail. Allowed max. - 2mm

7) **BATTERING**:- wear of rail ends at rail joints is known as battered rail. Allowed max. - 2mm

8) **RAIL WEAR**

(i) Vertical wear

For B.G. (a) 60 kg rail--- - 13mm

(b) 52---,, ---,,----- 8mm

(c) 90 r ----- 5 mm

(ii) lateral wear

A&B track ---- 8mm

C&D --,----- ----10 mm

(iii) angular wear. – Permitted max. 25 degree

9) UNEVENNESS:- To be measured on 3.6 m Gen Isolated Chords.

Limit --- On long term basis ---6mm - 10mm

On short term basis ---10 mm- 7mm

10) STRAIGHT NESS:- To be measured on 7.2 m chords.

Limit --- On straight track ---5mm-- 10mm

On curved track ---5 mm --7mm

11) CREEP:- Shifting of rail in longitudinal direction due to poor fastening, or due to emergency rake braking or due to skidding of engine wheel.

12) BUCKLING:- Increase of rail length due to effect of temperature.

13) Corrosion

14) Burning.

15) Kink.

16) BALLAST: To provide Cushing & to absorb vibration, ballast are provided.

Types of ballast:-

(1) CUSHION BALLAST: - depth of ballast below the sleeper.

FOR A cat. Track ---300mm

B&C -, ---- 250 mm

D --,, --- 200 mm

E -----,, ----- 150 mm

(2) CRIB BALLAST: - Wet been two sleepers. In the level of sleeper height.

(3) SHOULDER BALLAST: - Heap of the ballast at the end of the sleepers, to minimize the effect of lateral thrust.

Gen. Should not be less than 150 mm.

SIZE & SHAPE OF BALLAST: - In 50mm size with at least 30% sharp edges

17) SLEEPER

ROLE Of SLEEPER: - To hold the rails, distributes the load equally and to maintain the track gauge on prescribed limit.

TYPES Of SLEEPER: - Wooden sleeper, cst-9 , iron sleeper & concrete sleepers. Now a day's max. Concrete sleepers are being utilized .

SLEEPER DENSITY: - Number of sleepers per kms is known as sleeper density.

(1) If track density is more than 10 GMT:-

For A,B,C&D route ----- M+7.

For E ,, ----- M+4

(2) If track density is less than 10 GMT:-

For A,B,C route ----- M+7.

For D & E ,, ----- M+4

Where M is the master length of rail i.e. 13 Mtrs

Means no. of sleepers required in 13 Mtrs length is---13 + 7 = 20

for. ---,, -----,, in 1 Mtr ,,----- 20/13 = 1.540.

so that ,,----- in 1000 Mtrs ,, ----- 1.54x 1000 = 1540.

18) CONDITION OF FASTENERS, & FORMATION: -

During investigation, the condition of fasteners, & formation of track also to be observed for any type of abnormality.

Rolling Stock

During investigation the following parameters of rolling stock to be taken into account

Wheel

Wheel gauge – Wheel gauge to be measured at 4 locations and average OF them will be considered (1600 +2/-1mm.)

Thin flange – A thin flange increase the lateral play between wheel set and track which increases lateral oscillation (y/Q) / Angularity of wheel (Cond.-16 mm for goods,22 mm for coaching stock).

Sharp flange – Due to sharp flange wheel set can take two roads of slightly gaping point. (Cond. limit- 5mm.)

Deep flange – Deep flange of the wheel may hit the fish plate of rail causing derailment (Cond. Limit – 35 mm.)

Hollow tyre – It increases the conicity of the wheel which reduces the critical speed of the rolling stock and increase the lateral force (y)

Flat tyre – It can damage the rail due to successive impact and cause high stresses leading to rail fracture (Cond.- 50mm for coaching stock & 60mm. For goods stock)

Root radius too small – It increases the coefficient of friction between rail & wheel flange which increases the frictional force causing derailment (Cond. limit – 13mm)

Buffer

Height of buffer from rail level should be within 1105 mm. to 1030 mm.

Buffer projection to be within 635mm.– 584 mm.

Condition of buffer / CBC to be noticed for any crack/worn.

Wagon body – If the wagon is in loaded, the condition of consignment to be observed for over loading / uneven loading.

S&T –

- ❖ Improper setting of point during shunting operation
- ❖ Undetected obstruction between toe of switch and stock rail
- ❖ Approaching signal may be indirect cause of bunching and off loading of wheel

Others:

Other derailments occurring in shunting, marshalling yard, loco yard and siding

Notable points :-

- i) Before investigation first of all 1st derailed vehicle and wheel to be decided and point of mount & Point of drop to be marked.
- ii) Track measurement to be taken on loaded condition
- iii) There is no need of measurement in case of train wrecking and sabotage

In any case of derailment, observations to be made jointly by Sr. subordinates of different departments like CWI, SLI TI, PWI and representative of S&T department. A rough sketch of site to be prepared After then they will prepare a joint note mentioning the followings

- | | |
|------------------|-------------------|
| 1. Subject | 4. Conclusion |
| 2. Brief history | 5. Responsibility |
| 3. Observations | |

The joint note will be duly signed by all the nominated subordinates. If any point mentioned in the joint note not agreed by anybody he will submit dissent note by mentioning the logical points and copy of the same will be given to all of the signatories. After getting the dissent note others will submit their rejoinder.

12.4 PURPOSE OF ENQUIRY & TYPES OF ENQUIRY

Any occurrence which does or may affect the safety of the railway, its locomotive, rolling stock, permanent way, passengers or railway servants or which affects safety of others or which does or may cause delay to trains or loss to the railways is termed as accident.

Purpose of an Enquiry:-

- To ascertain cause of an accident.
- To formulate proposals for preventing a reoccurrence.
- To ascertain if any inherent defect in the system of working or in physical appliances such as, track, rolling stock & other working apparatus.
- To ascertain negligence or avoidable delay in relief & restoration.

Need of an Enquiry

- Provision of section 113 of railway act 89.
- Any accident attended with loss of any human life, or with grievous hurt, as defined in the IPC (45 of 1869), or with such serious injuries to property as may be prescribed.
- Any collision between trains of which one is a train carrying passengers.
- The derailment of any trains carrying passengers, are of any part of such train.
- Any accident of a description usually attended with loss of human life or with such grievous hurt as aforesaid or with serious injury to property.
- System working suspected defective.

- Railway staff responsible-prima facie or on police report.
- Cause of accident is not clear.
- On advice of CRS.
- Railway administrations decision.

Types of Enquiry

1. Commission of Enquiry

- Appointed by central government under commission of enquiry act 1952.
- Commission has powers of a civil court.
- Its findings are not binding on govt.
- Such type of enquiry is very rare.

2. Commissioner of Railway Safety Enquiry

- It is an independent agency, constituted under provisions of Section 113 of The Railway Act 1989.
- Such enquiry is obligatory in cases of-
 - i) Loss of human life as defined in IPC.
 - ii) Serious damage to railway property.
 - iii) Accident at unmanned level crossing only if loss of life/ grievous injury of passenger involves.
 - iv) Any other accident-at his discretion.
- CRS can summon and enforce attendance of any person it can examine and receive evidence under oath. It can requisition any public record or copies thereof from.
- CRS ENQUIRY is not obligatory if passenger travelling in the train is not affected and no passengers are hurt at level crossing accident.

- CRS enquiry withheld in case of constitution of commission of enquiry by Central Govt.
- Final report copy is sent to Railway Board, Railway Administration concerned, and Director IB-Ministry of Home. Affairs in case of sabotage.

3. *Magisterial / Judicial Enquiry*

- DM or any other magistrate appointed by state govt. may make an enquiry.
- No enquiry if commission of enquiry or any other authority nominated by central govt.
- Magistrate may order judicial enquiry for trial of any person criminal offence.

4. *Joint Enquiry*

- It can be at SAG, JAG, Sr. scale, Jr Scale or Sr. subordinate level.
- Enquiry committee has representatives from traffic, civil, mechanical, electrical, S&T etc.
- Committee is nominated by DRM/GM Depending upon the level.

Joint enquiry may be dispensed with if:

- a) CRS enquiry is ordered.
- b) Any other agency is appointed by central govt.
- c) There is no reasonable doubt about cause of accident.
- d) Any one of the departments has accepted the responsibility.

In case of c & d above, departmental enquiry is to be held

Proceedings of joint enquiry

- Conduct enquiry proceedings carefully.
- President of enquiry to warn all the witness against the untruthful all false statements.
- Certificate signed by the president to be forwarded with proceedings.
- Simple language in logical order.
- End of statement to be certified as “Read “accepted and correct or” Read”, explained, and accepted as correct.

Documents to be accompanied with proceedings

- Title page and particulars of accidents.
- History of accident.
- Description of the site if the accident.
- Sketch of the site of the accident.
- Findings , and reasons for conclusions
 - clear, brief, and to the point
 - indicate cause of accident, rules violated,
 - staff held responsible
- Note of dissident, if any.
- Reading of track, engine, wagons/ vehicles.
- Recommendation of the enquiry committee.
- Statement of witness with a list, and analysis of evidence.
- Plan of accident site and or other drawing in case of serious accidents.
- List of passenger, railway employee killed or injured.
- List of damages to loco, R/stock, track, OHE,S&T with estimated cost
- Relevant extract from train register log book, station diary, guard rough journal.
- Date of start and finalization of enquiry.
- Photograph of the site of serious accident.

- Note on serious or important discrepancies.
- Bio-data of staff held responsible.
- Relief and restoration.
- All the documents to be signed.

5. *Departmental Enquiry*

The departmental enquiries shall be ordered by DRM. The proceedings of departmental enquiry shall be drawn up in the same form as those prescribed for joint enquiries and the rules in regard to the conduct of joint enquiries shall apply to the conduct of departmental enquiries, in so far as they are applicable.

As per railway board latest instructions, following guidelines should be followed for accident enquiries by railways:-

- (i) All serious accident shall be enquired into by the Commissioner of Railway Safety.
- (ii) In case CRS or CCRS is not in position to inquire into serious accident cases the inquiry shall be done by JA grade inquiry committee with DRM as the accepting authority subject to the review by CSO.
- (iii) All the cases of collision falling under A1 to A4 categories shall be inquired into by committee SAG officers with GM as the accepting authority unless same is being inquired by CRS.
- (iv) All other consequential train accidents except Unmanned Level Crossing Accidents shall inquired into by a committee of JA grade officers and in its absence by branch officers. DRM shall be accepting authorities for these inquiries subject to the review by CSO.

- (v) Consequential Unmanned Level Crossing accidents and all other train accidents shall be inquired into by a committee of Senior Scale or Junior Scale Officers as the decided by respective DRM with DRM as the accepting authority.
- (vi) All yard accidents shall be inquired into by a committee of senior supervisors with Sr. DSO/DSO as accepting authority.
- (vii) All cases of indicative accidents shall be inquired into by a committee of Senior or Junior Scale Officers with DRM as the accepting authority.
- (viii) GM or DRM can have the inquiry conducted by a committee of higher level of officers then the above mentioned levels depending upon the seriousness of the accidents.
- (ix) In accident cases wherein the Inquiry Committee determines responsibility on the State Foreign Railway, the inquiry report should be put up to the PHOD of the concerned department of the railway on which the accident took place through CSO after which such inquiry report shall be accepted by the AGM (instead of DRM). Finalization of Inter Railway DAR cases arising out of such inquiry reports followed up by the PHOD of the concerned department of Railway on which the accident took place. If suitable response is is not received from respondent Railway at GM's level, then the case should be referred to Railway Board.
- (x) All case of equipment failures shall be inquired into by senior Supervisors/Supervisors of respective departments.

- (xi) All inquiries will be ordered by the concerned DRM except for enquiries into collisions as per item (iii) as above wherein GM will order the inquiries.

Schedule of procedure of completion of accident enquiry at zonal railway level

Following target dates have been given by Board of prompt finalization of enquiry:-

Ordering inquiry by DRM/GM

D+1

Commencement of Enquiry

D+3

Submission of Preliminary report

D+7

Acceptance of inquiry report by GM/DRM

D+10

Finalization of inquiry report by CSO/AGM

D+15

Submission of inquiry reports

D+20

Finalization of accident cases

D+90

*D-Date of accident

Time limits prescribed above are the maximum period of time. Railway should make efforts to finalize the enquiry report and

D&AR action as early as possible but not beyond the prescribed time limits.

Preservation of Records

Accidents of class A & B- 5 Years

Accidents of class C - 3 Years

13. ART AND ARME

Introduction: Accidents and Disasters are unpredicted and unavoidable. Indian Railway has its own mechanism to deal with rescue and restoration work during accidents and disaster is ART & ARME.

Accidents: Any unusual which effects the safety and transportation of Railway in form of damaging rolling stock, permanent structure and serious injuries / casualties to the Railway passengers / Railway staff is known as Rail accidents.

Any accidents involving more than 100 injuries should be termed as disasters.

Disasters: Disasters in Railway context is defined as a major accident leading to serious casualties and long duration of interruption of trains.

Disasters caused by Human and equipment failures. i.e.. Collisions, Derailments, Fire, Natural calamities, Sabotages.

13.1 ART- ACCIDENT RELIEF TRAIN

At present there are 174 ARMVs and 184 ARTs stationed at strategic locations over Indian Railway system

CLASSIFICATION OF ART.

- A class
- B class
- C class
- Other types of ART
 - ☞ SPART (Self propelled ART)

☞ Road ART (Modified road vehicle)

Composition of A class ART

1. 140 ton Crane with Match truck.
2. BCNHS (For Engineering and C & W Materials)
3. BRNHS (For Rails & Wheels)
4. RT (Staff car)
5. RT (Officers car)
6. RT (Packing van)
7. RT (Equipment van)
8. RT (HRE & Power van)
9. RT (Crane tool van)

Composition of B class ART

1. BCN (For Engineering and C & W Materials)
2. BRN (For Rails & Wheels)
3. RT (Staff car)
4. RT (Packing van & OHE van)
5. RT (Equipment van)
6. RT (HRE & Power van)
7. RT (Tool van)

Composition of C class ART

RT (Brake down van)

13.2 ARME- Accident Relief Medical Van

Classification of ARME

- 1) **SCALE 1 ARME:** SCALE EQUIPMENTS ARE STORED IN SPECIAL MEDICAL VANS STABLED IN SEPARATE SIDINGS. MEDICAL

VAN (RH), HAVE OPERATION THEATRE & MEDICAL EQUIPMENTS.

AUXILIARY MEDICAL VAN (RHV) HAVE ALL RESCUE EQUIPMENTS I.E. HRD(CUTTING EQUIPMENTS), S & T AND ELECTRICAL EQUIPMENTS.

- 2) **SCALE 2 ARME:** EQUIPMENTS STORED IN SPECIAL ROOMS ON PLATFORMS.

Authorities to order ART & ARME:- CME, CMPE, Sr.DME, DME

Codes for accident alarm siren / hooter

- Two hooters each of 45 seconds duration with 5 sec. interval indicate ART required at home stations.
- Three hooters each of 45 sec duration with 5 sec. interval indicate ART required at out station.
- Four hooters each of 45 seconds duration with 5 sec. interval indicate ART& ARME required at home station.
- Five hooters each of 45 seconds duration with 5 sec. interval indicate ART & ARME required at out stations.
- One long hooter of 90 seconds duration indicate cancellation of ART & ARME.

TURN OUT TIME & SPEED

- | | |
|------------------------------------------|-------------|
| ✓ Turn out time of ART in day | 30 minutes. |
| ✓ Turn out time of ART at night | 45 minutes |
| ✓ Turn out time of ARME with double exit | 15 minutes. |
| ✓ Turn out time of ARME with single exit | 20 minutes. |

List of tools & equipments on class A & B ART

- 1) Generator & electrical equipments
- 2) illumination
- 3) Oxy cutting equipments
- 4) Compressor pneumatic tools
- 5) Hydraulic Re railing equipments
- 6) Jacks
- 7) Wire ropes, slings & shackles
- 8) Chains, slings & wooden packing
- 9) Other mechanical equipments
- 10) Fitters tools
- 11) Blacksmith tool
- 12) Measuring instruments
- 13) Oil & grease
- 14) Locomotive spare parts
- 15) C & W spare parts
- 16) Engineering tools
- 17) Fire fighting equipments
- 18) Medical equipments
- 19) S&T equipments
- 20) Books & Manuals
- 21) Records
- 22) Camera & Videography

SPEED

Existing speed of ART	- 75 kmph
Proposed speed of ART	- 100 kmp
Existing speed of ARME	-100 kmph
Proposed speed of ARME	-140 kmph

140 T CRANE

- 140 ton crane is available with A class ART
- There are two types of 140 T crane in IR
 1. Jessop
 2. Gotwal
- All cranes are self propelled at a speed of 30 kmph.

Books & Manuals Req'd. in ART

- 1) Transportation manual
- 2) Accident manual
- 3) G & S R
- 4) IRCA part 3 & part 4
- 5) Telegraph code book
- 6) First aid manual
- 7) Safety first instruction book
- 8) Rules for working of crane
- 9) Working time table.

Sequence of Movement Of ART & ARME To The Accident Site

- ✓ ARME
- ✓ ARME from the other end
- ✓ ART
- ✓ ART from the other end
- ✓ Additional brake down special
- ✓ Special train carrying GM & other officers
- ✓ Unaffected portion of accident involved train if possible
- ✓ Empty coaching special for clearing passengers.

Duties of Mechanical Dept.

1. Ensure marshalling of ART according to site requirement before moving to accident site.
2. Ensure OHE power supply switched off before commissioning rescue/restoration work.
3. Toppling those coaches whose searches has been completed.
4. In case of suspected sabotage, ensure minimum interference to clues.
5. .Extricating injured passengers and dead bodies from coaches.
6. Take assistance from other dept.
7. Maximum number of coaches to be tackled simultaneously.
8. Road crane to be arranged to assist 140T crane.
9. Examined unaffected and re railed rolling stock and certify their fitness for further movements.

IRCA- INDIAN RAILWAY CONFRENCE ASSOCIATION

- ☞ HEAD QUARTER- DRM Building New Delhi
- ☞ WORKING: Under Rly Board(Member Traffic)
- ☞ ADMINISTRATIVE CONTROL-GM/Northern Rly
- ☞ HEAD: General Secretary (Traffic /Commercial Deptt.).

AIM:

- ✓ To upgrade the maintenance quality of rolling stock (carriage & wagon).
- ✓ Rate fixing and preparation of passenger ticket and goods charges.
- ✓ To dissolve the operational dispute between two interchanging point.
- ✓ Pre & final examination during POH & ROH to be carried out by neutral TXR (IRCA) and final fit memo to be issued to the concerning officer of the w/shop or sick line.
- ✓ Repair cost during POH & ROH & Other repair of carriage & wagon to be assess & repair cost sent to railway board.
- ✓ Suggestion and rake assessment of amount paid by commercial department. On account of railway claim to be service time to time and proposal sent to railway.

WORK:

- ✓ Mechanical deptt. : Final fitness of off POH / NPOH, off ROH & other wagon lying in sick line for miscellaneous defects to be issued by IRCA men i.e. NTXR.
- ✓ Operating deptt. To dissolve the operational dispute between two railways, preparation of time table etc.
- ✓ Commercial deptt: Rate fixing & preparation of passenger ticket & goods stock.
- ✓ Accounts: Accountant assessment of the expenditure to be checked by IRCA.

Mechanical Deptt. Concern: IRCA gives out the rules for the standards condemning sizes of various components used on rolling stock. They also give the guidelines for the maintenance of rolling stock in workshop and in open line. The rule books used for the carriage & wagon issued for the carriage & wagon branch of mechanical deptt. are: part III for wagon stock & part IV for coaching stock .

IRCA part III & part IV contain 4 chapters

Chapter Details

Chapter I	Definitions
Chapter II	Workshop repair practice
Chapter III	Maintenance practice in open line
Chapter IV	Rejection Rules

Rejectable defect in coaching stock

As per IRCA. Rule book part iv, chapter iv rejections are given from Rule No. 4.0-4.25.2:-

(4.1) Coaching stock must not be allowed with any chargeable, reject able and any other defects from work shop.

(4.2) Maintenance depots shall ensure the maintenance procedure givens in chapter II and III and No any reject able defects is allowed.

(4.3) Notwithstanding any provisions in the rules, coaching stock must not be allowed to run if in the opinion of a Train Examiner, it is in such a condition as if may cause an accident.

(4.4) Coaching stock must not be allowed with any defects having 'S' marks for Guidance of staff concern.

Example:- Axle Box Defects;

- Axle box lug/wing broken.
- 'S' - Hot box;
- Over due oiling
- Due repacking.
- 'S' - Axle guard defects;
Axle guard bridle bar crack, deficient , broken.
- Hydraulic dash pots broken
- Body defects; door bent
- Alarm chain damaged/deficient.
- Brake gear defects;
- Brake gear fitting deficient.
- Brake gear (Air brake system)-Any defects in brake system;
- 'S' - Any buffer dead.
- Draft gear + Coupling;

- 'S' - Draw bar, hook draft hook broken
- Draft gear + buffing in EMU;
- Infringement of O.D.C
- Trolley frame defects;
- 'S' - Bolster spring plank broken.
- Spring gear;
- Shifted more than 13mm
- Tyre defects
- 'S' - loose tyre
- Wheel defects
- 'S' - thin tyre, sharp flange etc
- Under frame defects
- crack or bent
- 'S' - Under slung tank suspension bracket broken
- 'S' - Buffer Height Variation more than 64 mm on same end
- 'S' - Axle Pulley Loose.
- 'S' - Brake Block Deficient. or excessive worn
- 'S' - Foot Board, Hand Hold deficient
- 'S' - Any Buffer Dead
- 'S' - Wheel Shifted on Axle