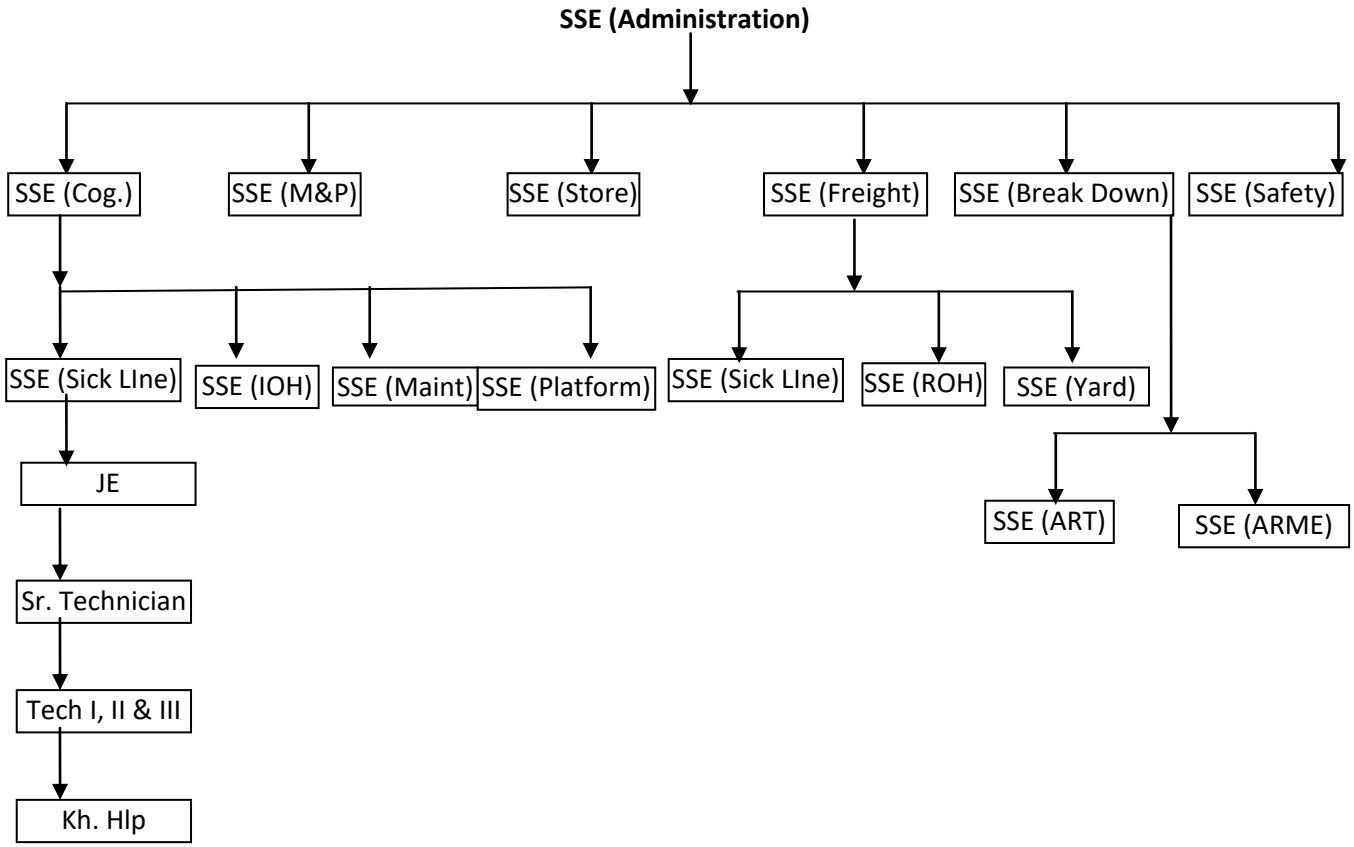
Supervisors Training Centre,
South Central Railway

COACHING THEORY (MCT – 06)

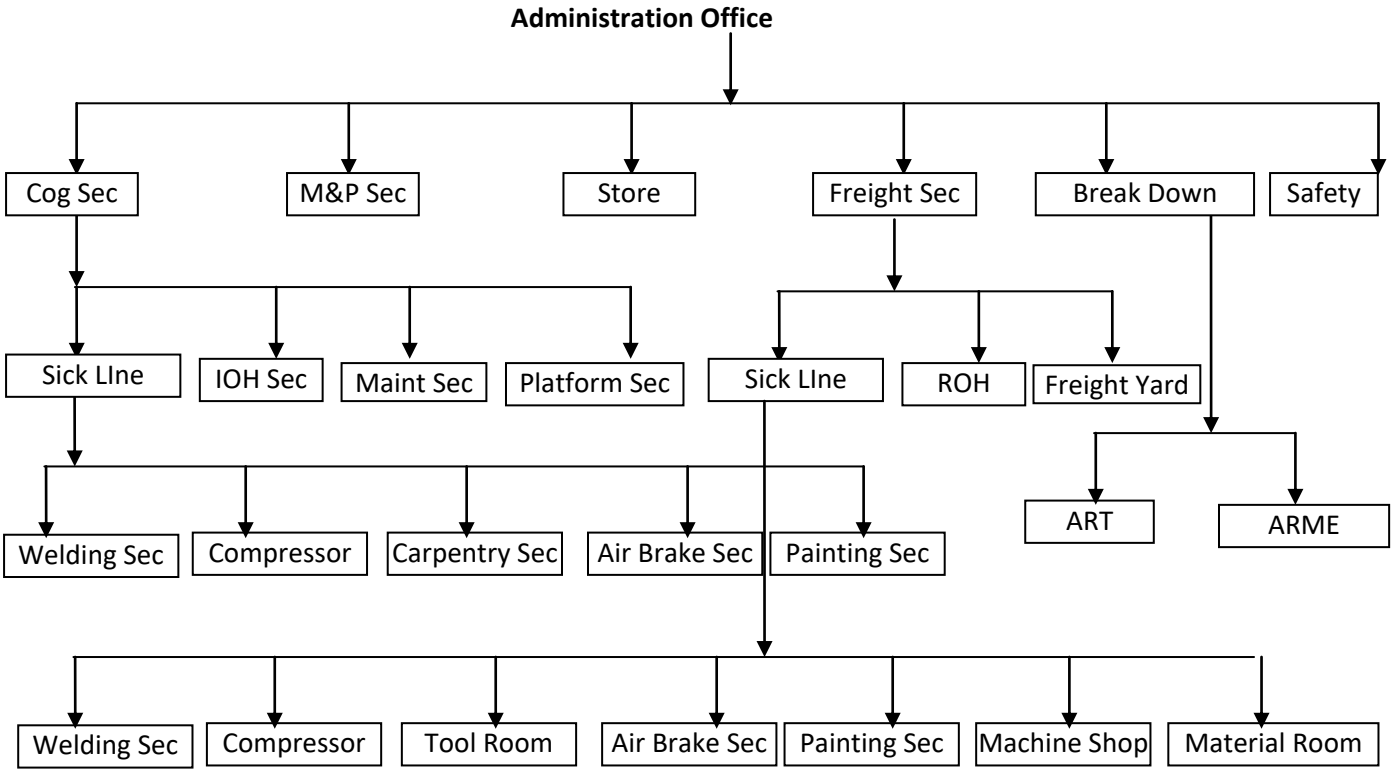
September 2017

INDEX

1. Overview of C&W Organization

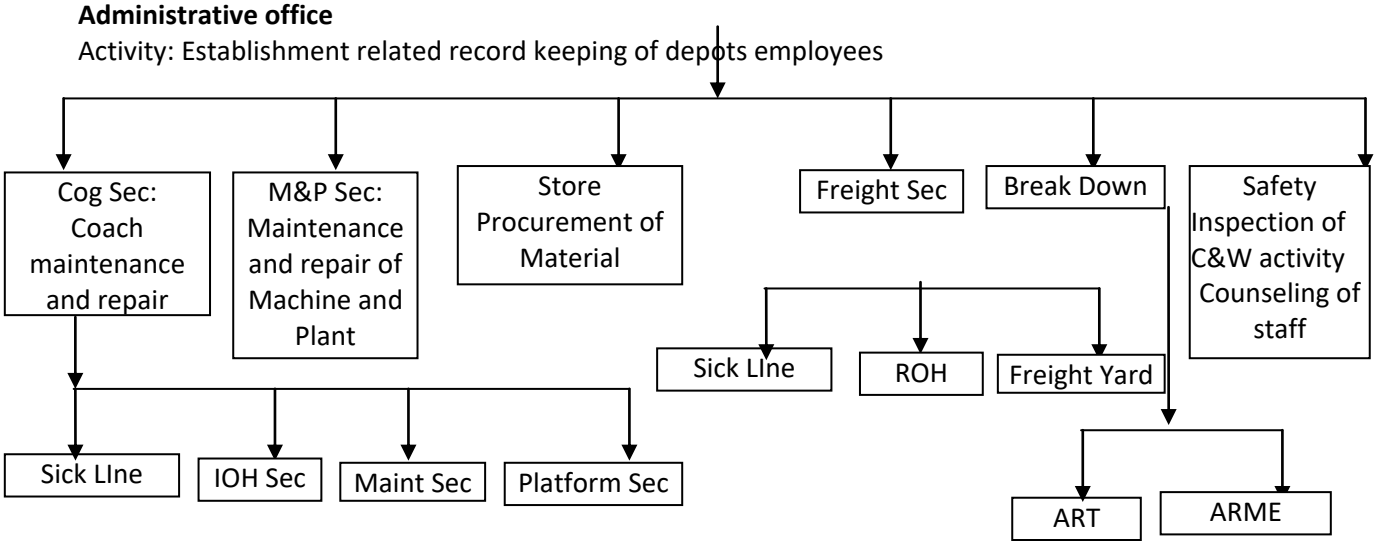


1.1. Layout of C&W Depot



1.2. C&W depot activity section wise:

Administrative office
Activity: Establishment related record keeping of depots employees



Coaching Section Activities
Sick Line Activity: Repair of unfit coaches
IOH section Activity: IOH of due / overdue coaches
Maintenance section Activity: Maintenance of primary / secondary depot based rakes.
Platform Activity:

1. Examination of through passing, terminating and origination trains.
2. Carriage watering of through passing trains
3. CTS of through passing trains
4. Trouble shooting of through passing trains
5. Any passenger complaints

Freight Section Activities
Sick Line Activity: Repair of unfit wagons
ROH section Activity: ROH of due / overdue wagons
Freight Yard Activity: Examination of freight trains (Intensive / CC / Premium)

Breakdown Section Activities
ART:

1. Maintenance of breakdown train including 140 T crane
2. Restoration work at site of accident

ARME:

1. Maintenance of Medical Van
2. Relief and Rescue operation at accident site.

1.3. Role of C&W depot

1. To maintain punctuality of trains
2. To ensure safe running of trains
3. To minimize sick marking / detachment and control of ineffective
4. Image building of Railway by providing passenger facilities i.e. Carriage watering, linen in AC coaches, cleanliness of coaches through CTS / OBHS and mechanized cleaning, Pest and Rodent control of coaches,
5. For attending en-route passenger complaint.
6. To avoid running of due / overdue IOH / POH / ROH coaches / wagons in train service.
7. To manage relief and rescue operation and restoration at the site of accident.
8. To ensure implementation of instruction regarding maintenance of coaches / wagons time to time issued by Railway Board / RDSO / Zonal HQ.

Objective of C&W depots:- Indian Railway is divided into 17 zones and each zone is divided into different division and each division is again divided into different depots At zonal level mech. Dept. is headed by CME and division level headed by Sr. DME (C&W) At division level following activities are being handled by C&W open line department.

i) To ensure maintenance and repair of carriage and wagon stock and to keep it in operational condition by providing following attention
   a) Examination of originating trains at maintenance depot and examination yards
   b) Examination of terminating trains at examination yards.
   c) Examination of through passing trains at examination yards/ station.
   d) ROH / IOH of wagon/ coach at maintenance depot.

ii) To ensure customer satisfactionby providing:-
   (a) Clean Train station services (CTS)
   (b) on board house services (OBHS).
   (c) Auto mechanized cleaning of coaches
   (d) Carriage watering of coaches.
   (e) Amenities and safety fittings in passenger coaches.
   (f) to ensure supply of superior and cleaned quality linen to the AC coaches passenger.

iii) To ensure implementation of instruction and modification regarding rolling stock, time to time issued by Rly Bd. and RDSO.

iv) To minimize ineffective of rolling stock by conducting :-
   (a) Periodical examination/maintenance at examination yard and maintenance siding.
   (b) By conducting rolling in and rolling out examination at intermediate C&W examination point.
   (c) To avoid non standard fitting/material.
   (d) To attend POH of rolling stock at nominated workshop.
   (e) Avoid to run due and overdue POH stock on train service.

2. Design & construction of Coaches

2.1 Types Of Coaches

1) ICF: - Integral Coach Factory. (Perambur, Chennai) & Rail Coach Factory, Kapurthala (Punjab)

2)**LHB COACHES:** LHB body with FIAT bogie (LinkeHolfmann Busch – German):-
Maximum Permissible Speed 160 kmph

3) **Hybrid Coach:** LHB Body on Modified ICF Bogie – Running in same of the Durontorake.

Dimensions of Coach Shell –

	ICF	**LHB/ HYBRID**
Length Over Buffer	22296 (mm)	24000 (mm)
Length Over Head Stock	21336 (mm)	23540 (mm)
Width	3245 (mm)	3030 (mm)
Height From Rail Level	3886 (old) 4025 (new) (mm)	4025 (mm)
Codal Life	25 (Years)	30 (Years)

MAIN COMPONENTS OF ICF BOGIE

UNDERFRAME:-

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

PRIMARY SUSPENSION:-

i) Lower Spring seat
ii) Axle Box Spring
iii) 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

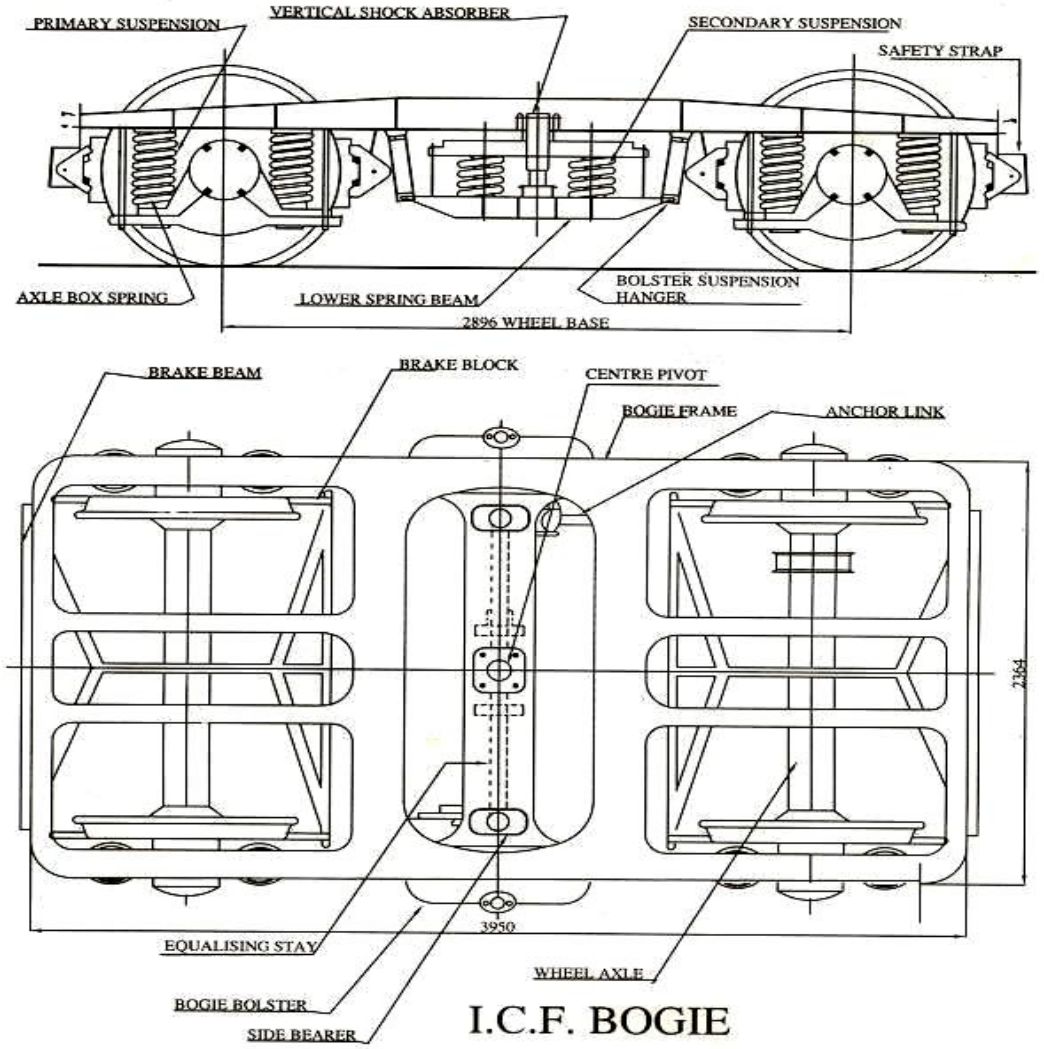
SECONDARY SUSPENSION:-

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 SALIENT FEATURES OF ICF A/C (ALL COIL) BOGIE



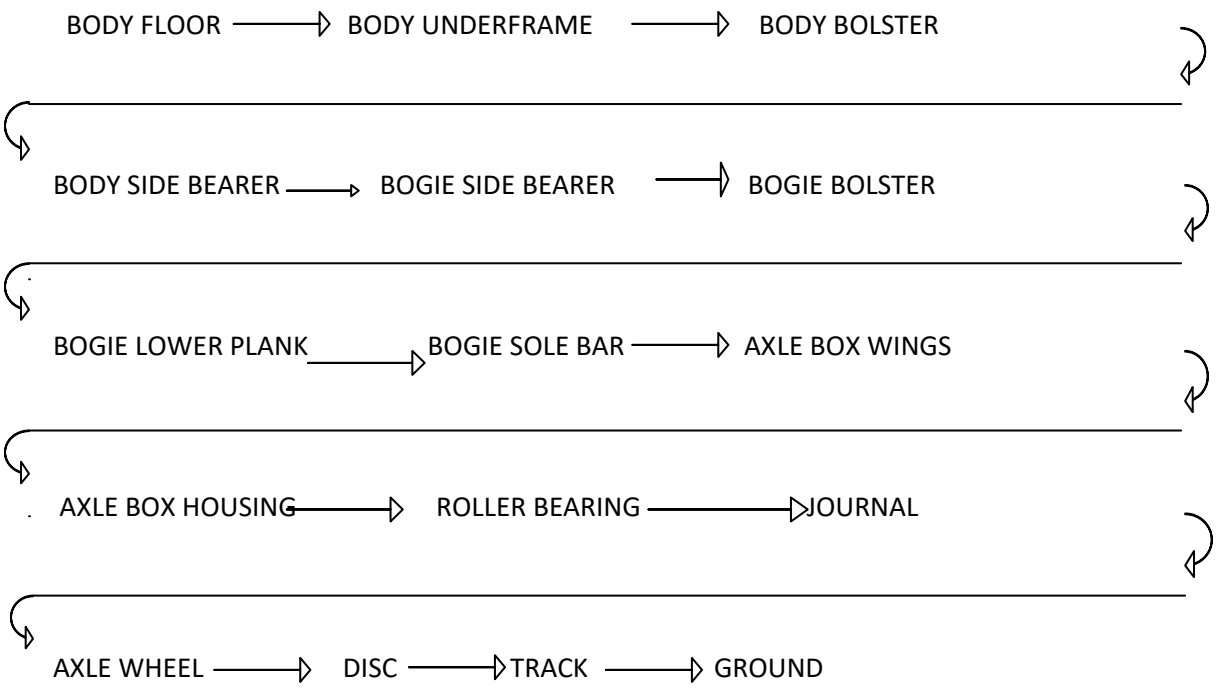
1) Bogie is designed to run on Indian Broad Gauge Track (1676 mm).
2) Provision of coil spring at primary & secondary suspension so that bogie is known as All Coil Bogie.
3) Bogie Head Stock is provided with pressed T- section and sole bar is with pressed I-section, but at the location of link brackets it is in box section.
4) Transom – Previously it was in C-section but now a days 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 center 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 - 837 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:-

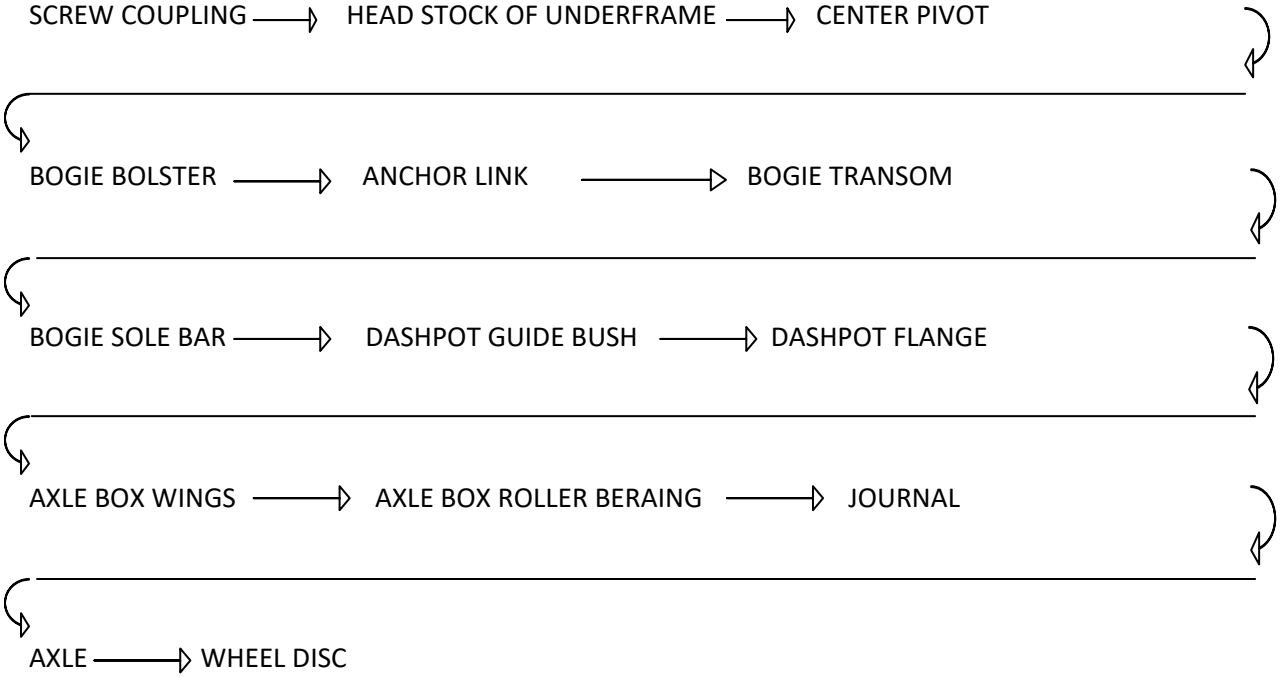
a) 'A' Clearance: - For 13 T – 43 +0/-3 mm, For 16 T – 27 +0/-3 mm
   It is a clearance to be provided between axle box crown & safety bolt.
b) 'B' Clearance: - It is a clearance to be provided between bolster top & bottom of sole bar that should be 40 +/- 5 mm to all type of bogie.

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.)

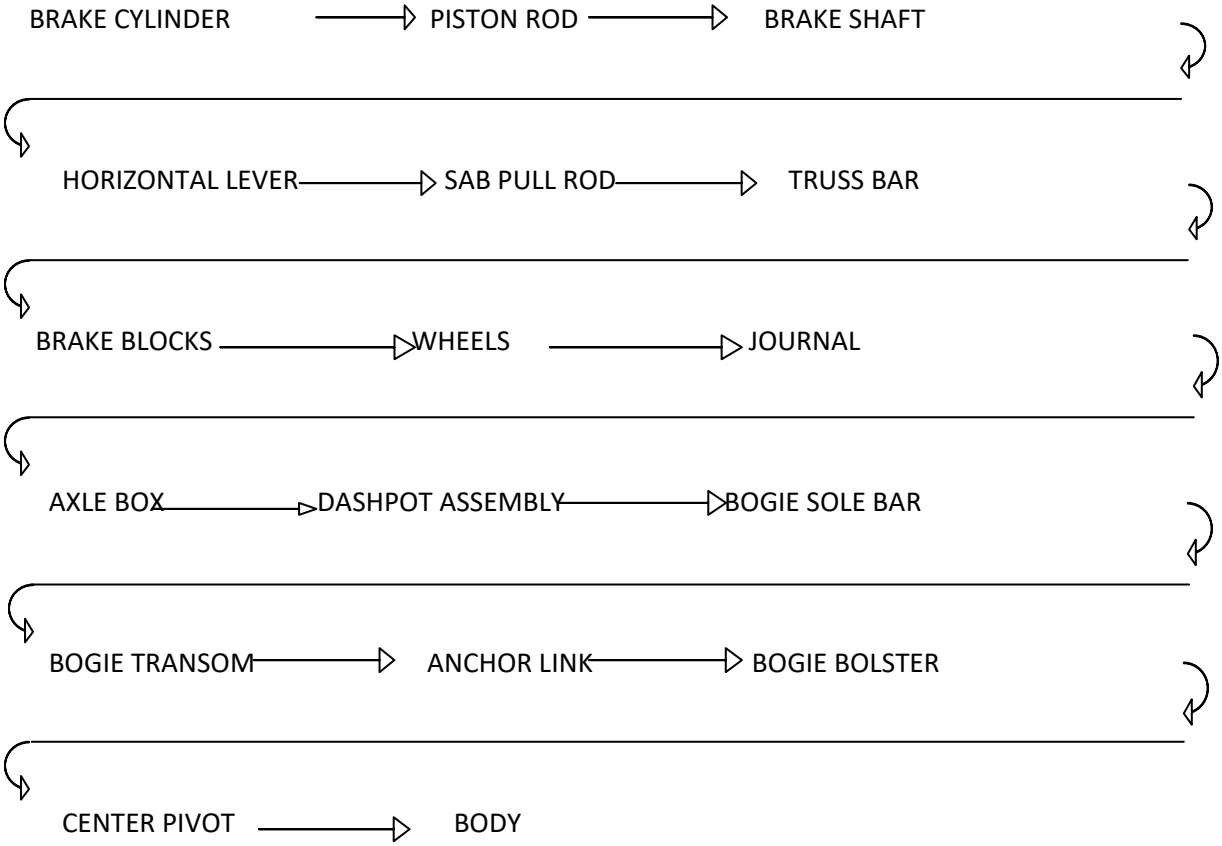
LOAD TRANSMISSION OF ICF COACH



DRAFT FORCE TRANSMISSION OF ICF COACH

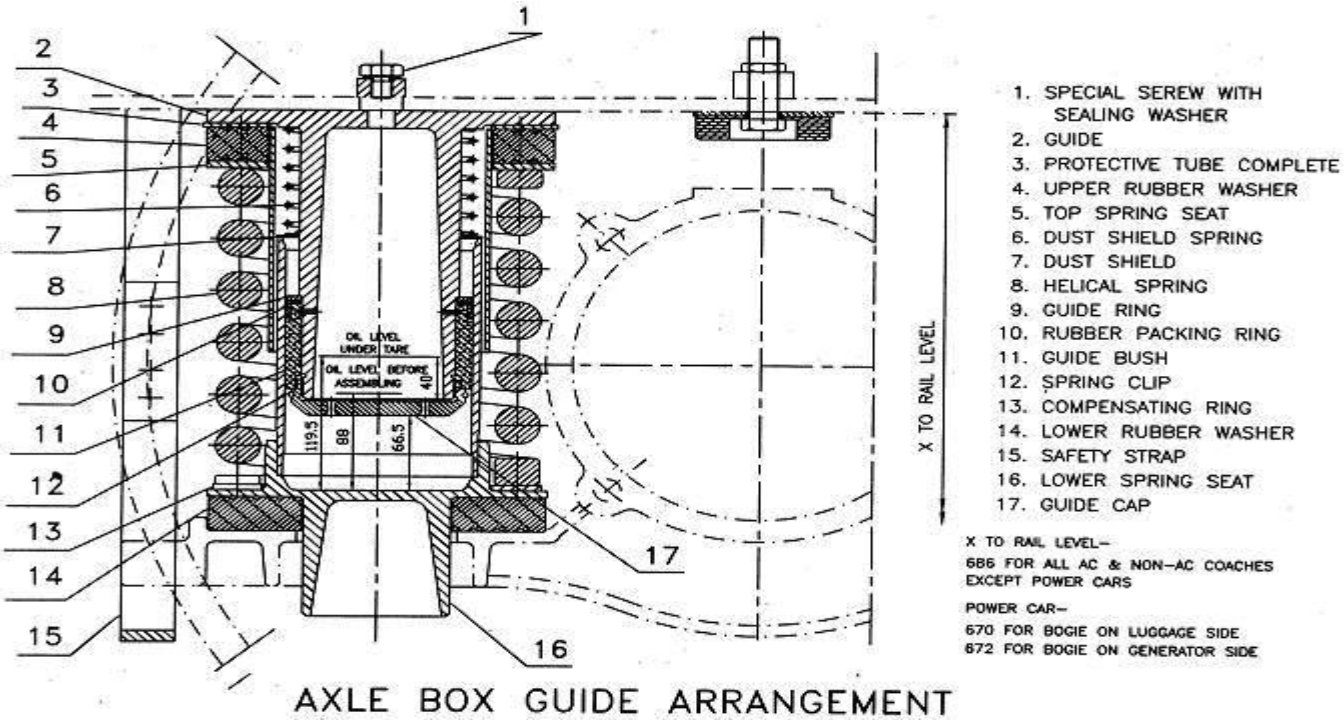


BRAKING FORCE TRANSMISSION OF ICF BOGIE TO BODY



1. AXLE BOX GUIDE WITH DASH POT 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



AXLE BOX GUIDE ARRANGEMENT

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 better 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 to achieve **40 mm** oil level above the guide cap in modified arrangement is approximately **1.6 liters** and in unmodified arrangement is approximately **1.4 liters**. As it is not possible in open line to distinguish between modified and unmodified arrangements, **40 mm** oil level is standardized for both.

Common Defects Found In Axle Guide Assembly, Causes And Their Remedial Action :

SN	Defect	Reasons	Remedies
1.	Perished rubber packing ring.	Poor quality of rubber packing ring	1. Replace rubber packing ring at every examination. 2. 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.	1. Maintain difference in wheel diameters on same axle within 0.5 mm. Use wheel diameter gauge with minimum 0.2 mm accuracy. 2. Level the coach. 3. The squareness and alignment of axle box

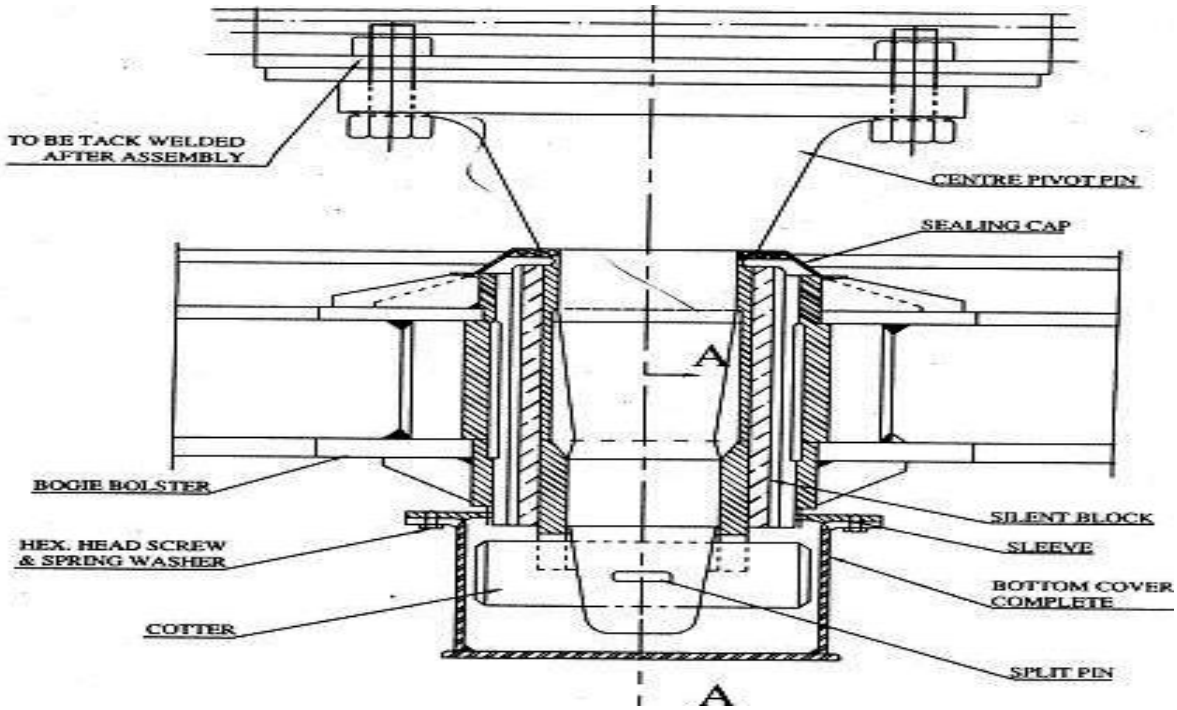
			guides should be checked with alignment gauges and corrected. 4. Vent holes should be sealed with gaskets screw tightened well after topping.
3.	Axle box springs rubber upper spring seat (protective tube)	-do-	-do-
4.	Guide bush worn.	-do-	-do-
5.	Lower spring seat surface worn.	-do-	-do-
6.	Guide ring broken	Axle guide is hitting lower spring seat. Weld joint of lower spring seat and tube is porous or cracked.	1. Guide securing bolt should not project out of guide cap. 2. Use good quality upper and lower rubber washers and correct number of compensating rings in the axle box guide assembly. 3. Adjust ABC clearance on leveled track. 4. Strip and re-weld lower spring seat correctly.
7.	Broken/distorted spring clip of guide cap.	-do-	-do-
8.	Guide cap securing assembly broken.	-do-	-do-
9.	Lower spring seat scored and dent mark on guide cap.	-do-	-do-
10.	Dust shield spring broken/distorted.	-do-	-do-
11.	Dust shield twisted or damaged.	-do-	-do-
12.	Guide threads damaged.	-do-	-do-
13.	Leakage from lower	-do-	-do-

2. **<u>Air Vent Screws</u>:** 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.

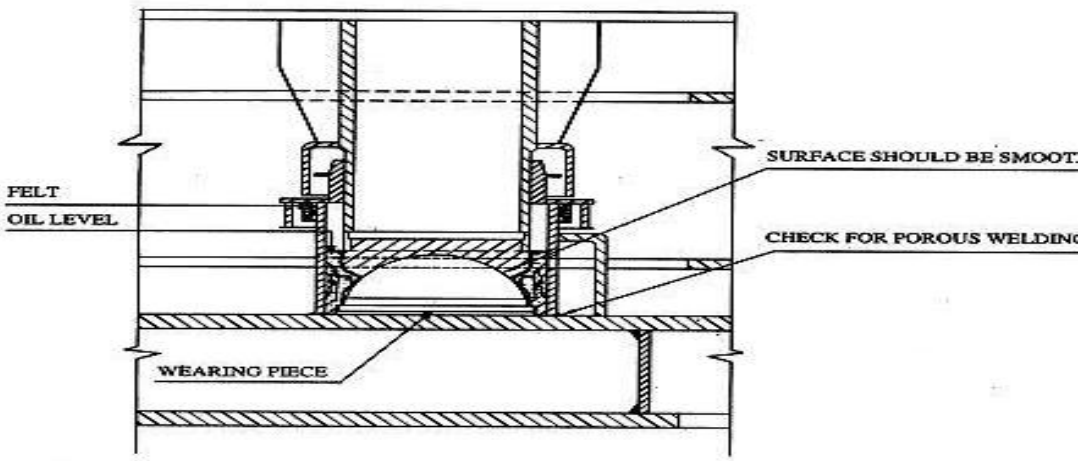
3. **Bogie Bolster Suspension:** The bolster rests on the bolster coil springs - two at each end, located on the lower spring beam which is suspended from the bogie side frame by means of bolster-spring-suspension (BSS) hangers on either side. The two anchor links diagonally positioned are provided with silent block bushes. The links prevent any relative movement between the bogie frame and coach body.

4. **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.

5. **Centre pivot arrangement:**
The centre pivot pin joins the body with the bogie and transmits the tractive and braking forces on the bogies. 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.

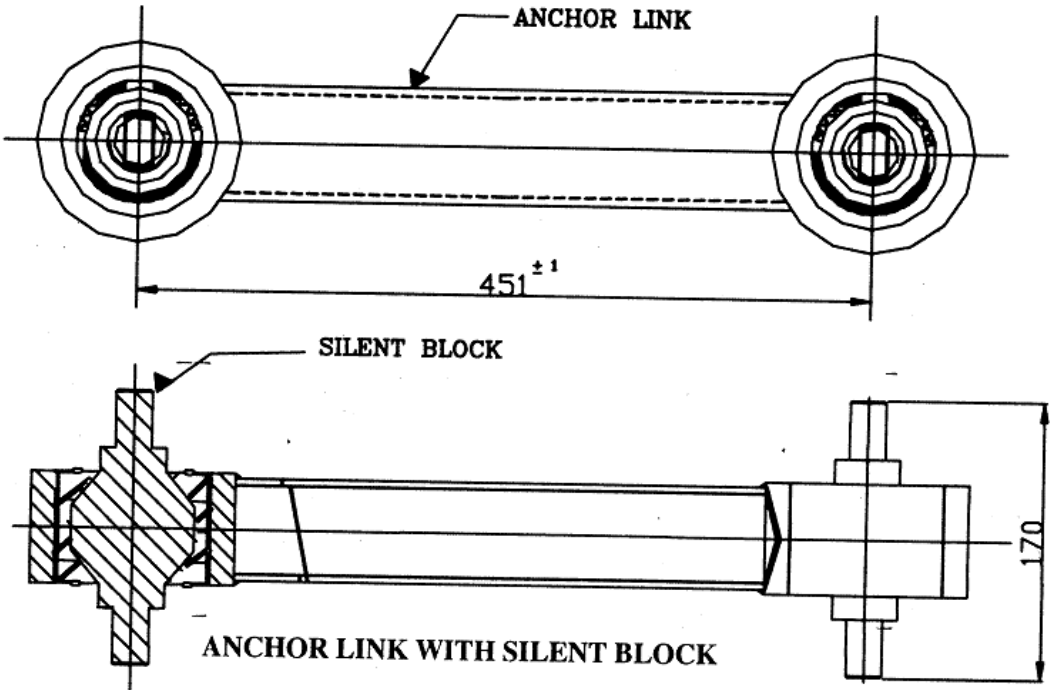


6. **Side Bearers:**
The side bearer arrangement consists of a machined steel wearing plate immersed in an oil bath and a floating bronze-wearing piece with a spherical top surface kept in it, on both sides of the bogie bolster. The coach body rests on the top spherical surface of these bronze-wearing pieces through the corresponding attachments on 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

7. **Anchor Link:** 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 across. The links can swivel universally to permit the bolster to rise and fall and sway side wards. They are designed to take the tractive and braking forces. The anchor links are fitted with silent block bushes



ANCHOR LINK WITH SILENT BLOCK

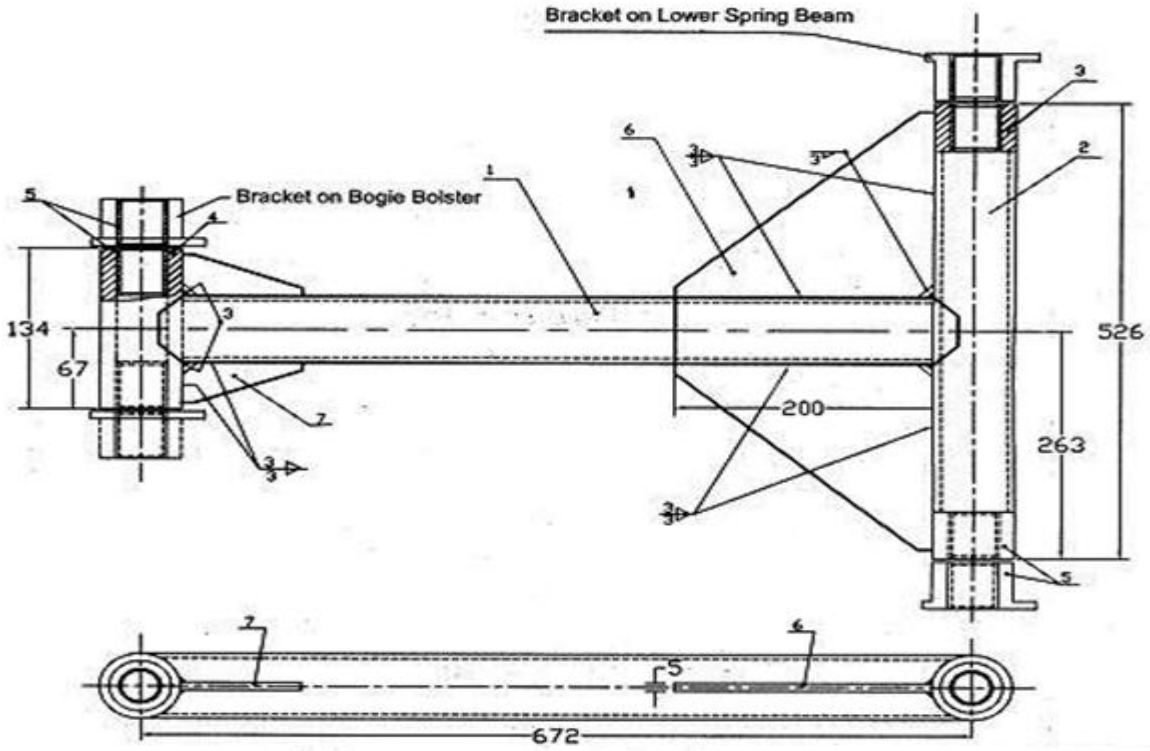
8. **Silent Block:** This is a synthetic rubber bush fitted in anchor link and center pivot of ICF bogies to transmit force without shock and reduce noise.

9. **Brake Rigging:** Brake rigging is provided to control the speed of the coach by transferring the braking force from the brake cylinder to the wheel tread. Brake rigging can be divided into two groups i.e. Bogie mounted brake rigging and coach under frame mounted brake rigging.

A. **<u>Coach Under Frame Mounted Brake Rigging</u>:** In 16.25 t axle load bogie the four lever 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**

B. **<u>Bogie Mounted Brake Rigging</u>:** 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

10. **<u>Equalizing Stays</u>:** This device has been provided on bogies between the lower spring plank and the bolster to prevent lateral thrust on the bolster springs which have not been designed to take the lateral forces. These links have pin connections at both ends and, therefore, can swivel freely.



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

11. **<u>Bolster Spring Suspension (BSS) Hangers</u>:** 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.

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

2.3 LIFTING OF THE BODY FROM THE BOGIE:-

A) <u>Required Tools &Equipments</u>:-

a) With the use of 4 no. of Mechanical Jacks (having capacity of 10 T each) OR

b) With the use of 4 no. of Hydraulic jacks (Having capacity of 10 Ton each) OR

c) With the use of 02 no. of Electrical operated Traveling Crane (having capacity of 20 T/25 T each)

d) With the use of 4 no. of Whiting jacks (having capacity of 20/25 T each)

B) **<u>Other Tools:-</u>**

a) Complete set of Spanners.

b) Different types of hammers.

c) Wooden Wedges & Packing.

d) Trestles.

e) Complete set of Gas cutting & welding equipment.

f) Tool kit

C) <u>Items to be disconnected before lifting of a body</u>:-

1) a) Removal of centre pivot cotter [If lifting is being done by E.O.T cranes or whiting jacks].

b) Removal of Unscrewing of centre pivot studs [If lifting is being done be mechanical/hydraulic jacks]

2) Unscrewing of air vent screw of dash pot.

3) Disconnection of Dynamo belt.

4) Disconnection of S.A.B pull rod.

5) Disconnection of lateral shock absorber if connected

6) Disconnection of axle box safety loops.

7) Disconnection of commode chute if infringing.

8) Disconnection of foot board.

9) Disconnection of dummy carrier if infringing.

10) Inserting required thickness of wooden packing between upper portion bolster & sole bar.

<u>Buffer Height Adjustment:</u>causes of low buffer height in ICF coaching stock

a) excessive wear of wheel (circumference)
b) Due to loss of proper stiffness of coil spring provided on primary and secondary suspension.
c) Due to excessive wear on side bearer's metal & bronze piece.

Piece	New size	Condemning size
Steel	10 mm	8.5 mm
Bronze	45 mm	42 mm

d) Due to excessive wear on link brackets, stone & pin provided on secondary suspension arrangement.

- Maximum buffer height = 1105 mm [In empty condition]
- Minimum buffer height = 1030 mm [In loaded condition]
- Minimum buffer height of coaching stock should not be less than 1090 mm at the time of releasing of coach from POH Workshop.

Procedure to achieve buffer height for ICF coaches.

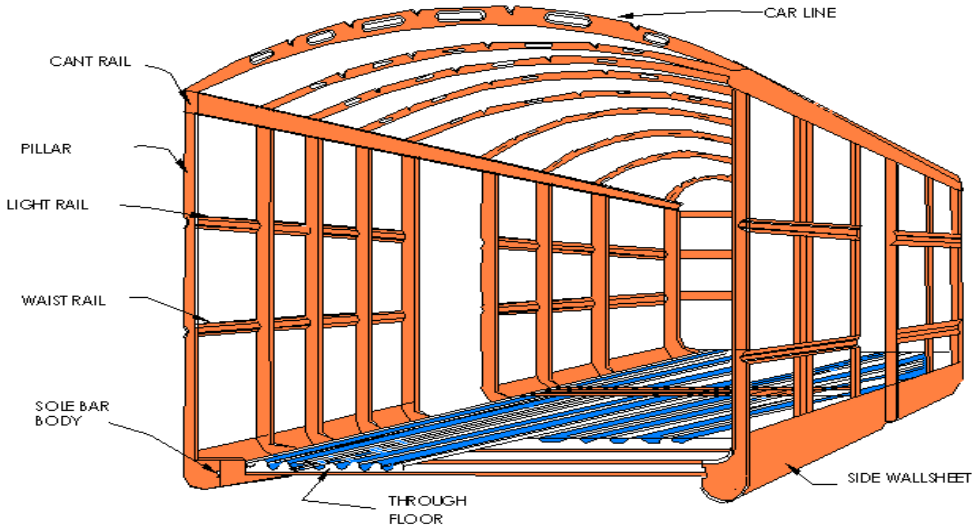
- To achieve buffer height a standard size of wooden packing pieces are used which are kept below the coil springs of primary suspension.
- New Wheel dia. :- 915 mm
- Condemning :- Solid Wheel: 825 mm.

SN	Wheel Diameter (mm)	Thickness of Wooden Packing (mm)
1.	Below 889 up to 863	13
2.	Below 863 up to 839	26
3.	Below 839 up to 825	38
4.	Below 825	48

Note:-

1) If required 6 mm compensating metallic ring can also be used. If further required wooden packing in half's can be utilized in 8 mm & 12 mm thickness but, it should be ensured that total thickness of wooden half packing + compensating ring should not be more than 20 mm.
2) Gap between axle box lug & safety loop also should not to be less than 40 mm.
3) Running clearances i.e. 'A' & 'B' also should be ensured.

ICF COACH SHELL / BODY



Salient Features of ICF Coach Shell / Body

1. **All Metal:-**ICF coach shell is made up of steel channels frames of thin sections except the seats & luggage bunks which are made up of wooden members.

2. **Light Weight:-**The weight of coach shell is reduced due to less use of wooden members. Anti CorrosiveCorten Steel (IRSM 41) is used for body fabrication purpose. As thickness of roof shell is 1.6 mm, corrugated floor side panel & end panel is only 2 mm. The use of gusset plate, knee & rivets are also avoided in under frame. Hence weight of ICF shell is reduced by 26% to 32% in respect to weight of IRS coach shell which was used in the past.

3. **Integral Construction:-**The shell of ICF coach is made with frame, Body side pillars, roof carlines, doors & windows, waist rail, light rail & cant rail are welded together with sole bar through side pillars. 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 paneling work. This type of structure gives the integral construction of coach body which forms the big tubular hollow construction which is light in weight**.**

4. **Anti telescopic construction:-**The shell of ICF Coach is designed to bear 45 tones of vertical load and 200 tones of longitudinal impact on side buffers. The coach body so designed that it is more strengthen at end portion as well as in passenger seating portion and less at the gallery portion. Due to which maximum kinetic energy can be absorbed by the end portion as get damaged during accident and rest kinetic energy also can be shared by corrugated flooring and other members of body shell, resulted passenger accommodation area of middle portion of shell is safe in view of damaging.

   With the result of these properties of shell entering of end portion of one coach shell is avoided to in adjacent coach body shell. For that shell construction is known as anti telescopic construction.

5. **Stress Skin Construction:-**The construction of the body shell in the end at side panel is multi point tag welded. As side panel is welded at waist rail, light rail, cant rail and car lines by means of CO_2 welding provided at perfect distance. 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 during run.

6. **Aerodynamic shell:-** To minimize air resistance during running , the shell body is specially constructed, the roof and turn under are made up in curved shape which minimize air resistance at high speeds.

7. **Anti corrosive:-**To achieve anti corrosive property Corten steel **IRSM - 41** (max at turn under and lavatory portions) is being utilized for paneling purpose. At the time of manufacturing sand blasting, grit blasting is also given on panel sheet which is helpful to prepare rough surface for painting resulted less chances of corrosion. Three coats of bituminous anti-corrosive paints are also given at welded portion and for other portion red- oxides paint is applied, for anti-corrosive treatment. Holes in trough flooring are also given for proper drainage of water. Especially 200 x 135 mm size elliptical holes are given in turn under portion for proper drainage of rubbish water coming from window shell. With the help of these facilities and precaution corrosion probabilities can be minimized. 19 mm thick ply or 12 mm thick compregue ply and 2.00 mm thick PVC flooring is utilized.

8. **Heat resistance :-**

   To develop heat resistance property in coach shell following precaution or facilities has been provided:-

   a) Silver / aluminum paint coat is provided on outer side of roof which reflects the sun rays coming outside the coach.

   b) In roof ceiling layers of insulting materials like asbestos / glass wool is provided which is bad conductor of heat resulted direct transmission of heat inside is minimized.

   c) In carlines, elliptical holes are also provided for proper air circulation from one compartment to another.

   d) No. of ventilators also provided on top of roof to exit smokes, gases and to circulate fresh air.

   e) Limpet sheet is also provided inside of the roof (2mm thick) which is bad conductor of heat.

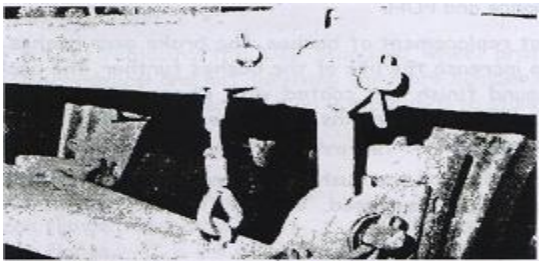
2.4 INDO – GERMAN MODIFICATIONS

Description Of Modification: These modification were adopted with the technical guidance of German team so that known as Indo- German modification are as under:-

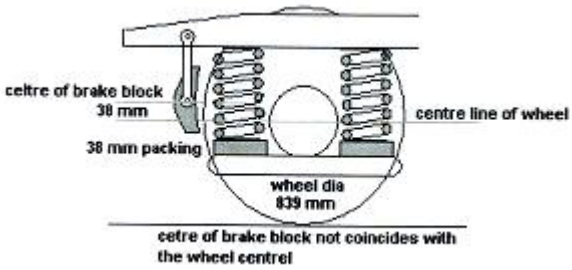
1. Use of nylon 66 bushes with case hardened N5 ground finish Class-ii pins:- previously resin bushes with N7 ground finish class -2 pin were used.

2. Modified design of brake shoe key and brake shoe head, previously width of the slot of brake shoe head was 60mm, it is reduced to 50mm .In new design of brake block key ,the camber is increased and length is decreased .

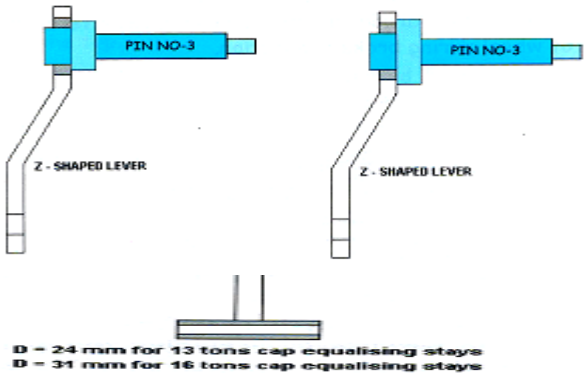
3. Provision of safety wire rope arrangement for brake beam, previously G shape safety brackets were used with brake beam but now wire rope safety brackets are used which are safe with less provability of breakage.



4. Fitment of modified brake block hanger in increasing length 235 mm from 205 mm. Length of the hanger is increased resulted no climbing cases of brake beam over to wheel.

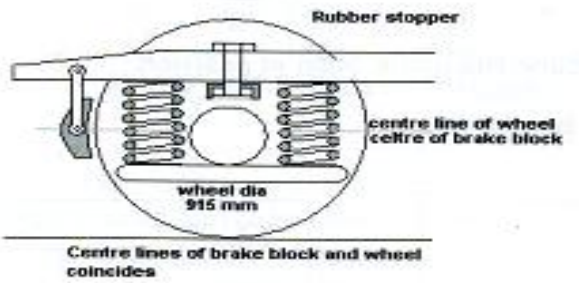


5. Provision of modified lever hanger pin. The width of the hexagonal head bolt is increased from 46mm to 51 mm to avoid inserting provability of hexagonal head bolt in z arm bushing dia.



6. Fitment of equalizing stay rod of 16 ton axle load also in 13 ton axle load bogies. With the fitment of 16 tone capacity equalizing stay rod breakage chances are reduced.

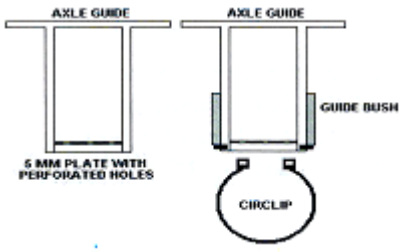
7. Provision of rubber stopper for hexagonal head bolt. Rubber pads of 10, 20, 35, 45mm with 4mm thick compensating rings are being utilized to maintain the A clearances in ICF bogie.



8. Slack adjuster articulation arrangement. It was the modification for vacuum brake coaches to avoid failure of SAB due to bending effects during negotiation on curve.

9. Provision of locking arrangement of axle box guide. To prevent the dropping of guide cap in pot,now a days integral type guide with cap are being utilized.

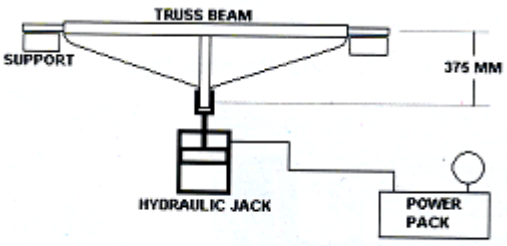
10. Use of integral type of buffer false plate for reclamation. In this modification the process of flat buffer reclamation is given.



11. Use of high capacity buffer pads. In this modification high capacity buffer pad of 1030 kg m is utilized, no use of 515 kg m capacity pads is recommended.

12. Dimensional check report for bogie covering the aspects of avoidance of welding joint under axle guide. Under this modification the squareness of bogie should be checked by work shop staff on arrival of coaches for P.O.H.

13. Modified brake beam for air brake coaches and testing procedure. Under this modification only 16 t capacity brake beams are to be used in16 & 13 t bogies.



LATEST MODIFICATION ON COACHES

1) Change in securing arrangement of anchor link, similar as in Fiat Bogie.
2) Use of Hopper type Shutters in place of foster Shutters.
3) Provision of ventilator with Arc shape fins with LAV for proper circulation of Air.
4) Provision of Resetting Handle on in panel for the resetting of ACP.
5) Increase of hole dia. in PEAV from 4 to 8 mm.

6) Provision of APD for Guard van valve and its handle.

7) Reduced of width of brake shoe head by 5 mm from inside.

2.5 Ride Index:

It has been found that human sensations are dependent on acceleration, rate of change of acceleration (impulse) and displacement. In other words, the product of these values could be used as measure of comfort/discomfort.

Riding is a quality of comfort experienced by passenger, depends not only upon acceleration, rate of change of acceleration & vibration but also some other factors as like noise, moisture temperature etc.

Calculation Formula given by Dr. Sperling,

$$\text{Ride Index} = 0.896 \sqrt[10]{\frac{\sum b^3}{\sum f} F(f)}$$

where:

b : Amplitude of acceleration

f : Frequency of acceleration

F(f) : a correction factor dependant on the frequency

Note: The accelerations referred to above are vehicle body accelerations, vertical or lateral, measured on the floor level just above the center pivot location.

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 :

RI	Appreciation	Fatigue Limit
1.0	Very Good	>24 Hrs
1.5	Almost Very Good	-Do-
2.0	Good	-Do-
2.5	Nearly Good	13 Hrs
3.0	Passable	5.6 Hrs
3.5	Still Passable	2.8 Hrs
4.0	Able To Run	1.5 Hrs

4.5	Not Able To Run	45 Mts.
5.0	Dangerous	15 Mts.

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/DMU		4.0

The ride index as described above gives the average riding quality of a vehicle over the chosen length of track (generally one kilometer). 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:-

1. By proper checking of primary suspension arrangement.
   - Checking free height &height variation.
   - Telescopic hydraulic dash pot & oil level in it (1.6 liters in modified & 1.4 liters in non-modified).
   - Gap between safety loop & axle box lug should be within limit i.e. 40 mm (old 20 mm).
2. Proper pairing of springs on secondary suspensions.
   - Free height of spring should be within limit.
   - Ensuring proper working of shock absorber.
3. Proper checking of side bearer, oil & bearing piece should be within limit.
   - Oil quantity should be 2.0 liters.
   - Thickness of bronze piece should not be less than 42 mm (45 mm – new size)
   - Thickness of metal piece should not be less than 8.5 mm (10 mm – new size)

   [6 mm dia. hole is provided at the centre of bronze piece for better lubrication /working]
4. Proper checking of silent bushes fitted in bolster for proper matching of centre pivot.
5. Proper checking of buffing gears.
   - Proper contact of buffer plunger.
   - Plunger stroke should not be more than 127 mm & less than 51 mm.
   - Wear on rubber pads should be within limit.
   - All securing bolts & nuts should be properly fitted.
6. Proper checking of draft gear.
   - Wear on rubber pads / coiled spring should be within limit.
   - Coupling should be in proper tight position.

- Other securing nuts, washers, cotters also should be in proper position.

7. There should be proper bushing of anchor links. Checking of silent bushes therein.
8. By checking silent bushes working / clearance of self alignment double row spherical roller bearing.
9. All break gear pins should be provided with proper bushing.
10. Piston should be proper working condition, means piston travel should be uniformly, and it should not be sticky.
11. Berth should be provided with cushioning.
12. Dynamo pulley & belt should not be loose.
13. It should also be ensured that there should not be any wheel defect as like flat faces (not more than 50 mm) deep flange, skidded wheel, sharp flange, thin flange.
14. In excess of this the Ride Index also can be improved by ensuring p/way maintenance, signal aspects & engine man ship of the driver.

3. AIR BRAKE SYSTEM

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

Necessity to introduce the Air Brake in rolling stock : The existing vacuum brake has got its own limitations like brake, fading, increased application and release timings etc., In practice it is not reliable to trains in higher altitudes due to insufficient vacuum levels in brake van and train engine.

So the overcome all these, 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 system:

The advantage of Air brake is

1. Uniform brake power is possible throughout the train in airbrake but it is not possible in case of vacuum brake since the pressure drop at the rear of the train is up to 20%
2. The propagation rate of compressed air is 260 m/sec to 280 m/sec when compared to 60 to 80 m/sec. in the sec. in of vacuum brake.
3. The Air brake trains have potentiality to run longer than 600 meters length.
4. The air brake trains have potentiality to run heavier loads than 4500 tons.
5. Shorter breaking distance.
6. Suitable for higher altitudes.
7. Compact and easy to maintain.
8. Consumption of spare parts is very less.
9. Simple brake rigging.
10. Quicker application and release, so better punctuality can be achieved.
11. Better utilization of rolling stock since less maintenance and pre departure detention.

Types of Brake System used in Indian Railway Rolling Stock:-

1) Single pipe graduated release & application conventional air brake system utilized in Goods Stock.
2) Twin pipe graduated release & application conventional system utilized in Coaching Stock.
3) Twin pipe graduated release & application Bogie Mounted Air Brake System at present utilized in more than 98% coaches in place of conventional twin pipe air brake system.
4) Twin pipe graduated release & application Axle Mounted Disc Brake System, utilized in LHB coaches made by RCF Kapurthala.

Types of Air Brake System:-

1. **Direct Release & Application System**:- (100% creation & drop of pressure)

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 brakes is initiated.

2. **Graduated Release & Application System**:-

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

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

There are two types of Graduated Release Air Brake:-

1) Single Pipe Air Brake System.
2) Twin Pipe Air Brake System.

1) **Single Pipe Air Brake 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 & release of brakes.

i) At present running in goods stock.(Except latest developed BOX-N HL, BCN HL wagons)

ii) Releasing time is more 45– 60 sec.

2) **Twin Pipe Air Brake System :-**

i) In addition to brake pipe, there is one more pipe called feed pipe , running loco to the brake van to charge the auxiliary reservoir continuously to 6 kg/cm^2.At present running in coaching stock and also in latest developed BOX-N HL, BCN HL wagons)

ii) Releasing time is less 15 – 20 sec

MAIN COMPONENTS OF AIR BRAKE SYSTEM(SINGLE PIPE)

1) Brake pipe – dia. 32 mm (for goods) & Pressure 5 kg/cm2.
2) MU washer
3) Palm Coupling
4) Air Hose (Length: 660^{+6}_{-0}mm)
5) Cut Off Angle Cock
6) Grip Seal Joint
7) Branch Pipe (Dia.: 20 mm)
8) Isolating Cock
9) Dirt Collector
10) Common Pipe Bracket
11) Intermediate Piece

12) Distributor Valve

13) Control Reservoir

i) 6 liter (Goods): 5 kg/cm^2

ii) 9 liter (Coaching): 5 kg/cm^2

14) Auxiliary Reservoir

i) 100 liter (Goods): 5 kg/cm^2

ii) 200 liter (Coaching): 6 kg/cm^2

15) Manual Release Handle

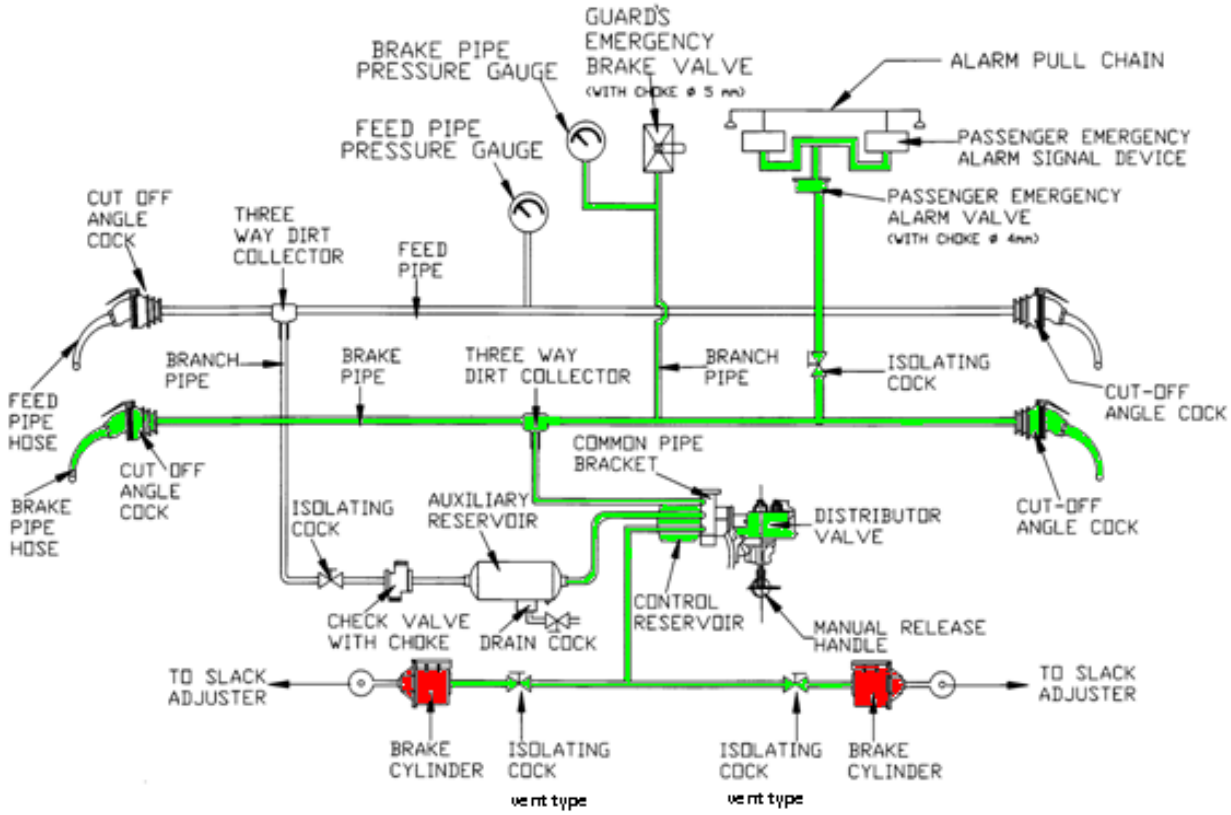
16) Isolating Handle of DV

17) Drain Cock in DV

18) Branch Pipe for BC

19) Isolating Cock for BC

20) Brake Cylinder Dia. – 355 mm (Pressure max. 3.8 ± 0.1 kg/cm^2)



SCHEMATIC LAYOUT OF TWIN PIPE GRADUATED RELEASE AIR BRAKE SYSTEM

Extra Fitting For Coaching:-

1) Feed Pipe – Dia. 25 mm & pressure: 6 kg/cm^2

2) Non Return Valve with Choke: dia. 3 mm

3) Isolating Cock & Dirt Collector for FP

4) Branch Pipe for PEAV & PEASD.

i) PEAV choke dia.: 8 mm (NEW)

ii) PEAV choke dia.: 4 mm (OLD)

5) Isolating Cock for PEAV & PEASD

6) Vertical Pipe for Guard Van Valve

7) Guard Valve with Handle & choke dia.: 8 mm

8) Guard Van Valve BP & FP gauge

Working Principle Of Air Brake System:

Under normal conditions the Brake pipe is charged with 5kg/cm^2 from the loco. The control reservoir and the Auxiliary reservoir are also charged with 5 kg/cm^2 from BP through Distributor valve in case of single pipe system. In twin pipe system the auxiliary reservoir is charged to 6 kg/cm^2 through feed pipe.

When the brake pipe is 5 kg/cm^2 the brake cylinder is connected to exhaust through distributor valve in order to keep the brake 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.

The different processes involved in working of Air brake system:

The processes involved in working of Air brake are

a) Charging

b) Application

c) Release

d) Manual Release

During Charging:

a) Brake pipe is charged with 5 kg/cm^2 by the drivers brake valve from the Loco

b) Feed pipe is charged with 6 kg/cm^2

c) AR is charged with 6 kg/cm^2 (Up to 5 kg/cm^2 is charged both brake pipe and feed pipe Beyond 5 kg/cm2 & up to 6 kg/cm^2 it is exclusively charged feed pipe.

d) The CR is charged through the distributor valve to 5 kg/cm^2 from BP

e) During charging Brake cylinder is connected to exhaust through distributor valve to keep the brakes in released condition.

During Brake Application

The brake pipe is reduced in steps as given below

SN	Stages	BP pressure is reduced by
1	Minimum Reduction	0.5 to 0.8 kg/cm^2
2	Service application	0.8 to 1.0 kg/cm^2
3	Full service application	1.0 to 1.5 kg/cm^2
4	Emergency application	5.0 kg/cm^2
5	Release stage	No reduction (BP at 5.0 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 $\pm$ 0.1 kg/cm^2 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. (i.e. 2.5 times charging of BC as per reduction in BP but it is applicable only up to 1.5 kg/cm^2 of pressure drop in B.P.)

NOTE : Before AR is connected to BC the AR and CR are disconnected from BP and BC is also disconnected from Exhaust.

The AR is continuously charged to 6.0 kg/cm^2 during brake application by Feed pipe. The CR pressure should constant at 5.0 kg/cm^2. However there may be a little drop in CR pressure during brake application due to the design feature.

DURING RELEASING / RECHARGING

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 5.0 kg/cm^2 from the brake cylinder is completely exhausted and the brakes are released fully.

MANUAL RELEASE

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 is given a brief pull which is provided at the bottom of the DV. 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.

DIFFERENCE BETWEEN AIR BRAKE & VACCUM BRAKE SYSTEM:-

SN	AIR BRAKE SYSTEM	VACCUM BRAKE SYSTEM
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 into BC up to 3.8 kg/cm^2	In vacuum brake , air at atmospheric pressure is admitted.
3.	DV 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.	Brake application is caused by the inward movement of the Piston.
5.	BC is connected to AR during brake application & to exhaust during brake release through the DV.	VC is directly connected to the train pipe during brake application & release.
6.	No brake power fading.	There is always a brake power fading to the exhaust of 20%
7.	Uniform brake power is possible throughout the train due to the higher propagation rake of compressed air (260 to 280 m/sec.)	Uniform brake power is not possible due to the lower propagation rake of atmospheric air in the vacuum. (60 to 80 m/sec.)
8.	Air hoses are used to provide flexible connection between adjacent vehicles.	Hose pipe are used to provide flexible connection between two adjacent vehicles.
9.	Palm ends / coupling heads are used on the coupling side of air hoses.	Universal couplings are used on the coupling side of hose pipe.
10.	For any reason, if the cylinder has to be made in operative, it can be conveniently done by closing the isolation cock.	If the cylinder has to be made inoperative, the train pipe nipple or the siphon pipe has to be dummied.
11.	MU washers are used to make air tight joints.	IR washers are used to make the air tight joints.
12.	Emergency braking distance is 632 m (4500 tones trailing load level track at 65 kmph speed).	Emergency braking distance is 1097 m (4500 tones trailing load level track at 65 kmph speed).

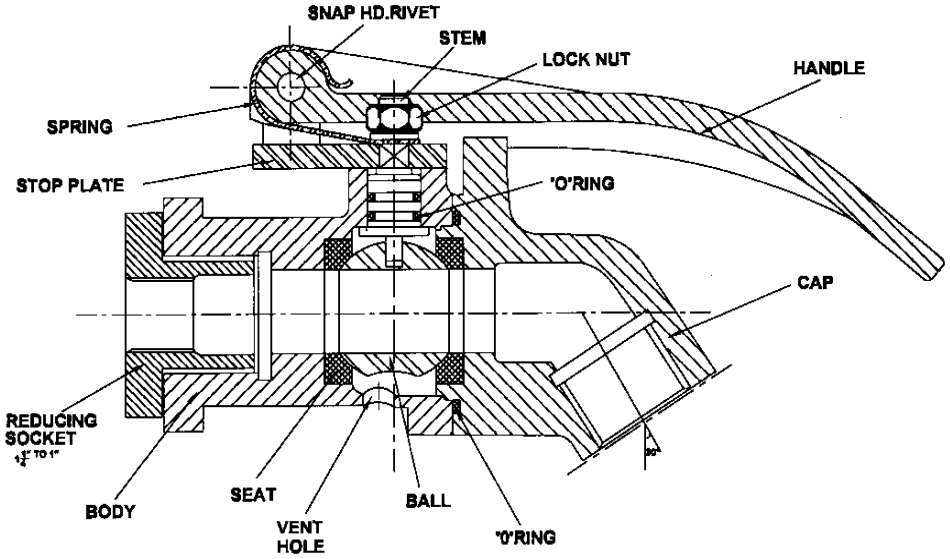
3.1 AIR BRAKE SUBASSEMBLIES

1) **Common Pipe Bracket –** Common Pipe Bracket is permanently mounted on the under frame of a vehicle. One face is mounted with distributor valve along with intermediate piece and other pace with control reservoir. The advantage of fitting a common pipe bracket is to remove the distributor valve for repair or replacement without disturbing the pipe connections.

1) **INTERMEDIATE PIECE –** Intermediate piece serves the purpose of blanking all the other parts on the common pipe bracket front face other than required for a particular make of distributor valve. Intermediate piece is mounted on the common pipe bracket face with a common gasket and the distributor valve is fastened to the intermediate piece.

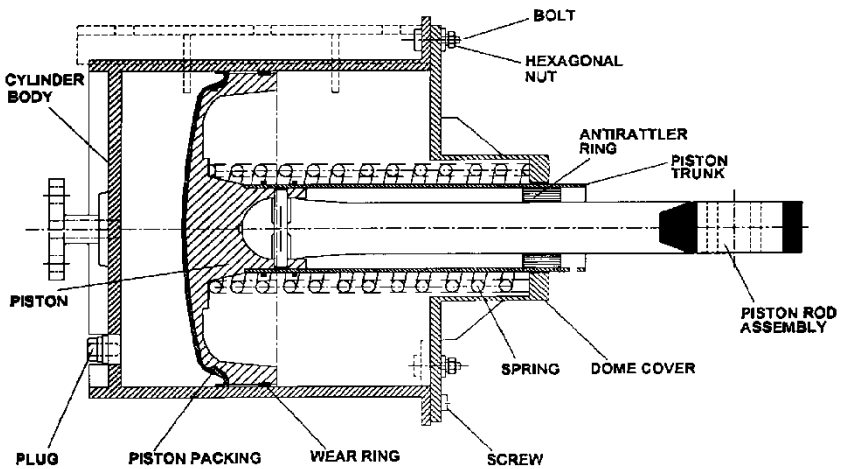
2) **BRAKE PIPE HOSES –** In order to connect two successive wagons, the brake pipes (BP) installed on the under frame are fitted with flexible hoses. Length – max 666 mm , min – 784 mm

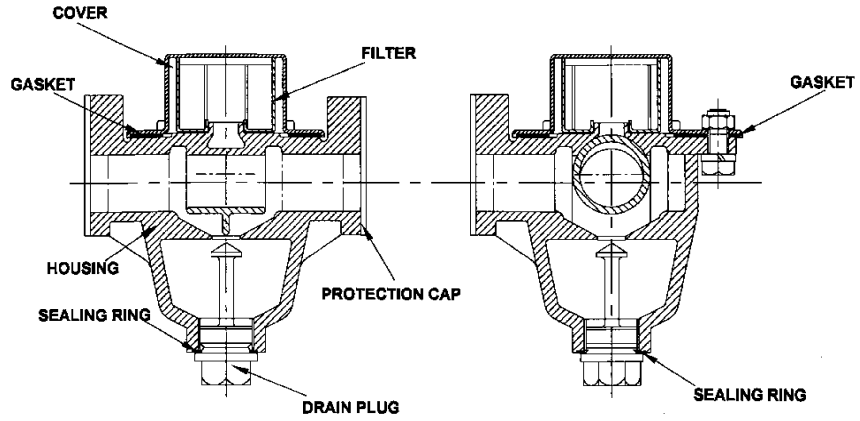
3) **BRAKE PIPE COUPLING –** To connect subsequent wagons, the hoses of BP are screwed to coupling and hose nipple by means of stainless steel 'Bend it type clips. The coupling is designed in the form of palm end and hence also known as palm end coupling. Since a joint is formed at the coupling head, leakage may take place, through it. Therefore, it is necessary to subject the hose coupling of brake pipe to leakage test. The air brake hose coupling are provided in the brake pipe line.



4) **CUT OFF ANGLE COCK** – Cut of angle are provided on the air brake system to facilitate coupling and uncoupling of air hoses. When the handle is parallel to cut off angle cock, the air can easily pass through the cock. The position of the handle is known as open position. When the handle is placed perpendicular to the cock body, thereby closing the passage of air. This position of handle is known as closed position. The cut off angle cock is to be completely dismantled and overhauled during POH or when there is some specific trouble.

5) **BRAKE CYLINDER** – Brake cylinder is provided for actuating the brake rigging for the application and release of brakes. The brake cylinder receives compressed air from auxiliary reservoir after bring regulated by the distributor valve and develops mechanical brake power by outward movement of its piston assembly.

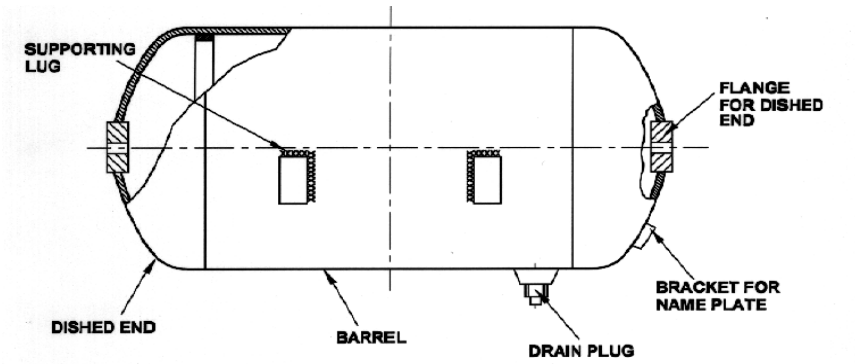




SECTIONAL VIEW OF DIRT COLLECTOR

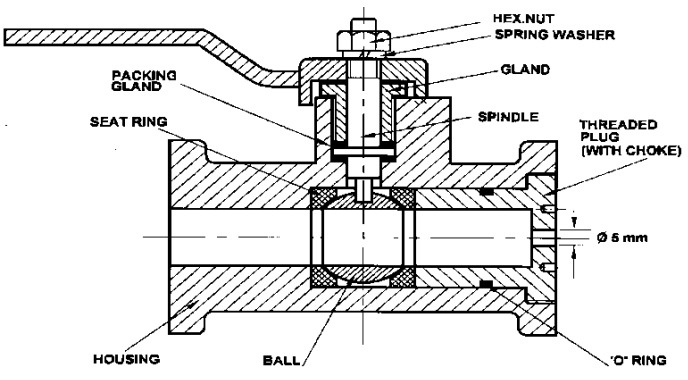
6) **DIRT COLLECTOR** – Dirt collector are provided at the junction of the main pipe and branch pipe in both feed pipe and brake pipe. These are meant for removing dust, moisture and scale practices from air before it enters the DV & AR. This is achieved by centrifugal action.

7) **AUXILARY RESERVOIR** – It's a pressure vessel and its function is to feed dry compressed air to the brake cylinder for application of brakes. AR is charged through brake pipe as well as feed pipe in coaching. Pressure in AR for goods single pipe – 5 kg/cm^2 and for Coach twin pipe 6 kg/cm^2. Capacity of AR in Goods, Coaches, BVZC are 100 ltrs, 200 ltrs, 75 ltrs respectively. No. of AR provided per wagon is 1 and No. of AR provided in Rajadhani Coaches per coach – 2 (2 x 100 ltrs. Is conventional) & 1 (1 x100 in BMBC) Charging time of AR (6000 litre or one complete rake) 180 – 240 sec.



AUXILIARY RESERVOIR

9) **GUARD'S EMERGENCY BRAKE VALVE**- GEBV is provided in the Guards compartment. This valve provides a facility to the guard initiate brake application in case of any emergency. Dia. of Guard van valve choke – 8 mm



10) **CONTROL RESERVOIR** – The

control reservoir is mounted on the under frame of coach very near to the DV and connected through a small chock and a pipe with the DV. During braking operation and releasing operation through recharging operation, the air pressure inside the control reservoir remains unaltered. Only during manual release the air of control reservoir escapes to the atmosphere through release valve of DV. Capacity of CR in per wagon and Coach are 6 litre and 9 litre respectively.

11) DISTRIBUTOR VALVE – DV is most important functional component of Air Brake System and is also some time referred to as the Brain of air brake system. It is connected to brake pipe AR & BC. It senses the BP pressure variations & work automatically to provide brake application as well as brake release. The distributor valve assemble consists of a valve body, a common pipe bracket and CR.

The DV mainly performs the following functions:-

i) Chare the air brake system i.e. CR & AR to regain pressure during normal running condition charging time (0 to 4.8 kg/cm2)

Type of DV	**CR Charging**		**AR Charging**	
	KEO	**C_3W**	**KEO**	**C_3W**
Old timing	160 $\pm$ 10	260 $\pm$ 20	170 $\pm$ 10	270 $\pm$ 30
New timing	185 $\pm$ 25	165 $\pm$ 20	140 $\pm$ 30	175 $\pm$ 30

ii) Helps in graduated brake application, when pressure in brake pipe is reduced in steps.

iii) Helps in graduated brake release, when pressure in brake pipe is increased in steps.

iv) Quickly propagates reduction of pressure in brake pipe throughout the length of train by arranging additional air pressure reduction locally inside the DV.

v) Limits max. Brake cylinder pressure up to 3.8 $\pm$ 0.1 kg/cm^2 for full service/emergency application.

vi) Controls the time for brakes application & brake releasing depending on service condition.

ITEM	**WAGON**	**COACH**
BC Filling time (from 0 to 3.6 kg/cm^2)	18 – 30 Sec.	3 – 5 Sec.
BC Release time (from 3.8 to 0.4 kg/cm^2)	45 – 60 Sec.	15 – 20 Sec.

vii) Facilitates complete discharge of air from the air brake system manually with the help of QRV/DRV.

viii) Projects overcharging of CR when brake pipe pressure is quickly increased for releasing brake

SN	**KEO**	**C_3W**	**Function**
1	Three pressure valve	Main valve	Supply of requisite amount of pressure in brake cylinder, when B.P. pressure is reduced, also it provides passage for BC pressure to exhaust in atmospheres when BP pressure is raised.
2	U-controller with U chamber	Quick service valve	The function of this part is to create initial pressure drop in brake pipe pressure by allowing a sudden entry of BP pressure into large volume bulb / U chamber at the start of brake application. This ensures rapid propagation of pressure

			reduction in BP throughout the length of train
3	Minimum pressure limiter	Inshot valve	When application is initiated causes rapid charging of brake cylinder up to a determined pressure to overcome rigging resistances.
4	Max. pressure limiter	Limiting device	Restrict the max. BC pressure to 3.8 $\pm$ 0.1 kg/cm^2
5	Check cover	Application of release chock	Regulates application & release times.
6	A - controller	Cut off valve	Connects the B.P. to C.R. during charging & cut off the connection when B.P. pressure is reduced for brake application.
7	R - charger	AR check valve	Helps in charging the AR in addition to charging. It checks flow of F.P. into B.P. in dual pipe system &also checks back flow of air pressure when B.P. pressure when B.P. pressure is reduced for brakes application
8	Quick release valve (QRV)	Double release valve (DRV)	Allows the brakes of a coach to be released by means of single brief pull to release wire, without any loss of air in A.R.

12) Passenger Emergency Alarm System

Passenger emergency alarm system consists of two components:

A. Passenger Emergency Alarm Signal Device (PEASD).

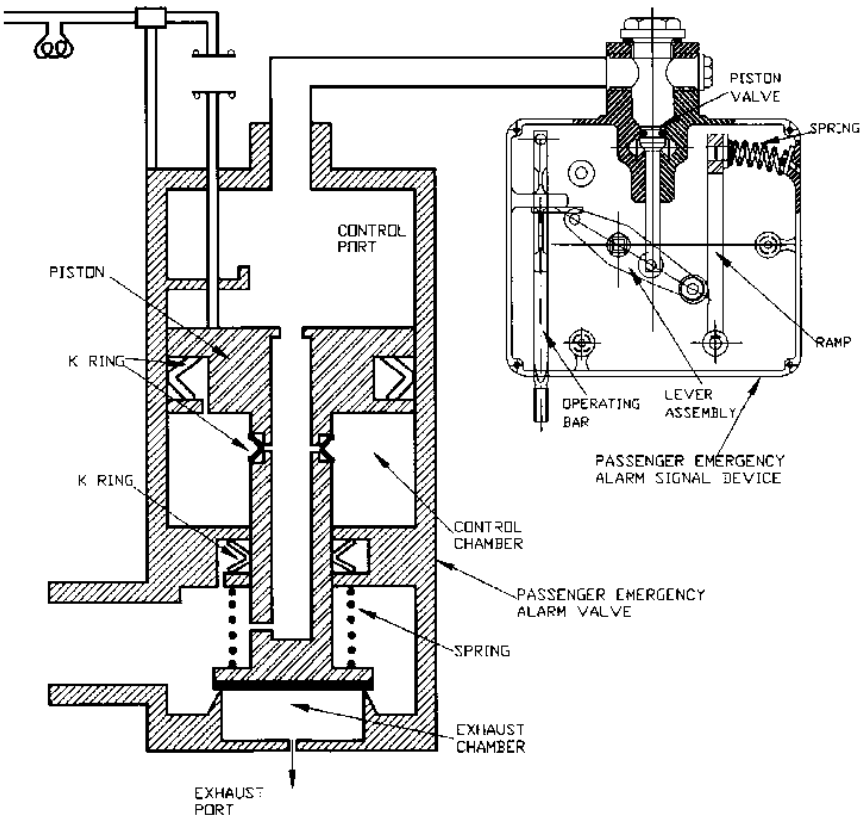
B. Passenger Emergency Alarm Valve (PEAV).

These two components in combination give an indication to the driver that some passenger is in need to stop the train. The indication is transmitted from the coach when the passenger pulls the chain

13) Passenger Emergency Alarm Signal Device

Passenger Emergency Alarm Signal Device (PEASD) is a manually operated pilot vent valve. It is operated through mechanical force exerted by pulling the alarm chain provided inside the coaches for emergency use.

The passenger emergency alarm signal device does not need any maintenance during normal service except when it is found damaged or is due for periodic overhauling.



Working: When ever chain is pulled to stop the train, the

rocker arm; provided in PEASD, slides and actuate the pilot valve to open the atmospheric hole, as a result the BP pressure is reduced in PEASD. As the PEAV is connected in series with PEASD resulting BP pressure is also reduced in upper chamber of the PEAV. Due to variation of BP pressure in both the chamber of PEAV the main valve floats from its position & relate the lower chamber with the atmosphere after opening of the modified choke (8 mm dia.) this fast venting of pressure create reduction of pressure in BP pipe of the said coach & brakes take place to stop the train.

3.2 TROUBLE SHOOTING & REMEDIAL MEASURES

SN	CAUSE	REMEDY
1.	MU (Multiple Unit) washer is damaged or displaced.	Change the damaged one or reset the displaced one.
2	Brake pipe joint leakage or Drain plug leakage.	Tighten all loose joint to stop leakage.
3	Hand brake in ON condition.	Check that Hand brake is in release condition.
4	Improper setting of empty load Device.	Ensure proper setting of empty load device i. e. loaded /Empty condition.
5	Horizontal beam's guide brackets jammed.	Ensure smooth working of horizontal lever.
6	Improper working of SAB.	Replace the faulty SAB with a good working SAB.
7	Exhaust port of DV is chocked condition or DV not working properly.	Replace the faulty DV with a good working DV
8	Brake cylinder spring stuck up (commonly) or broken (rarely)	Release brake cylinder spring in proper position using the check not at the end of brake cylinder. Replace the broken spring with a new one.
9	Any part of brake rigging is in jammed condition.	Ensure smooth operation of all parts of brake rigging.
10	Brake beam stuck up in bracket beam pocket or brake beam hanger pin jammed.	Ensure free movement of brake beam in brake beam pockets.
11	Cut off angle cock is partially closed.	Cut of angle cock is opened fully.

4. VACUUM BRAKE SYSTEM

Brakes are essentially meant for controlling the speed and stopping the train. Different Brake System are exist depending upon the requirements.

The brake system should meet the following basic requirements.

- Should be automatic and continuous i.e., in the event of train pasting, brakes should automatically apply.
- Shortest possible emergency braking distance.
- Maximum possible braking force.
- Shorter brake application time.
- Shorter brake release time.
- Low exhaustibility of brake power under continuous or repeated brake application.
- Ease In maintence.
- Minimum “run in” and “snatch” action during braking.
- The vacuum brake system derives its braking force the atmospheric pressure.
- The atmospheric will pressure will act on the lower side of the piston in the vacuum cylinder.
- The vacuum is maintained above the piston .
- The nominal vacuum is maintained 510mm.
- This will give as effective pressure of 0.7kg/cm^2 in the piston.
- The vacuum is created in the system by the ejector or the exhauster mounted on the locomotive.

4.1 THE MAIN PARTS OF VACUUM BRAKE SYSTEM

1) The vacuum cylinder suspended by trunion from the under frame.
2) Brake shaft.
3) Brake rigging i.e., pull rod, levers etc.
4) Train pipe and pipe connections.
5) Hand brake (lever or screw type).
6) Empty-loaded Tie rod.
7) Slack adjuster

4.2 VACUUM BRAKE CYLINDER:-

There are two basic types of vacuum brake cylinder in use on goods stock E type and F type.

- In type brake cylinder the volume of upper chamber in enhanced by provision of a dome or casing which forms the integral part of the vacuum cylinder.
- In F type vacuum cylinder, the top is kept flat but a separate vacuum reservoir is provided which is connected to this upper chamber through syphon pipes.
- The higher volume of the upper portion ensure higher efficiency of the vacuum cylinder.

DEPENDING ON THE DIAMETER OF THE CYLINDERS

They are further divided into:

SN	TYPE	SIZE	STOCK WHERE FITTED
1	E	457mm	All 16ton axle load wagons except BVG & BVM
2	E	533mm	on BWL, BWT, BOB, BOBX, BOBS.
3	F	533mm	on BWS, BRS, BRH, BVG and BVM.
4	F	560mm	on BOX, BCX and BOI.

4.3 VACUUM CYLINDER OVER HAULING & FITTING

DO'S:

1. Check for serrations in Barrel & Piston
2. Check for any crack near Trunions on Barrels, Lock for blow holes near Trunions.
3. Replace all Rubbers components with new ones.
4. Before assembling, gap between piston Rib & the pan top edge, should be checked and it should be not less than 19 mm.
5. Provide "Spacer Ring" of suitable thickness to ensure 19mm gap between top edge of pan and piston lip.
6. Ensure the use of modified "Nylon Guide Bush to 55/M DRG in place of copper / bronze bush.
7. Ensure that "STOPPER TUSS" is provided in 533 mm E Type vacuum cylinder to prevent slippage of piston.

8. Ensure the use of " Modified Ball value seating" with 8 mm hole and corresponding " CAGE" & " BALL"
9. Ensure that inside Trunion Brackets are of Modified version & Modified wherever possible (Bolted in instead of Welded)
10. While fitting overhauling cylinder piston rod comes exactly in the centre of Fork Arm.
11. Ensure free movement of trunion in Brackets, by applying necessary lubricant.
12. Ensure to stencil the ticket no. staff inside the vacuum cylinder.
13. Ensure to stencil the name of shop on the vacuum cylinder.
14. Ensure "Rolling Ring" at the lowest periphery with the seam of Rolling ring straight.
15. Ensure the "Piston Rod" cotter holes are opposite to the release value locations.
16. Ensure that one of the trunion comes exactly in line with the ball value & release value location.
17. Ensure in built passage in the casting to the chamber side is clear.

DONT'S:

1. Don't use old gland packing rings.
2. Don't use old joint rings.
3. Don't use old rolling rings.
4. Don't use worn out guide bushes.
5. Don't use brass guide bushes.
6. Don't use old stuffing Box joint washer.
7. Don't use piston rod with bottom key ways.
8. Don't use bend piston rod.
9. Don't use broken components.
10. Don't use piston with serration or crack.
11. Don't use PAN (F type) or barrel with lugs broken.
12. Don't use old release value joint washer.
13. Don't use old or torn piston cap washer.
14. Don't use barrel with cracks near trunion or blow holes.
15. Don't use barrel without "thickening pack".
16. Don't use old or defective rubber components.
17. Don't expose rubber components to heat, oil, grease & loose electric circuit.

METHOD OF BALANCED VACCUM TEST

1. Connect the vacuum cylinder to the source of vacuum so that the balance vacuum control value comes between the vacuum to a maximum of 460 mm. with the lever in horizontal

position and a minimum of 356 mm with the lever in vertical position with the exhauster working.

2. Fit the spring to the position rod.
3. Create the vacuum of 460 mm.
4. Destroy the vacuum of cylinder.
5. Twenty Minutes after destroying the vacuum create the balancing vacuum of 356 mm (lever of control rod vertical) the position of cylinders in good condition should partly descend but not completely those which completely descend oar faulty and should be attended to.
6. Increase vacuum to 460 mm (lever of the control rod horizontal) when piston should completely descend those which do not descend are faulty and are required to be attend.

REASONS:

When vacuum is recreator released piston does not came down.

1. Twisted rolling ring.
2. Leakages of air to the bottom of piston head due to defective neck, ring or diaphragm washer.
3. A bent piston rod.
4. Too light guide bush or any other item obstructing free dropping of its own.
5. Wrong alignment of suspension BKT trunnion BKT bolt missing etc.,

PISTON GOES UP AND DROPS SUDDEN

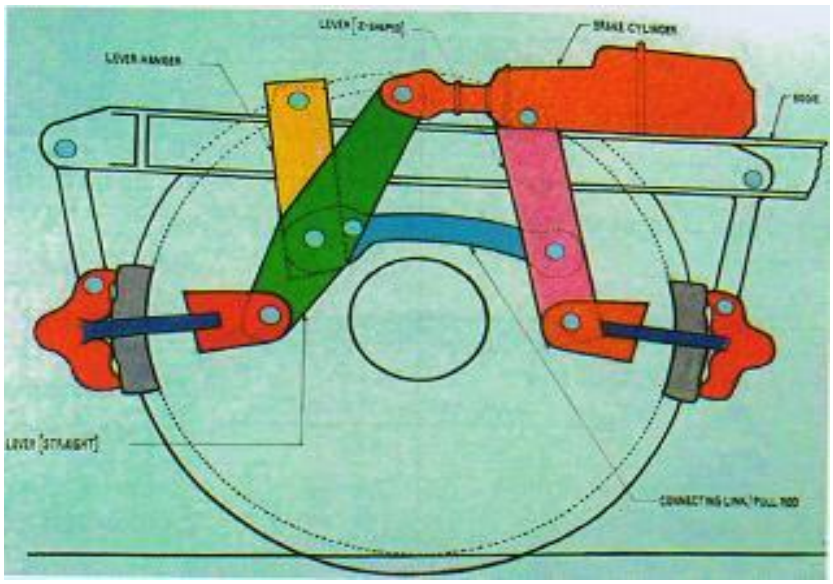
1. Serrations of barrel, piston rod worn.
2. Wrong sized rolling ring.
3. Slack head.

5.Bogie Mounted Brake System

Introduction

- In order to overcome the problem faced due to breakages and malfunctioning of SAB en-route and also due to the frequent breakages and replacement of cast iron brake blocks.
- The SAB is completely eliminated by providing the brake cylinder on the bogie itself, & frequent breakages and replacement of C.I. brake blocks are minimized by providing high friction composite 'K'-type brake blocks.

Advantages Of BMBS

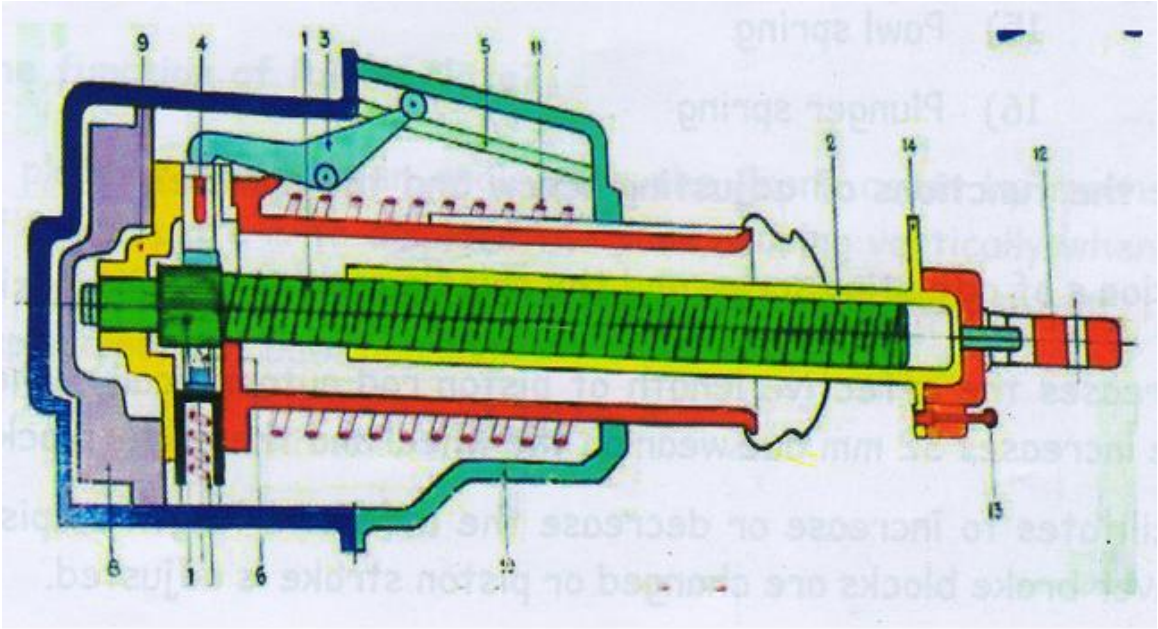


- In built single acting slack adjuster to take up a slack automatically.
- Weight is reduced and C.C. can be increased (weight is reduced 492 kg per coach as compared to conventional coaching stock)
- Number of pin joints is reduced 102 to 84.
- Fulcrum losses are reduced.
- Braking distance can be reduced at a speed of 110 km ph with 18 coaches is 800 m. (Conventional stock is 905 m.)
- Maintenance cost is low.
- Noise is reduced due to under frame mounting, SAB is eliminated.
- Mechanical efficiency is increased.
- Reliability of brake system is increased
- Speed of the train can be increased due to better controlling of train.
- Wheel Wear is reduced due to co-efficient of friction of 'K'-type brake block is 0.25.
- Mechanical advantage is increased.
- 13 T (Non-AC) 1:4 (in conventional) & 1:7.6 (In BMBC)
- 16 T (AC) 1:5.5 (In conventional) & 1:8.4 (In BMBC).
- Life of the brake block is increased. (5.5 to 6.0 times in compare to C.I.).
- Mounting and dismounting of brake cylinder is easy during IOH & POH.
- Weight of the brake block is reduced resulted transportation and handling is easy.

OTHER DATA OF B.M.B.S : -

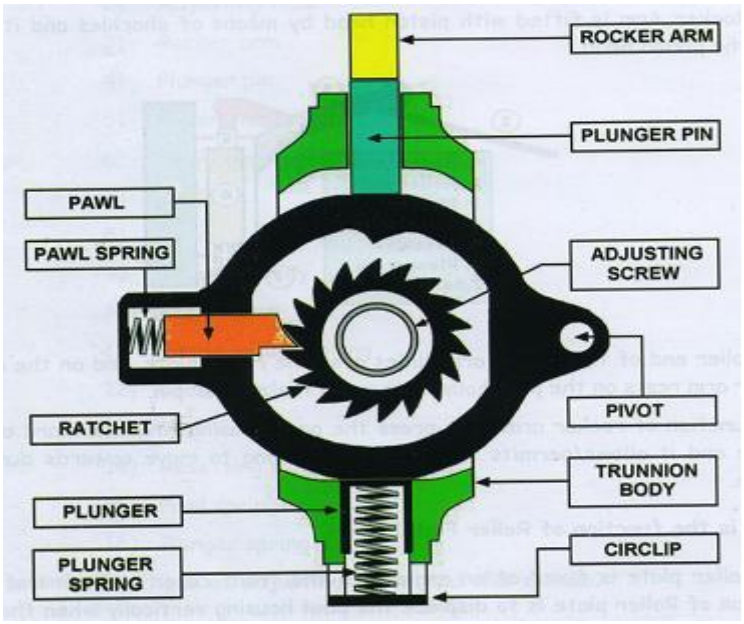
- Totally four numbers of 8" dia. (203 mm) size brake cylinders are used in place of two nos.14" (355 mm) cylinder in convention air brake system.
- It has an inbuilt single acting slack adjusting cap automatically to an extent of 305 mm slack adjustment whenever the piston stroke is increased more than 32mm(clearance increased due to wear on brake block and wheel).

- These cylinders are mounted with central longitudinal members connecting the bogie transom and head stock on either side.
- Piston stroke should be maintained within 32 mm.
- The total number of teeth on adjuster ratchet is 18 nos.
- The circumferential displacement of ratchet in one stroke is by 20 degree.
- The liner displacement of adjuster tube in one stroke is only by 0.366mm.
- The liner displacement of adjuster tube in one complete rotation of ratchet is by 6.4mm.
- As a conclusion to adjust 25 mm of slack total 72 braking strokes are required.



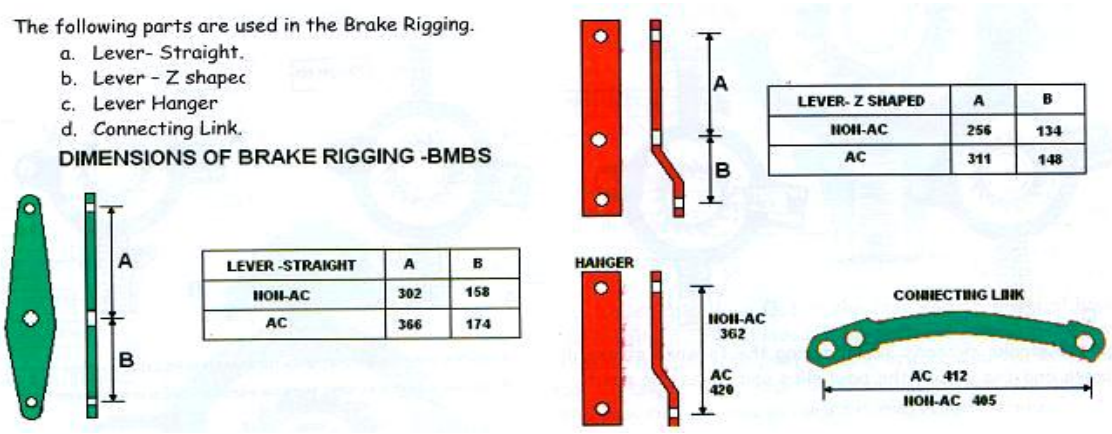
MAIN COMPONENTS OF BMBC

1. Adjuster screw with Ratchet
2. Adjuster tube
3. Rocker arm
4. Roller plate
5. Pawl Housing Ring
6. Pawl
7. Piston
8. Trunnion Body
9. Front Cover
10. Piston Return Spring
11. Cross Head
12. Latch
13. Resetting Plate
14. Pawl Spring
15. Plunger Spring
16. Ratchet



Precautions to be followed while maintaining the BMBC.

- Ensure the bogies are provided with high friction K type composite brake blocks.(as the coefficient of friction of Composite Brake Block L – Type is 0.17, K - type is 0.25 & for Cast Iron Brake Block it is 0.12).
- Ensure that floating lever, Z-arm are not interchanged between AC / Non-AC coaches.
- Ensure connecting link (Curved Pull-rod) is not interchanged between AC / Non-AC coaches.
- Whenever wheel dia. is reduced below 839 mm, ensure the curved pull rod hole is shifted to next inner hole.
- Ensure the pull rod is not reversed.
- Ensure 38 mm packing is given in between dash pot and axle box wing whenever wheel dia. is reduced to 839 to 813 mm.
- Whenever red mark is seen on the adjusting tubes replace all the brake blocks since further take up of clearance is not possible. If slack take up feature is not possible then adjuster tube to be extended to outside by disengaging of latch provided with resetting plate
- Snout out position should be kept on 3 O' Clock to 9 O'clock (Old 6 O' Clock to 12 O' Clock)



WORKING PRINCIPLE

- Whenever driver applied the brakes, piston is charged at 3.8 kg/cm^2 of pressure.
- Piston assembly started to move in forward direction,
- But there will no any change in the position of adjuster ratchet if the piston stroke is within 32 mm
- If the piston stroke is exceeded more than 32mm, in return stroke the fulcrum of the rocker ram is change resulted the pressure on plunger pin is released and pawl housing ring is started to rotate in clock direction due to release of pressure, mean while ratchet also rotate on its axis and change circumferential position by 20 degree (shifting by one teeth only) and then locked by pawl.
- Due to change of this clock wise position of ratchet ,the adjuster tube takes place the liner displaced outward outside at a rate of 0.366 mm per stroke and locked it in permanent feature resulted the gap between wheel and brake block is reduced.

FUNCTIONS OF MAIN PARTS

(1) ADJUSTING SCREW AND ADJUSTING SPINDLE

- The adjusting screw is connected with a ratchet and forms a single unit. The adjusting screw is provided with double starts thread with a pitch of 1/8" (3.15mm). The ratchet is provided with 18 teeth.
- The function of adjusting screw is to move the adjusting tube forward to increase the effective length of piston rod automatically and also decrease/increase the effective length of piston rod manually. When the adjusting screw completes one full rotation. It makes adjusting tube to move forward by $2\times\frac{1}{8}^{"} = \frac{1}{4}^{"}$ (6.3mm)
- If the ratchet is moved/rotated by one teeth the adjusting screw is rotated by $\frac{360°}{18}$ = 20°, which in turn moves the adjusting tube outward/forward by $\frac{1}{4}^{"} = \frac{1}{72}^{"}$ (0.33mm). It is clear that to move the adjusting tube forward automatically by $\frac{1}{4}^{"}$ it requires 18 return strokes or to move the adjusting tube forward by 1" it requires 72 return strokes.

(2) ROCKER ARM:-

Rocker arm is fitted with piston head by means of shackles and it moves along with y=the piston head.

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

(3) 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. It converts the linear displacement of pawl housing.

(4) PAWL HOUSING RING/PAWL:-

The pawl housing ring is fitted with pivot pin of trunnion body at one end and the other end of the pawl housing ring moves 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 is kept between trunnion body and the pawl housing to move the upward during forward stroke.

The function of pawl housing, the pawl is to move the ratchet by one tooth, whenever piston stroke exceed 32mm to increase the effective length of the piston rod during return stroke.

5.1 DIFFERENCE BETWEEN SAB & INBUILT SLACK ADJUSTER OF BMBC

- It is double acting. It can both take up & pay out the clearance automatically between the wheel and brake block.
- The effective length of pull rod is decreased during take up the clearance between wheel & brake block.
- The effective length of pull rod is increased or decreased with reference to the control rod 'A' dimension.
- It maintains a uniform piston strokes for all the cylinders throughout the formation.
- Spindle is made up of triple start thread.
- To adjust the slack, the length of the pull rod is increased or decreased during forward stroke.
- When length of the pull rod increased manually the clearance between the wheel & brake block increases.
- It does not require adjustment of piston stroke every trip.
- It is a single acting. It can only take up the clearance automatically between the wheel and brake block.
- The effective length of piston rod is increased during take up the clearance between wheel & brake block.
- The effective length of piston rod is increased only when the piston stroke exceeds the pre-determined on working stroke of 60mm.

SN	Description of Test	Results Required	Observation	
1	AR Charging Time from 0 to 4.8 kg/cm^2 (Main Reservoir pressure > 7.5 kg/cm^2	270 $\pm$ 30 sec for C_3W (170 $\pm$ 10 sec for KE)		
2	CR Charging Time from 0 to 4.8 kg/cm^2 (Main Reservoir pressure > 7.5 kg/cm^2	260 $\pm$ 20 sec for C_3W (160 $\pm$ 10 sec for KE)		
3	Leakage Test (Brake Release). Check DV Leakage by Soap water only at joints.	No Leakage		
4	**FULL SERVICE APPLICATION & RELEASE**			
	BC filling time from 0 to 3.6 kg/cm2	3 to 5 seconds		
	Maximum Brake Cylinder Pressure	3.8 $\pm$ 0.1 kg/cm^2		
	Leakage Test (Application). Check DV Leakage by Soap water only at joints.	No Leakage		
	BC Release time from 3.8 $\pm$ 0.1 kg/cm^2 To 0.4 kg/cm^2	15 to 20 seconds		
5	**OVERCHARGE PROTECTION** (BP pressure 6 kg/cm^2)	CR pressure should not increase by more than 0.1 kg/cm^2 in 25 sec.		
	CR overcharge reduction test. Overcharge CR to 5.7 kg/cm^2 and pull double release lever for 3 seconds.	Overcharged CR should come to regime pressure of 5 kg/cm^2		
6	**EMERGENCY APPLICATION**		Single pipe	Twin pipe
	BC filling time from 0 to 3.6 kg/cm2	3 to 5 seconds		
	Maximum Brake Cylinder Pressure	3.8 $\pm$ 0.1 kg/cm^2		

	Leakage Test (Emergency). Check DV Leakage by Soap water only at joints.	No Leakage		
	BC Release time from 3.8 $\pm$ 0.1 kg/cm^2 To 0.4 kg/cm^2	15 to 20 seconds		
7	**SENSITIVITY & INSENSITIVITY**			
	BP pressure drop at the rate of 0.6 kg/cm^2 in 6 Seconds	Brake should start applying within 1 sec.		
	With a pressure drop stopped immediately after the operation of QRV.	Brakes must remain applied.		
	BP pressure drop at the rate of 0.3kg/cm^2 in 60 Seconds	Brakes must no apply.		
	REFEEDING			
	Create leak in BC through a 2 mm choke	BC pressure should decrease initially but re-feeding should be available and BC pressure should get stabilized at some pressure		
7	**GRADUATED APPLICATION** Decrease BP pressure in steps as below BP Pressure (Kg/cm^2) 4.8 4.6 4.4 4.2 4.0 3.8 3.6		B. C. Pressure	
	Continue Graduated Application until max. BC Pressure is obtained	BP pressure drop must be between 1.4 and 1.6 kg/cm^2		
	BP Pressure at maximum brake application	BP pressure drop must be between 3.4 and 3.7 kg/cm^2		
8	GRADUATED RELEASE Increase BP pressure in steps as below BP Pressure (Kg/cm^2) 3.6 3.8 4.0 4.2 4.4 4.6 4.8		BC Pressure	
	Check BP Pressure when BC pressure is 0.4 kg/cm^2 (Recharging pressure to release BC Fully)	4.85 kg/cm^2 approx.		

9	**QUICK RELEASE TEST**		
	Apply emergency brake & pull briefly the double release valve lever	BC & CR are automatically exhausted to zero	
	CR check valve reset test. Start recharging of the system	CR should be isolated from atmosphere when BP pressure exceeds 0.2 kg/cm^2	
	Twin pipe operation Repeat the test : Full service application & Release. Emergency application.	Fill in column against test nos. 3 & 6	

- The piston stroke of the cylinders is not uniform throughout the formation and varies up to 60mm.
- Adjusting screw (spindle) is made up of double start thread.
- To adjust the slack the length of the piston rod is increased during return stroke.
- When the effective length of piston rod is increased manually, the clearance between the wheel & brake block decreases.
- Every trip the piston stroke requires to be adjusted.

Bogie Mounted Brake system:

SN	***Description***	***Bogie Mounted brake System***
1	*Slack Adjuster*	*Internal*
2	*Type of Slack Adjuster*	*Single Acting*
3	*Capacity of Slack Adjuster*	*305 mm*
4	*Size Brake cylinder*	*08 inches*
5	*No. Of Cylinders*	*04 per coach*
6	*Brake force available on brake head*	*1 Ton*
7	*Type of Brake Block*	*High friction Composite K- Type Brake Block*
8	*Coefficient of Brake Block*	*0.28 – 0.30*
9	*Thickness of Brake Block*	*50 mm*
10	*Piston Stroke*	*Working stroke – 32 mm*
11	*Capacity of Truss Beam*	*13 Ton*
12	*Weight of Brake Block*	*2.5 kg*
13	*Anti Vibration Bracket*	*Eliminated*
14	*Horizontal Lever*	*Eliminated*
15	*Bogie Pull Rod*	*Eliminated*
16	*Life of the Brake Gear Components including Wheel*	*More*
17	*Number Brake Gear Adjustments*	*02*

5.2 Testing of Distributor Valve

AIR BRAKE TESTING:-

1) Engine Testing
2) Continuity Test
3) Rake Test
4) SWTR / SCTR

1) ENGINE TESTING :- (RDSO – Pamphlets 9408)

With the use of 7.5 mm diameter test plate (master test plate gauge) .

- **Object:-**To check the leakage in engine & compression capacity of engine.
- **When to be Conducted:-**If there is any dispute between C & W and Loco department regarding creation of requisite pressure in engine as well as in the rake.

- **Procedure:-**
  - i) Detach the engine from rake.
  - ii) Ensure -
  - a) MR pressure – 8 – 10 kg/cm2
  - b) BP pressure – 5 kg / cm2
  - c) FP pressure – 6 kg/cm2
  - iii) Ensure pressure in BP at 5 kg/cm2 & open the cut off angle cock from the both sides (front & rear) to drop the BP pressure suddenly to wash out the system.
  - iv) Close the angle cock & charge the BP again at 5 kg/cm2.
  - v) Apply master test plate gauge with rear side of the BP hose palm.
  - vi) Open the cut off angle cock of same BP hose & ensure the pressure in master test plate gauge. After 60 sec not to be more than 1 kg/cm2 or gauge reading should not be less than 4 kg/cm.
  - vii) If drop is more than 1 kg/cm2 , it indicates that said engine is leaking or having low compression capacity .
  - viii) Engine must be detached from the rake & other engine is required for train operation.
  - ix) Same procedure can be adopted to check the leakage in FP.

- **Joint Committee Members:-**
  - i) On examination station – LI + CWI + Dy. SS
  - ii) On road side station – Driver + Guard + TXR
  - iii) In Goods yard – SSE/ SE + LI + AYM / CYM.

2) CONTINUITY TEST:-

To be conducted by Guard & Driver.

- **Object:-** To check the continuous flow of air from engine to last vehicle (or any floating obstruction)

- **When To Be Conducted:-** Before departure of primary / secondary rake from platforms or if any attachment

- Detachment of engine or rolling stock in the road side station.

- **Procedure:-**

  i) After completion of rake on plat form, before departure guard & driver jointly conducted the above test to ensure flow of air.

  ii) At first guard & driver will communicate with walkie- talkie or telephone to perform the continuity test.

  iii) After that guard will drop 1.0 kg/cm2 of BP pressure from last vehicle & ask driver for same pressure drop is sensed in engine.

  iv) If yes, now driver will drop total amount of BP pressure in engine & same is asked by the guard.

  v) After drop assistant driver & guard will come down from the train and ensure brake application especially in at least two or three vehicles near to engine and rear brake van.

  vi) If brakes are applied same should be released (in two or three vehicles) & communicate each other.

  vii) At last requisite pressure is created in engine and brake van & train is ready to go.

3) RAKE TESTING:-

The different activities / tests to be performed during rake test-

A Carry out visual examination

B Prepare of test rig for rake test

C Leakage, service application & release test

6.Maintenance manual

7. Couplings& Buffers

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

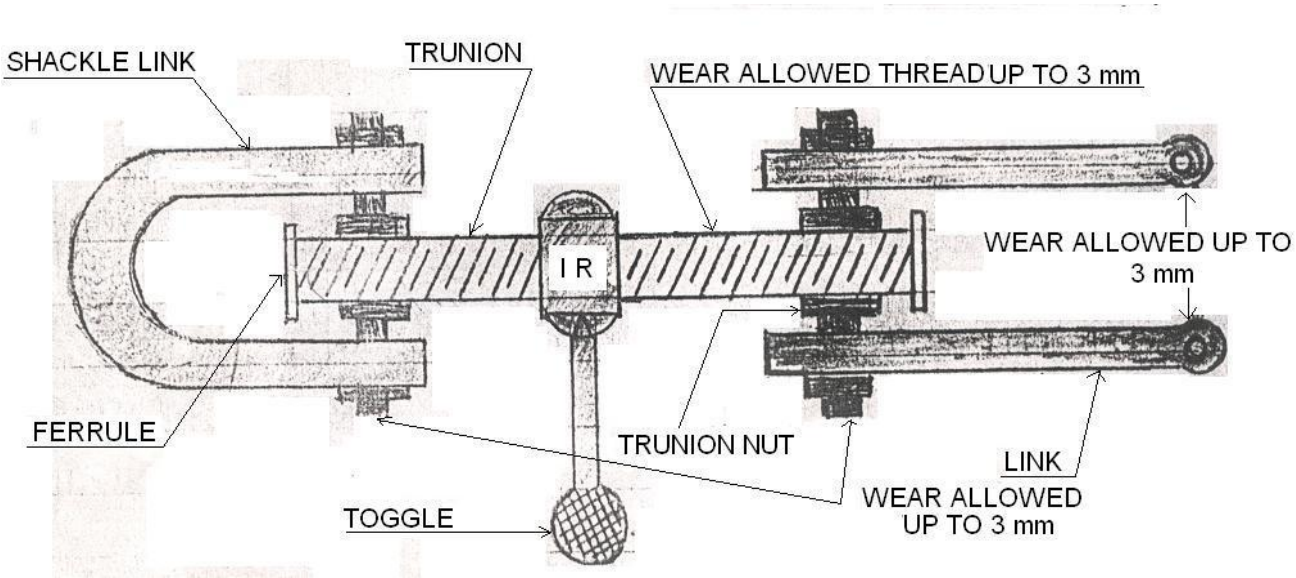
i. Conventional Draft Gear
ii. Centre Buffer Coupler

Main components of conventional draw gear are as under:-

1. Draft Hook.
2. Draft Links
3. Draft Key
4. Draft Spring/ Draft Pad.
5. Cotter
6. Washer
7. Bent Pin(U-Pin)
8. Hexagonal Nut.
9. Screw Coupling

Parts of Screw Coupling.

I. Shackle.
II. Link.
III. Trunnion Nut.
IV. Ferrule.
V. Screw Rod.
VI. Washer.
VII. Gravity Lever.



In 1984 use of Enhanced Screw Coupling was started, which is again modified in 1998.To identify this coupling a Dumbel 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

Modification:

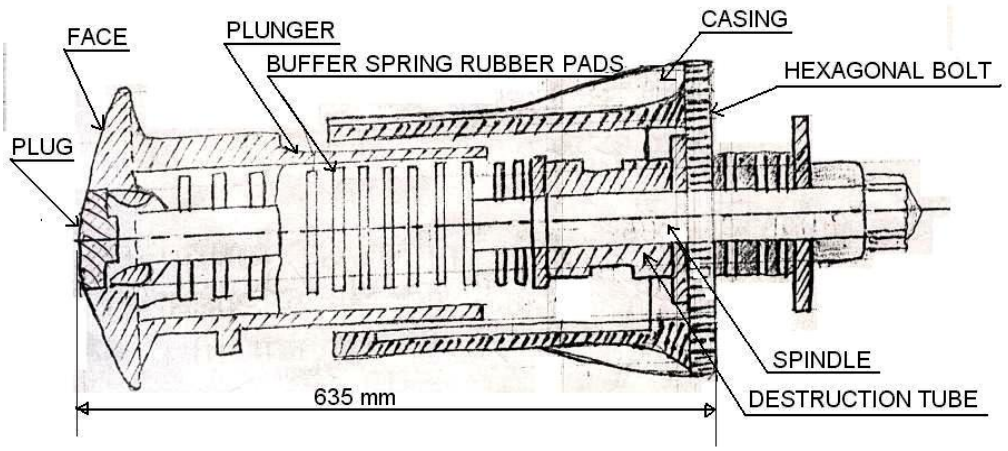
Sl. No.	Description	Non Modified	Modified	Remark
1	Working Capacity	36 Ton	36 Ton	
2	Proof Load Capacity	60 Ton	70 Ton	
3	Breakage Capacity	Draw Bar – 108 T S/ Coupling – 112 T	130 T for both	
4	Stamping Mark	C – 60.61	IS – 5517	

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

7.2 BUFFING GEAR

Two buffers are provided, on body head stock to absorb the longitudinal impact occurred during run on both ends, at a distance of 1956 mm. The role of buffers is also to transmit push impact to its trailing end stock. The main components of Buffing Gear are as under:-

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



BUFFER ASSEMBLY IN ICF COACHES

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 WH)

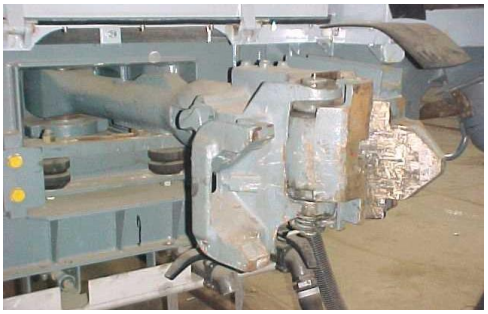
Other data:-

Max. Height in Empty condition – 1105 mm
Min. Height in Loaded condition – 1030 mm

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 kg m (New Type)

'H' TYPE CBC COUPLER

Coupler:



- The coupler provides a means of mechanically connecting individual adjacent vehicles in order to make a train.
- The coupler is located at both end of each vehicle.
- When connected to a coupler of an adjacent vehicle it allows the vehicle to move independently to accommodate track curvature and elevation change while remaining connected together.

Advantages of CBC:

- High hauling capacity permits to attach more No. of coaches.
- Rake fitted with CBC can be run with comparatively high speed.
- No need to provide separate Buffing Gears. Hence the incidence of Buffer interlocking is avoid.
- Coupling/Uncoupling can be done easily from track side.

"H" Type Tight Lock Coupler:

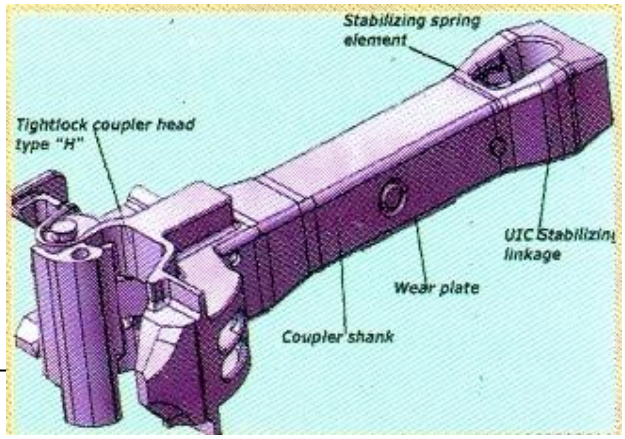
- The AAR "H" type tight lock couplers are used in LHB/HYBRID coaches instead of screw coupler.
- The coupler is opened manually using the coupler operating rod and is closed automatically when the couplers on adjacent vehicle are mated.
- The coupler automatically locks when fully mated.

Main Parts Of "H"type CBC:

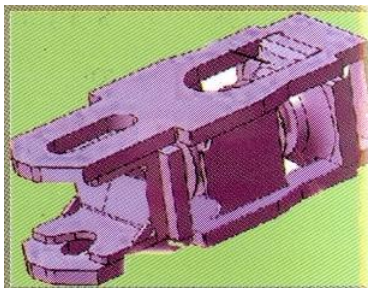
- "H" Type Tight Lock Coupler Head.
- Draft Gear.
- Supporting Device.
- Manual Uncoupling Device.

"H" Type Tight Lock Coupler Head:

- The coupler head has a shank/Draw bar cast together with the head.
- Parts like Knuckle, lock etc, are assembled in the coupler head to enable coupling and uncoupling.



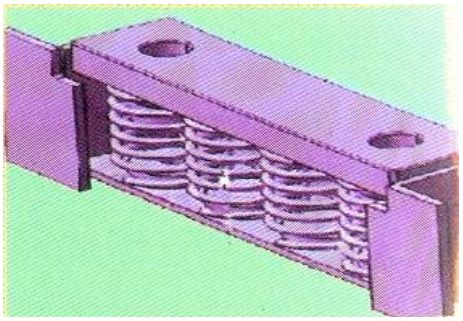
- Tail end of the draw bar is provided with the UIC stabilizing link and connects to the draft gear through the central pin.
- A backlash compensation device is assembled in the shank at tail end of the coupler head.



Draft Gear:

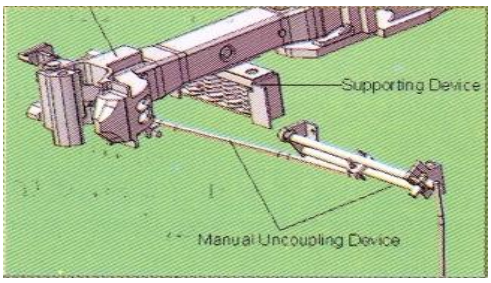
- The Draft Gear is a double acting device for energy absorption during coupling and services.
- The device is designed to fit into the draft gear pocket of the Coach and absorb the dynamic energy in both i.e. draw and buff modes.

SUPPORTING DEVICE:



- Supporting device comprises of four preloaded springs.
- The device is placed on a platform and bolted to the car structure.
- The coupler head rests on the top wear plate of the supporting device and this device supports the coupler weight.
- Its main parts are- Wear plate, Frame, Compression spring, Nut & Bolts.

Manual Uncoupling device:



- The manual uncoupling device is mounted on one side near end wall of coach connecting the uncoupling mechanism on coupler head through the sliding rod.
- Handle of device is unlocked, lifted and then rotated in the clockwise direction for uncoupling.
- After coupling, locking of the handle has to be ensured to prevent unauthorized uncoupling.

TECHNICAL DATA:

- Draft Gear capacity:
  - Dynamic energy absorption capacity: 45 kj (min).
  - End force : 1600kN (max)
- Stroke: Tension- 58 mm, Compression- 80mm.
  - Pre load : 30 kN,
- Strength of Coupler Head with Draft Gear :
  Tensile load = 1000 kN, Compressive load = 2000kN.

Bending test of Coupler head: 300kN.

- Coupler length : 1030± 5mm
- Weight of coupler : 500kg.
- Gathering range: Horizontal: ± 110mm, Vertical : ± 90mm.
- Maximum horizontal swing coupler : ± 17.85 º
- Maximum vertical swing coupler : ± 7 º
- The maximum slack is restricted to 3.5 mm

Salient Features:

- Coupler head is a standard AAR 'H' type with backlash compensation device.
- 'H' type coupler provided with anti climbing feature.
- Coupling is possible under angular misalignment both horizontally & vertically.
- The coupler permits coupled trains to negotiate vertical and horizontal curves and allows rotational movement.
- Uncoupling can be achieved manually from track side by means of a combination of rod & levers.
- Draw Gear ensures cushioning effects in both buff & draft.

Check points for proper coupling:

- Knuckle and coupler head machined faces should be parallel.
- Telltale slot should be clear of Rotary Lock Lift Lever.
- Rotary Lock Lifter rib should be vertical.
- Securing Bolt of manual uncoupling device should be in locked condition. This is to prevent manual uncoupling inadvertently.

Check points for proper uncoupling:

- Securing Bolt should be in unlocked condition. Uncoupling device handle can be operated to uncouple.
- Rotary Lock Lift lever should be visible.
- Rotary Lock Lifter rib should not be vertical.
- Knuckle and coupler head machined faces should not be parallel.
- No oil grease should be applied on coupler parts such as Knuckle, Lock, and Rotary Lock Lifter etc.

Condition for coupling:

- Coupling is possible under any of the following conditions.
  - When both knuckles are in open condition.
  - When one knuckle is open & other is in closed condition.
- Condition will not permit coupling.
  - If both knuckles are in closed condition coupling will not take place.

8.Passenger & Amenities fittings

The fittings which are provided inside the coach for Luxurious & Comfortable & also for non strenuous journey are called as “Amenity Fittings “.

Safety Fittings: - The fittings which are fitted in the coach for safety of passengers & their luggage are called as “Safety Fittings “.

Compartment:-

Amenity Fittings	**AC Coach**	**1st Class Coach**	**2nd Class Coach**	**Sleeper Coach**
Folding or Fixed Table	Y	Y	N	Y
Tumbler Holder	Y	Y	N	N
Waste Paper Basket	Y	N	N	N
Mirror with Shelf below	Y	Y	N	Y
Coat Hook	Y	Y	Y	Y
Foot rest for Upper Birth riding	Y	Y	N	Y
Fans	Y	Y	Y	Y
Upper Birth	Y	Y	N	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: -	**AC Coach**	**1st Class Coach**	**2nd Class Coach**	**Sleeper Coach**
Luggage locking wire	Y	Y	Y	N
Alarm Chain	Y	Y	Y	Y
Upper Birth Safety Rail	Y	Y	N	N
Doors latch & cutch	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

9. IRCA Part IV

IRCA- INDIAN RAILWAY CONFRENCE ASSOCIATION

1. *HEAD QUARTER- DRM Building New Delhi*
2. *WORKING: Under Rly Board(Member Traffic)*
3. *ADMINISTRATIVE CONTROL-GM/Northern Rly*
4. *HEAD: General Secretary (Traffic /Commercial Dept.)*

***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: IRCA Part III for wagon stock & IRCA 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

TRANSPORTATION CODES FOR COACHES

S.No	Transportation code	Details
1	W	VESTIBULE
2	G	SELF-GENERATING
3	S	SECOND CLASS
4	F	FIRST CLASS
5	L	LUGGAGE VAN
6	R	GUARD BRAKE VAN
7	Y	LADIES COMPARTMENT
8	J	ICE COMPARTMENT
9	Q	ATTENDENT
10	D	VENDORS COMPARTMENT
11	P	POSTAL VAN
12	U	KITCHEN
13	CB	PANTRY CAR
14	CD	DINING CAR
15	CN	SLEEPER CLASS THREE TIER
16	CW	SLEEPER CLASS TWO TIER
17	CZ	CHAIR CAR
18	CT	TOURIST CAR
19	AC	AIR CONDITIONED
20	FC	FIRST CLASS WITH COUPE
21	FF	UPPER CLASS
22	SC	SECOND CLASS WITH COUPE
23	GS	SECOND CLASS WITH SELF GENERATING EQUIPMENT
24	LL	LUGGAGE VAN WITH LAVOTARY
25	JJ	REFRIGERATOR COMPARTMENT
26	M	MILITARY CAR ORDINARY
27	MA	MILITARY CAR AMBULANCE
28	ML	MILITARY CAR KITCHEN
29	MF	MILITARY FIRST CLASS
30	ART	ACCIDENT & TOOL VAN OR RELIEF VAN
31	ARME	AUXILARY RELIEF TRAIN WITH MEDICAL EQUIPMENT
32	CT	TOURIST CAR
33	CTS	TOURIST CAR FOR 2^{ND} CLASS PASSENGERS
34	CZACEN	AIR CONDITIONED CHAIR CAR WITH END ON GENERATION
35	ERR	FOUR / SIX WHEELER
36	EN	END ON GENERATION
37	MN	MID ON GENERATION
38	ERU	FOUR / SIX WHEELER SELF PROPELLED TOWER VAN
39	FCS	FIRST CLASS COUPE AND SECOND CLASS
40	FSCN	FIRST CUM II CLASS 3-TIER SLEEPER

41	GS	SECOND CLASS FITTED WITH SELF GENERATING EQUIPMENT
42	LR	LUGGAGE WITH BRAKE VAN
43	NMG	NEW MODIFIED GOODS
44	OHE	OVER HEAD EQUIPEMNT INSPECTION CAR
45	PPS	FULL BOGIE POSTAL VAN
46	RA	INSPECTION CARRIAGE (ADMINISTRATIVE)
47	RAAC	AIR CONDITIONED INSPECTION CAR
48	RD	INSPECTION CARRIAGE (SUBORDINATE)
49	RE	INSTRUCTION VAN (MOBILE TRAINING CAR)
50	RH	MEDICAL VAN
51	RHV	AUXILIARY MEDICAL VAN
52	RK	DYNAMOMETER CAR
53	RN	GENERATING VAN
54	RR	TRAIN CREW AND REST VAN
55	RS	STORES VAN
56	RT	ACCIDENT AND TOOL VAN OR RELIEF VAN
57	RZ	TRACK RECORDING CAR
58	SLR	SECOND CLASS LUGGAGE AND BRAKE VAN
59	SMN	POWER CAR WITH MID ON GENERATION
60	VP	PARCEL VAN
61	VPC	PARCEL VAN CONVERTED
62	VPU	MOTOR CUM PARCEL VAN
63	VPH	HIGH CAPACITY PARCEL VAN
64	WSCZAC	VESTIBULED II CLASS AIR CONDITION CHAIR CAR
65	WCD	VESTIBULED DINING CAR
66	WCRAC	VESTIBULED AIR CONDTIONED TWIN CAR
67	WCTAC	VESTIBULED AIR CONDITIONED TOURIST CAR
68	WFAC	VESTIBULED AIR CONDITIONED FIRST CLASS
69	WFC	VESTIBULED FIRST CLASS
70	WGACCN	VESTIBULED SELF GENERATING AIR CONDITIONED THREE TIER
71	WGACCW	VESTIBULED SELF GENERATING AIR CONDITIONED TWO TIER
72	WACCW	VESTIBULED AIR CONDITIONED TWO TIER
73	WGFAC	VESTIBULED SELF GENERATING AIR CONDITIONED FIRST CLASS
74	WGFACCW	VESTIBULED SELF GENERATING FIRST CUM AC 2-TIER
75	WGSCN	VESTIBULED SELF GENERATING SECOND CLASS THREE TIER

76	WGSCNLR	VESTIBULED SECOND CLASS THREE TIER WITH LUGGAGE & BRAKE VAN
77	WGSCZ	VESTIBULED SELF GENERATING SECOND CLASS CHAIR CAR
78	WGSCZAC	VESTIBULED SELF GENERATING SECOND CLASS CHAIR CAR AIR CONDITIONED
79	WGSD	VESTIBULED SELF GENERATING SECOND CLASS DOUBLE DECKER
80	WLRRM	VESTIBULED LUGGAGE CUM BRAKE VAN WITH DIESEL GENERATING MOTOR CAR
81	WSCZAC	VESTIBULED SECOND CLASS AIR CONDITIONED CHAIR CAR
82	WSLRN	VESTIBULED SECOND CLASS, BRAKE CUM LUGGAGE AND POWER CAR

10. Repair & maintenance of Coaching Stock

MAINTENANCE SCHEDULE: Periodic Maintenance Expiration And Operations Summary

In the following table the periodic expirations of the operations are summarised.

The indication in kilometers, to which said expirations make reference, is priority in comparison to those temporal. The latter are valid if the routes of the roadway correspond to the suitable period.

TIME	km (x 1000)	TYPE
daily	-	DA
1 week	8	D1
1 month	33	D2
6 months	200	D3
1 year	400	D4
2 years	800	W1
4 years	1600	W2
8 years	3200	W3
16 years	6400	R1
24 years	12800	R2

Note: 'D' stays for 'Depot', 'W' for 'Workshop', 'R' for 'Rehabilitation

Periodic maintenance expirations

In the following Table II are listed all the maintenace operations described in detail on the maintenace cards in paragraph 6.3.

MAINTENANCE OPERATION	PERIODICITY DA-D1-D2-D3-D4-W1-W2-W3-R1-R2										CARD NR.
Wheels and axle check			X	X	X	X	X	X			01
Brake disc wear check			X				X				02
Axle bearings and instruments	X	X	X		X	X	X	X	X		03
Electric equipment	X	X	X						X		04
Control arm check			X	X	X		X	X			05
Primary suspension check		X			X	X	X	X	X	X	06
Primary suspension dampers check		X			X			X			07
Brake equipment check	X	X	X			X	X				08
Check hand brake equipment		X	X	X				X			09
Pneumatic equipment check		X					X		X		10
Bogie frame check			X	X	X		X			X	11
Rotation limiter check				X					X	X	12
Anti-roll bar assembly check			X	X		X	X				13
Secondary suspension check		X			X	X	X	X		X	14
Dampers check		X			X			X			15
Traction center check			X	X			X	X			16
Rubber pads check			X	X			X	X			17
Bearing running temperature check				X							18
Bearing inspection						X		X			19

Maintenance operations summary

11.1 CLASSIFICATION OF COACHING MAINTENANCE DEPOTS

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

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

Standard Facilities:-

1. Covered accommodation
2. Flooring & pit for repair & examination
3. Office & store facilities
4. Sick line yard
5. Machinery & plant

Covered Accommodation:

1. Track length of under covered accommodation for any type of sick line must be at least 4% of the holding capacity(based coaches)

OR

Total track length should not be less then coaches in view of repair purpose whenever working space required for each coach is 35m

OR

Track length should not be less then 140m for any type of sick line.

2. It is essential to provide 50% track length under a covered area with pit examination facilities.

3. In pit there should be proper light arrangement.

4. It should also be ensured that it is provided with drainage facilities with 1% inclination & required number of man holes.

5. At least hoist crane in capacity 3 to 5 tones also should be provided across the track.

6. The width of the covered accommodation should be normally 15 meters and should be normally cover two tracks under it. The gap between two adjacent track should not be less than 7.5 meters. Where overhead crane is provided. If overhead gantry is not provided the can be maintained to 6 meters.

7. It should be ensured that proper space is provided beside the track for free and easy movement of transport vehicles as like fork lift, lister, trolleys, truck, etc.

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

Machinery And Plant:

To avoid heavy manual labour, wastage of manpower and to provide efficient working of depot, suitable adequate machinery and plant is required which are as under.

SR.NO. PARTICULARS

1. Self propelling whiting jacks
2. Coach shunter-portable wrench type.
3. Welding plant 200 amp capacity with double load
4. Gas cutting & welding equipment
5. Vacuum exhauster
6. Air compressor(150cfm)
7. 2 tones hoist with tram beam.
8. Sawing machine.
9. Diesel jeep with 2 trolleys.
10. Wood cutting saw machine.
11. Fork lift truck.
12. Hand shearing machine.
13. Portable furnace
14. Centre lathe 230mm (9") chuck.
15. Wheel lathe.
16. Manipulator/fixture for bogie.
17. Ultrasonic testing apparatus.
18. Tool post grinder.

TOOLS:

1. Pneumatic hand tools
   (a) Grinder (b) Drill (C) Chipper/buster (d) Riveter
2. Electric power tools.
   (a) Pop riveting tool gun (b) Drill (c) Bolt tighter/torque wrench.
3. Hand tools including torque wrenches as required.

Sr.No.	Test benches and miscellaneous items.
1.	D.V. Testing bench.
2.	Air Brake cylinder overhauling testing bench.

Primary Depot and Secondary Depot

Sl.No	Primary Depot	Secondary Depot
1.	Maintenance works attended by based depot is called primary depot.	Maintenance works attended by terminating depot other than based depot is called secondary depot.
2.	Preparation of DRS card is done by primary depot.	Only cross checking of items as per DRS card or only shortage, missing should be provided by secondary depot.

3.	Primary maintenance depot is responsible to prepare history card of coach.	Intimation to primary depot is essential whenever 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 duty of primary maintenance depot to send the coaches for POH or NPOH if due or required.	It is not duty of secondary depot but it assist in sending the coaches for POH or NPOH through primary depot.

MAINTENANCE SCHEDULES TO BE FOLLOWED IN COACHING DEPOTS

a) To maintain coaching stock in good condition, the following preventive maintenance schedules are prescribed to be carried out in carriage depots on divisions where rake has been based for primary maintenance.

1. **Trip schedule**- After every trip by primary maintenance depot.
2. **Schedule A** - Monthly (**1 month ± 7 days**)
3. **Schedule B** -Quarterly (**3 months ± 15 days**)
4. **IOH** - 9 months + 30 days
5. **POH** - 18 months

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

1. **TRIP SCHEDULE :-**

Trip schedule is attended per trip of the rake. The trip is being attended by Primary depots. No need to detach the coach from the rake during trip schedule. Total distance traveled by passenger rake in a trip up and down is more than 3500 km. Following procedure is adopted during the trip schedule:-

1. All under gear parts are thoroughly examined.
2. All moving parts are lubricated.
3. Complete examination of buffing & draw gear for its proper functioning. Lubrication is essential.
4. Coupling should be free in its screw i.e. ensure easy movement of coupling.
5. Proper examination of primary suspension arrangement.
6. Ensure the leakage of dash pot and oil level of dash pot.
7. Proper securing of safety strap and safety loop.
8. Proper examination of secondary suspension. Ensure the working of spring, shock absorber, safety strap & safety loop.
9. Proper examination of wear in suspension link bracket, pin & shackle stone.
10. Examine the proper function of shock absorber & securing bolt.
11. Examination of equalizing stay rod for its proper securing.
12. Examination of proper securing of bolts & cotters & silent bushes of centre pivot.

13. Ensure the proper function of side bearer or its oil level.
14. Changing of worn & wear brake blocks & pin & adjustment of brake power.
15. Proper cleaning of coach from inside & outside & disinfections.
16. Spraying of pesticides elements.
17. Checking of all points & pipe joints & other fittings & filling of water tank.
18. Proper opening & closing of vestibule doors.
19. Checking of amenity & safety items.
20. All falls plate examination of vestibule.
21. Testing of alarm signal, guard van valve & its gauge.
22. Preparation of DRS card & brake power certificate.

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

1. The revised POH periodicity from 12 to18 months is applicable to all Mail/Express coaches for which Railway shall arrange transportation of bogies from and to work shop.
2. A marking on the coach below return date shall be specified to distinguish 18 months periodicity.
3. The general sequence of coach will remain as per existing coaching maintenance manual.
4. The items of trip schedules; 'A' and 'B' schedules will remain same.
   The coach will be given 2 quarterly schedules B 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/1.0in jan-2008.

5. CMIs, SMIs and technical circulars/pamphlets issued time to time by RDSO schedules followed for necessary modification and replacements.
6. As per requirement of bogie as unit exchange, the bogies should be collected from workshop considering transportation time plus two days before spare.
7. The periodicity of overhauling of DV is changed from 24 months to 18 months (during POH)
8. Work shop to switch over PU painting at workshop as advised by RDSO.

2. SCHEDULE `A' :** Schedule `A' is required to be given **every month + 7 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.

'A' schedule maintenance:

(i) All items of primary/secondary maintenance schedule.
(ii) Test the working of brake cylinders for proper application and release.
(iii) Thorough inspection of brake pipe, feed pipe and their connecting pipes to brake cylinder, distributor valve, and Auxiliary reservoir and hose coupling for leakage and attention.
(iv) Carry out manual brake release test on every coach to ensure proper functioning of release lever of distributor valve.
(v) Micro switch of ACP should be tested by electrical staff for proper functioning.
(vi) Clean Dirt collector filter with kerosene and refit.
(vii) Test the working of slack adjuster in under frame mounted air brake system. Repair/Replace the defective slack adjuster.
(viii) Examine loops/ brackets and their securing devices and rectify.
(ix) Examine for wear and replace if required brake hanger pins, brake blocks and brake heads.

The following items of work should be attended during Schedule `A' examination, i.e., monthly examination:-

(i) All items of primary/secondary maintenance schedule.

(ii) Intensive cleaning of coaches.

(iii) Intensive cleaning of lavatory pans and commode with specified cleaning agent.

(iv) Thorough flushing of tanks.

(v) Checking of water pipes, flush pipe, flushing cocks, push cocks, etc., for ease of operation and free flow of water.

(vi) Thorough dis-infection of all compartments.

(vii) Thorough inspection and repairs of draw gear.
(viii) Thorough inspection and repairs of buffers.
(ix) 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 when the oil is below the plug and replenished with specified grade of oil so that wear plate is fully covered by oil.

(x) Inspection and repairs of commode chute.

(x) Thorough check and repairs of sliding doors and vestibule doors for easy and smooth operation and correct alignment and all wearing parts, loose screws, etc.

3. SCHEDULE `B':**Schedule `B' is required to be given every **three months + 15 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.

Air brake system

(i) Same as 'A' schedule

Other assembly maintenance

(i) Besides brake system other items should be attended as given below:
(ii) All items of Schedule `A'
(iii) Painting of lavatories from inside.
(iv) Thorough inspection and repairs of brake gear components.
(v) Thorough checking of trough floor, turn under, etc., from underneath for corrosion.
(vi) Touching up of painted portion, if faded or soiled.
(vii) Overhauling & testing of alarm chain apparatus.
(viii) Testing of guard van valve.
(ix) Greasing of equalizing stay rod.

4. FOR IOH:

i) Coaches required for detachment for IOH.
ii) For maintenance of major break–down/ mal-functioning of any subassembly etc. the decision whether the coach is to be detached from the formation for attending to

maintenance/replacement of major subassembly is dependent on maintenance requirements, operational convenience, time availability etc. The decision is taken by the Engineer (C&W). Coach failure report should be made.

ii) At depot, the coach that is detached for IOH is taken over to the washing line for cleaning, lubrication and minor maintenance. The coach that are detached due to a major defect in the distributor valve, brake cylinder, Auxiliary reservoir etc, is taken to the pit line for the replacement of such sub-assemblies, on unit exchange basis. The detachment of coach is carried out so as to make the maintenance or testing activities convenient and faster so that the coach is made ready for use without delay.

PROCEDURE: The activities performed to detach a coach with Air Brake system are as under-

i) Safety precautions shall be taken to prevent injury while detaching/attaching a coach.
ii) Remove the clamps on the cut-off angle cocks. Close the cut-off angle cock of both feed pipe and brake pipe on both sides of the coach that has to be detached.
iii) Close the cut-off angle cocks of the feed and brake pipe of adjacent coaches. This is to ensure that the air pressure locked up in the air hose coupling gets vented to atmosphere through the vent hole of the cut-off angle cock.
iv) Observe above mentioned safety measures to close all the four cut-off angle cocks on either side of the coach to be detached so that while opening air hose coupling, it may not cause injury due to air pressure inside.
v) Release the brake of the coach to be detached by pulling the manual release lever of the distributor valve.
vi) Open the Feed Pipe and Brake Pipe hose coupling from both sides of the coach.
vii) If the air pressure of brake cylinder does not vent by pulling the manual release valve of distributor valve, open the brake cylinder vent plug to drain the air pressure.
viii) Uncouple Screw coupling and detach the coach.
ix) Observe all other safety measures as prescribed.

5. IOH :

Air brake maintenance:

(i) IOH is required to be given **every nine months +30 days** at the nominated primary depot.

(ii) Coaches are required to be detached from the rake and taken to the sick line for examination and repairs.

The following items of work should be attended during IOH.

Air brake system maintenance:

(i) Check brake cylinder for loose rocker arm plate and change on Bogie Mounted system.
(ii) Brake cylinder should be checked for smooth functioning and prescribed stroke. Defective brake cylinders shall be sent for repairs.
(iii) Guard's van valve should be tested.
(iv) Test BP & FP air pressure measuring gauges with master gauge and replace if found defective. 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 base workshops for testing, repairs and calibration.
(v) Thoroughly clean Dirt collector filter in kerosene or replace on condition basis.
(vi) 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.

Other assemblies maintenance:

(i) All items of Schedule `B'

(ii) Thorough repairs of running gear including running out of bogies where considered necessary. Bogies which are working on rake links earning more than **nine months** must be run out and unit exchanged with overhauled bogie received from workshop.

(iii) Touching up damaged paint of coaches on outside as well as inside.

(iv) Thorough cleaning and removal of dust, rust, dirt, etc., accumulated at the pillars through the turn under holes, with coir brush and compressed air.

(v) Thorough examination and repairs of upholstery, cushions, curtains, etc.

(vi) Thorough checking and full repairs of all window shutters, safety catches, safety latches, staples and hasps of compartment, lavatory, body side and vestibule doors for ease of operation.

(vii) Thorough checking and repairs of UIC vestibules, their rubber flanges metal frames, doors, fall plate, locking gear, etc., for ease of operation and safety.

(viii) Thorough checking and repairs of all cracks and worn out portions of flooring of 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 adjoining areas, corridor sides - more so in case of those SLRs which are used for 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 taken for the following:-

i) 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.

ii) Drain holes provided in the trough floors should be kept clean and unclogged. If during the cleaning of these drain holes any accumulation of water is observed, the affected area should be very carefully inspected for possible corrosion.

iii) A register should be maintained of the primary maintenance coaches on the subject.

i. During this lifting schedule, 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 do these repairs or are prohibited to be done in the maintenance depots, the bogies should be sent to the shops for carrying out these repairs.

ii. The detailed table of maintenance activities to be carried out during IOH schedule is enclosed as appendix-G.

iii. The date of intermediate lifting should then be stenciled at the appropriate place in schedule chart on the end panel

Note:

1) **Intermediate Overhauling of Shatabdi/Rajadhani Exp. Coaches are attended in nominated workshop only.**
2) **Intermediate overhauling of newly built coaches are to be attended after 12 months only wheels are to be replaced**

RPC-4 Revision-June 2017

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.

S. N.	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 plate form/at other end
1	Rajdhani/ Doronto train	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. Terminating examination at terminating station.	Complete air brake testing with fresh BPC at both ends
1A	Shatabdi trains	At primary end	At primary end	At both the ends	At primary end	---do---	Complete air brake testing with fresh BPC at both ends

2	Mail/Exp. Round trip >3500 kms /ICF or 4000 kms/LHB	At primary end	At both the ends	At both the ends	At both the ends	---do---	Complete air brake testing with fresh BPC at both ends
3 (a) (i)	Mail/ Exp round trip <3500 km for ICF and 4000 km for LHB (except category 1 trains)	At primary end	At primary end	At both the ends	At primary end	---do---	Only continuity check if stabled at platform. Otherwise endorsement on original BPC is required
3 (a) (ii)	Mail/ Exp train touch primary station more than once in 3500 km(ICF) or 4000 km(LHB) and 96 Hrs., whichever is earlier(exclude 1, 1(a) trains)	At primary end	At primary end only once in 3500 Km (ICF) or 4000Kms (LHB)	At both ends	At primary end	---do----	Only continuity check if stabled at platform. Otherwise endorsement on original BPC is required

3b	Inter connected Mail/ Exp round trip run up to 3500 km(ICF) or 4000km(LHB)	At primary end	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	At primary end	---do----	Only continuity check if stabled at platform. Otherwise endorsement on original BPC is required
4	Passenger trains with toilet including interconnected passenger trains/ shuttles	At primary end	To be done after 3500 km or 96 hrs after issue of original BPC whichever is earlier at primary end	At primary end and each terminal	At primary end	---do----	Only continuity check if stabled at platform. Otherwise endorsement on original BPC is required
5	Passenger trains without toilet	At primary end	To be done after 3500 km or 7 days, after issue of original BPC whichever is earlier only at primary end	At primary end and each terminal	At primary end	Once a day at primary end or at nominated terminal	Only continuity check if stabled at platform. Otherwise endorsement on original BPC is required

6	Dedicated parcel Trains	At primary end	To be done within 4500km or 10 days whichever is earlier	At primary end	At primary end	En route after every 250-350 km location to be decided by Rly for each train. Terminating examination at terminating station.	Only continuity check if stabled at platform. Otherwise endorsement on original BPC is required
7	Military/ Election special train	At primary end	To be done within 3500km(ICF) or 4000 km (LHB) or 96 days whichever is earlier	At primary end and each terminal	At primary end	---do---	---do---

Note:- Internal cleaning, passenger amenity attention and watering may be done at platform line or nominated stabling line provide 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

Sl.No.	IOH	POH	NPOH
1.	It stands for intermediate overhauling.	It stands for periodic overhauling.	It stands for non periodic overhauling.
2.	IOH of coach is attended after 9 months of POH.	POH of Passenger carrying vehicle M/Exp -18 months,	Time Period is not fixed for any vehicle for NPOH
3.	IOH of coach is allowed in sick line where facility to lift the coach is available.	POH is allowed in nominated workshops only.	NPOH is done only in workshop or in nominated major sick line.
4.	During IOH all the parts of under gear thoroughly examined and replaced if necessary.	At the time of POH all parts of under gear are dismantled and should be replaced if there is any wear and tear.	Only indicated defects & safety items are attended.
5.	At the time of IOH painting of coach is not necessary, only required places are touched up.	Painting of whole coach is necessary.	Complete painting of coach is not necessary, only required places are touched up.
6.	Profiling of wheel is necessary.	Profiling of wheel is necessary.	Profiling of wheel is on need based.

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 sulfides. Oxidation takes lace only when steel surface exposed to atmosphere or moisture. Chemical reaction is as follows:

$$4Fe + 3O2 \text{ --------} 2Fe2O3$$

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 week.

Effect of corrosion: Corrosion of materials is liable to performance of the product, loose 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.

10.2 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 aluminum 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.

10.3 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 moldings are welded and where ventilators are fitted. RDSO instructions to be followed

10.4 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.

A) 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 comprege 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.

B) 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 touchup 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)

1st day	–	Remove old paint
2nd day	–	One coat of red oxide zinc chromate primer
3rd day	–	One coat of brush filler followed by spot putty
4th day	–	Filler 2nd coat (spot putty if necessary)
5th day	–	Rub down with silicon carbide paper
6th day	–	One coat of under coat
7th day	–	Flat with silicon carbide paper.One coat of enamel finishing.
8th day	–	Flat with silicon carbide paper. 2nd coat of enamel finish
9th day	–	Lettering and miscellaneous work

C --- Schedule

1st day	–	Washing with soap solution touchup damages with primer
2nd day	–	Spot putty if necessary and one coat of under coat
3rd day	–	Flat with silicon carbide paper apply one coat of finishing Enamel
4th day	–	Flat with silicon carbide paper apply second coat of Finishing enamel.
5th 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. Incase of heavy corrosion replace the component.
5) Ensure painting of wagons during ROH. painting/ paint touchup 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 counseled about the corrosive effect of acids from batteries.

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

11. BRAKE POWER RULES

11.1 Brake power Certificate

Brake Power Certificate is a document prepared in triplicate by the C&W Engineer in the prescribed format and jointly signed by the C&W Engineer, Guard and driver of the train. The C&W engineer retains original copy and the duplicates are handed over to the driver and the Guard. Brake Power Certificate can be issued only after a thorough examination of the train and after testing the effectiveness of the brake power.

Certification of Coaching stock shall be done as per Railway Board Policy Circular (RPC 4).

Certification of Freight Trains shall be done as per the JPO/SWR No.2/2009 dated 12.11.2009

A qualified C&W Engineer is only the competent authority to issue the BPC. Any alteration in the BPC will make it invalid, however it can be valid when countersigned by the person issuing the BPC. Validity of the BPC cannot be extended.

Speed restriction is imposed when the composition of a train consists of:

1. ISMD Load
2. Travelling Crane
3. Sick/Damaged vehicles

Speed restriction, if any imposed should be endorsed at the top of the front page of the BPC and signed by the C&W Engineer.

11.2 Percentage of brake power for Originating trains

All coaching stock should be with 100% brake power from the originating station.

On originating BG and MG vacuum goods trains, there shall be 85% and 80% effective brake power respectively, subject to observance of any higher limit prescribed by the Railways for particular Ghat/other sections.

The minimum originating brake power for air braked goods trains, running on end-to-end pattern of examination, shall be 85% except wherever local instructions have specified higher level of brake power to meet specific requirement. Exception shall only be made after prior approval of Chief Rolling Stock Engineer has been obtained for each individual case.

Percentage of brake power for Premium End to End trains shall be 95% from the originating station.

The originating brake power for air braked goods trains; running in close circuits shall be 100%.

Percentage of brake power for trains' en-route:

When the driver experience difficulty in controlling the train and has reason to ask for a check on the adequacy of brake power, he shall contact control office.

The section controller shall take the advice of the C&W controller and the Power controller in dealing with trains reported as having inadequate brake power.

The controllers shall take into consideration the difficulty reported by the driver, proximity to a major station/yard, scope for moving the train, if necessary, at restricted speed, scope for moving train examination staff to the en-route station, blocking a line at the en-route station affecting through traffic etc. The decision shall depend on the circumstances of the case on hand. The driver and guard shall do check for the adequacy of brake power enroute. Depending on the circumstance, a loco inspector and a train examiner may be arranged to jointly check with the guard and driver.

If in such en-route checking, the train is found to have a brake power percentage above 70% there is no need to take up brake power up gradation.

Level of air pressure in locomotive and brake van

Coaching stock should have the following pressure in Train Engine and Brakevan;

	On locomotive	In rear SLR
BP	5.0 kg/ Cm2	4.8 kg/ Cm2
FP	6.0kg/ Cm2	5.8 kg/ Cm2

Minimum air pressure level of brake pipe in the air braked freight train in locomotive and brake van should be as follows.

No of wagons	On locomotive	On last wagon
Up to 56 BOXN /40 BCN	5.0 kg/ Cm2	4.8 kg/ Cm2
Beyond 56 BOXN /40BCN	5.0kg/ Cm2	4.7 kg/ Cm2

Validity of the brake power certificate shall be as per RPC 4 for coaching stock and JPO for freight trains

Test to be carried out on the loco to identify the problems If the locomotives do not create sufficient vacuum

Vacuum Locos;

Blockage test: Remove one end of the vacuum hosepipe and raise it upwards. If more than 8cms vacuum is created, there is a blockage in the system. Repeat the procedure on the other end of the locomotive.

Efficiency test: Diesel/electric locomotive shall be tested to ascertain that on 8 mm dia leak hole in 3 mm thick plate, with single exhauster working at slow speed on electric locomotive and with engine working at idle speed on diesel locomotive, the vacuum level should be 53 cm. In case of Diesel locomotive in the formation of 70 FWU or more, a 12 mm test plate shall be used and the loco shall create 45 cm of vacuum. The blockage and efficiency tests on diesel and electric locomotives shall be carried out not only before turning it out from the shed but also in the yard to rule out loco defects whenever the train is held up for creation of vacuum.

Leakage test: If the above conditions are achieved, then tests shall be carried out to ensure that maximum leakage rate on diesel/electric locomotive shall not more than 7cm / min.

The leakage test on the locomotive shall be carried out in the shed only.

Air Locomotive:

Compressor Efficiency test:

Place A9 handle in emergency position and ensure 10.0 Kg/cm^2 in main reservoirs, close the angle cock of the brake pipe.

Couple 7.5 mm dia leak hole special test coupling fabricated to RDSO design KDP 5691 with the brake pipe coupling of the locomotive.

Move the A9 handle from emergency to release position to charge the BP to 5 kg/ cm^2 open the cutoff angle cock of the brake pipe, the brake pipe pressure should drop from 5kg/cm^2 , check the BP pressure with the help of the gauge fitted in the locomotive. The BP should not drop below 4 Kg/cm^2 within 60 seconds.

12. TRAIN LIGHTING & AC

The procedure to be followed shall be as per guide lines given below.

12.1 VISUAL INSPECTION

Carry out visual inspection of the machine and record the following:-

- Serial number and name plate particulars of the machine.
- Check that rotor rotates freely.
- Check the suspension bushes.
- Check insulation resistance
- Check continuity of the field and stator
- Check alternator tension rod
- Check the bearing noise with shock pulse meter

12.2 ELECTRICAL CHECKS

Carry out the following electrical checks and record the following:-

- Open the cover of the terminal box and check whether the internal termination and terminal board are intact.
- Tighten all the connections on the terminal board.
- Using a multimeter, check continuity between
    - Field terminal F+&F-
    - Stator terminals U&V, V to W and W to U
- Check the insulation resistance by 500 V megger between

- Stator terminals and frame of machine
- Field terminals and frame
- Field terminals and stator terminals

(Note : Minimum insulation resistance should not be less than 1 Mega ohms for 4.5 kW under worst weather conditions and 20 mega ohm for 18/22.75 kW respectively)

12.3 OVERHAULING

- The machine received for overhauling should be externally cleaned with wire brush and wiped before dismantling.
- Clean and re-grease the bearing after removing the bearing from the bearing housing. Only Servo Gem (RR-3) grease shall be used.
- Clean the mating surface of the end shield.

- While removing and placing the rotor, care should be taken that the rotor does not rub over the field coils.
- If any grease has crept into the stator surface, clean it before assembling.
- If stator and rotor parts are found rusty, clean. Apply the insulating varnish (air drying) of recommended grade. Impregnation of the varnish shall be done in an air circulated oven.
- Change the alternator suspension nylon bushes 100% and change the suspension pin on condition basis.
- Apply the insulating varnish (air drying) of recommended grade. Impregnation of the varnish shall be done in an air circulated oven.
- After complete fitment and greasing, the bearing noise shall be recorded using shock pulse meter.

Only bearing of SKF/FAG shall be provided as**iv.**

12.4 INSULATION RESISTANCE TEST

Between stator. winding and earth	Above 1 M Ω
Between field winding and earth.	Above 1 M Ω
Between field Winding and stator.	Above 1 M Ω

Regulator

Short all terminals (Live parts) together and check the insulation Resistance between the Live parts and earth.	Above 1 M Ω

Note: The insulation resistance of all the above should be measured by 500 V megger.

A. **NO LOAD TEST**

Connect the alternator and regulator with a resistance/battery load. Run the Alternator at base load (1 A) at various speed from 357 rpm to 2500 rpm. This voltage should not exceed ± 5% of set the voltage. The cut in speed should also be checked. It should not be more than 357 rpm at 108 volts at zero loads.

B. LOAD TEST

Connect the alternator and regulator with resistance/battery load. Run the alternator at half load i.e. 19 Amp. and full load 37.5 Amp. Respectively at various per re speed from 600 rpm to 2400 rpm. Setting shall be done at 1500 rpm and half load 19A before starting the test. The voltage should not exceed ± 5 % of the set voltage at a speed from 600 rpm to 2400 rpm. The set voltage can be 120 V, 122 V, 124 V at 19

Amp. 1500 rpm. Check the MFO (minimum speed for full output) i.e. 37.5 Amp. for 4.5 kW alternator, it should not be more than 600 rpm.

C. TEMPERATURE RISE TEST

For 4.5 kW Alternator

Run the alternator at 600 rpm and apply the load. The alternator should be capable of giving 37.5 Amps at 120 Volts. Run the alternator at 2500 rpm with full load for five hours with a fan cooling the body. Check the temperature at different part of the alternator and should be as follows:-

a) Power diode - Should not exceed 100 ^{0}C at ambient of 50^0 C.

b) Alternator terminal - Should not exceed 100 ^{0}C at ambient of 50^0 C.

c) Bearing temperature - Should not Exceed 85 ^{0}C at Ambient of 50^0 C.

d) Stator and Field - Should not Exceed 90^{0}C at Winding load of 37.5 Amps.

12.5 RECTIFIER REGULATOR UNIT

The procedure to be followed shall be as per guidelines given below.

- Check the terminals and inside wires for heating signs and looseness. Blow out the dust. Recommendation of RDSO. Replace the damaged wiring/terminals. The wiring of the regulator shall be done systematically,
- Check the PCB circuit with PCB testing kit or multimeter to identify defective components. Replace the defective components.
- Check field transformer for correct voltage. Replace, if found defective.

V- BELTS/ TENSIONING GEAR

- The existing V belts shall be replaced with the new V belts 4 Nos. having same grade/make. The old V belts removed from service to be destroyed.
- Tensioning gear shall be removed and its spring shall be checked for proper functioning. If required moving parts of tensioning device including spring shall be replaced.

'V' GROOVED AXLE PULLEY

The procedure to be followed shall be as per guidelines given below:

- Check the axle pulley for slippage, tightness and physical damage to grooves. Ensure availability of locking nuts and split pins in position. Check the alignment of axle pulley with the alternator pulley and adjust. Change the rubber packing.
- Replace the pulley if any groove is damaged/broken/worn-out.

- The pulley shall be replaced after four years period or earlier on condition basis.

BATTERY AND BATTERY BOX

The procedure to be followed shall be as per guidelines given below.

- Remove the cells from the battery boxes on arrival of the coach in workshop and bring them in the battery shops for maintenance. Record voltage and specific gravity of each cell.
- Clean exterior of the cell/ mono block thoroughly. Wash top of the battery with a 10% solution of soda and a wire brush. During such cleaning, it is necessary to ensure that the micro porous vent plugs are mounted on the cells so that the water does not enter into the cells.
- Battery boxes shall be cleaned/repaired and repainted with anticorrosive epoxy based paint after removing the battery. Check the opening of welds and cracks thoroughly especially on load bearing members, vicinity of mounting bolts etc. Detection of minor hair line crack shall be done with ultrasonic testers.
- Top up cells wherever necessary with distilled water. The level should be corrected as indicated on the float.
- If there is corrosion/sulphation on the inter-cell- connectors etc., clean them thoroughly and protect from further corrosion by applying petroleum jelly or Vaseline. Cell connectors and fasteners should be changed on condition basis.
- Replace defective sealed float guide and micro porous vent plugs, if any.
- Clean micro porous vent plugs and sealed float guides and ensure that vent holes are in order.
- Record lug date to determine the life of the battery.
- Charge the battery fully till 3 constant half hourly readings of voltage and specific gravity are obtained. This will indicate that battery is fully charged.
- Discharge the battery at 10 hrs discharge rate. While discharging, record the voltage and specific gravity.
- Record the capacity of the battery during discharge. It should not b In case while discharging, any of the cells fall below 1.8 volts, disconnect the cell from the circuit for treatment with one or two cycles of slow charge and discharge.
- After two cycles of charge and discharge, recharge the cells fully.
- Battery box vertical/horizontal member shall be checked for any minor/hair line cracks, its mounting arrangement ensuring proper securing through nut bolts/washers etc.
- In case of VRLA Batteries, SMI no.RDSO/PE/TL /SMI/0001-98 (Rev.0) dt. 01.06.98 and RDSO/PE/TL/SMI/0002-98 (Rev.0) dt. To be followed.

WIRING (After 2 years for new coaches and 1 year for old coaches)

The wiring shall be completely inspected for damage by opening side panels, end wall near EFT's and also near fittings after stripping. The re-wiring shall be done on condition basis or planned on the basis of life of 20 years for cables.

The cables used for re-wiring shall be as per IS: 694-1990 (Third Revision) The cables taken up for re-wiring shall be done through PVC conduits in super structure conforming to IS: 2509. Bushes/Grommets used shall be of Hard PVC as per BS: 1767-1951 or to grade 6 of IS-5831 latest. Flexible conduits used, if any, under water tank shall be as per IS: 6946.

Coach insulation

Insulation resistance of the coach shall be measured with 500 V megger. IR value should be minimum 2 Mega ohms but it should not be less than 1 Mega ohm under highly humid/wet weather.e less than 80% of the rated capacity.

Cable termination joint

- All cable joints shall be checked for its loosness or heating signs. Loose joints and cables having damaged insulation shall be replaced/repaired. All cable ends shall be properly socketed with crimping type sockets.
- Surface of crimping sockets and bus-bars shall be cleaned to remove the oxide film from the jointing surface before making a bolted joint and shall be coated with corrosion resistant conducting grease of approved make to prevent reformation of oxide film.
- Fire retarding PVC grommets to IS:1767 or grade 6 of IS:5831 shall be provided at all cable entry points in metallic members.
- The under-frame wiring if running loose shall be provided in flexible steel conduit.
- All inspection covers shall be opened to check the distribution boards and condition of wiring.

General Precautions

- Do not peel insulation for testing. If wires are found with peeled insulation replace them with fresh wires. If peeling is of short length apply proper PVC adhesive tape.
- Do not use twisted joints of aluminum cables to avoid oxidation and improper contacts and over heating/earth fault due to loose strands.
- Remove earth fault by isolation method instead of hit and trials and short circuiting of opposite polarity of earth. Use proper rating of fuses both in branch circuits, rotary panels and regulator boxes for field and main fuse.
- Use HRC fuse to the extent possible except for branch which may be done with re-wirable tinned copper fuse. In the absence of HRC fuse use correct size equivalent re-wirable fuse. Do not use under rated or over rated rewirable fuse to avoid faulty tripping of defective circuits.
- Use connectors for lights & fans.
- Ensure extra length of cables near termination’s for future maintenance and replacement, if found inadequate at the earliest opportunity.
- Check for earth fault on every maintenance and rectify those detected.

- Do not tamper with regulator potentiometer setting unless tested in a proper alternator drive having variable speeds.

12.6 SWITCHES, LIGHT FITTINGS, ETC.

Light fittings

The light fittings, reflectors, clear acrylic sheet cover, glass globe, holders, etc., shall be checked and cleaned. Any defective part shall be replaced. Anti- theft arrangement for fluorescent light fittings shall be checked as per ICF Drg. No. ICF/SK-7-6-079.

Rotary Switch Cum Junction Box

Strip the housing from the coach and clean thoroughly and remove oxidation from terminal points and check the function of rotary switches. Fit back the same and do the connections using corrosion inhibiting compound for betterconductivity and to avoid oxidation of all contacts.

FANS

- Dismantle the lower guard, upper guard, blade and fan motor.
- Check the guard assembly, repair/replace if necessary.
- Check the blade angle with a measuring gauge. Correct the same, if necessary.
- Check the insulation resistance of the fan motor. The IR value should not be less than 2 Mega ohms as specified in IS: 6680-1992.
- Check the fan leads and change it if necessary.
- Check the armature winding and field coil, repair/replace, if necessary.
- Check the commutator for grooving, pitting marks, ovality, blackness etc. Polish the commutator if required.
- Check the carbon brush and brush spring. Replace by correct grade of carbon brush as recommended by RDSO. The fan spring should meet the requirements given in IS: 6680. Replace the same if necessary.
- Apply air drying insulating varnish if IR value of the armature and field coils is low; give impregnation treatment in an air circulated oven.
- Clean the ball bearing, check for noise, replace if necessary or grease it with recommended grade grease.

Testing

i) Check the load current at rated voltage. The wattage of the fan should not exceed the value specified in IS: 6680.

ii) Check the air delivery of one or two fans from a batch to ascertain the correctness of the blade angle. The value of the air delivery shall not be less than that specified in IS: 6680.

NOTE:

- SKF/FAG (imported) make bearings for alternator procured directly from manufacturers as specified in the RDSO specification shall be used. Use of other makes of bearing is not permitted.
- Shock pulse meter shall be procured by Railways and workshops to monitor condition of the bearing regularly during maintenance service and after replacement of defective bearings.
- Induction heater/oil bath shall be used for heating the bearing to the required recommended temperature.
- The pulley condition such as wear on V group, pulley key way, shaft way, groove angle etc. shall be monitored during POH. Proper gauges shall be used for checking "V" groove of the pulley.

12.7 DO'S AND DON'TS FOR MAJOR EQUIPMENT

ALTERNATOR

DO'S

- Do ensure the correct polarity of field winding i.e. positive connected to F + while measuring the continuity of the field winding, otherwise the alternator will not self excite.
- Do check the proper compression force on the tensioning spring with indicator plate by tightening the special nut.
- Do keep the terminal box tightly closed.
- Do open the terminal box once in a week and clean the accumulated dust, if any.
- Do check tightness of the connection regularly, at least once in a week.
- Do use the cable grommets or cable gland of correct size for reducing the vibration of terminal connections. It is preferable to anchor the cables externally to avoid shocks and vibrations on the terminals.
-

DON'TS

- Don't use improper tools to handle the alternator, it may damage parts of the alternator.
- Don't re-grease the bearing frequently. Re-greasing should be done after thoroughly cleaning the bearing with white spirit. It is preferable to re-grease the bearing only during POH.
- Don't over-grease the bearing.
- Don't keep the belts in over tension as this may reduce life of the belt.

REGULATOR

DO'S

- Do check the regulator terminal box once in a month for loose connections and for cleaning the dust.
- Do short all seven terminals of the terminal box before measuring the insulation resistance.
- Do ensure that DC '+' and DC '-' are connected to battery positive and battery negative respectively. Wrong connection will damage main diodes.

DON'TS

- Don't disturb the settings of the regulator shunt and potentiometer.
- In any circumstances the burden resistance setting should not be disturbed.
- Don't open the regulator box unless there is a defect.
- Don't use a megger to test the components. Use multimeter.
- Don't reverse the field terminals on regulator and alternator.
- Never use a fuse wire for field fuse. Always use HRC fuse of specified value.

`V' BELTS

DO'S

- Use belt of the same length for a set.
- Belts should be stocked in lots as per date of receipt and use in the principle of first in first out basis. The belts shall be stored in a well ventilated room free from direct sunlight and moisture.
- Ensure correct belt tension i.e. 330 Kg for 18 kW, 22.75 kW and 25 kW alternators and 105 kg for 4,5 kW alternators. The tolerance of tension shall be $\pm$ 5 kg in both cases.
- Re-tension newly fitted belts after first trip.
- Maintain a gap of approx. 75 mm between sup upto the split pin for the 18 kW, 22.75 kW, 25 kW Alternators and 55 mm for 4.5 kW alternators.
- Maintain proper alignment between axle pulley and alternator pulley.
- Replace ulley with burn out grooves i.e. 0.8 mm depression on sides and bottom of grooves with uniformly shining surface.
- Form grades of the belts received from the stores/suppliers after checking on belt measurement gadgets. The grading of belts should be between 48 and 52 only of matched sets.

DON'TS

- Do not allow loose belts.
- Do not disturb the nut and check-nut on free end of tension rod if proper gap is available between supporting plate and fixing nut i.e. 75 mm for AC coach alternators and 55 mm for TL alternator.
- Do not use repaired pulleys.

- Do not use old and new mixed belts in sets.
- Belt should not have any oil or grease traces ,if persist clean it by soap and water.
- The matched set should have belts of one manufacturer only. Do not use belt of same grade of different manufacturer in a set.

13. LHB COACHES

13.1 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 effect a quantum jump in quality and speed of Railway coaches.

“M/s Alstom and LinkeHolfmann 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 LinkeHolfmann 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.

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 tear 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, 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.

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.

MAINTENANCE SCHEDULES OF LHB STOCK

Coaching Depot Schedule

Schedule D1 **:** Trip/Weekly at nominated primary maintenance depot

Schedule D2 **:** Monthly ± 3 days

Schedule D3 **:** Half Yearly ± 15 days

Shop Schedule

Shop Schedule I **:** 18 months / 6 lakh Kms whichever is earlier

Shop Schedule II **:** 36 months / 12 lakh Kms whichever is earlier

Shop Schedule III **:** 72 months / 24 lakh Kms whichever is earlier

European Style Toilet Indian Style Toilet

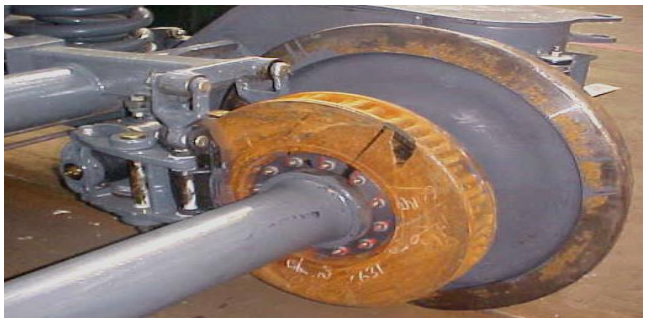
SAFETY RELATED PROVISIONS

- 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.
- 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.

13.2 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 over all 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 AARcentre 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, 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

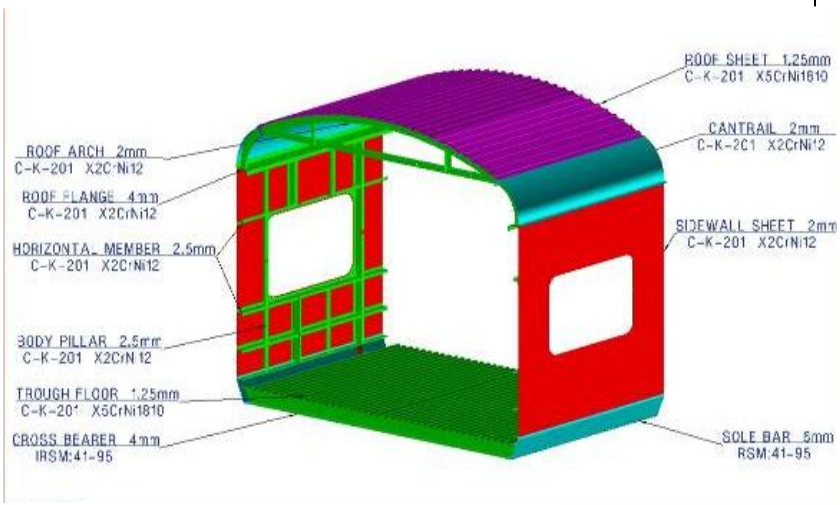
DESIGN FEATURES OF LHB COACHES

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

13.3 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.

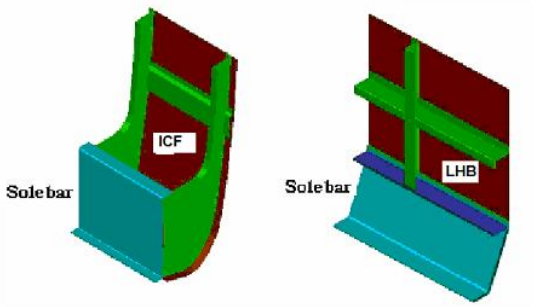


Various types of steels used in construction of LHB Coaches

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 have 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.

Inter-locking joints of vertical & horizontal members is adopted for structural joints

13.4 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.

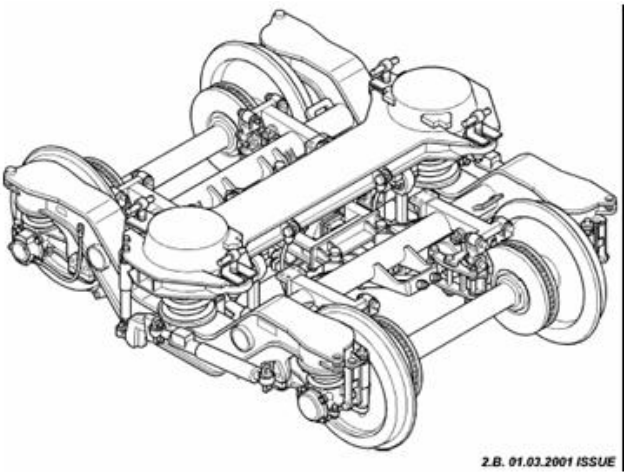
Since there is vertical space constraint between the top and bottom bolster, it is not possible to provide softer secondary suspension springs which are required for the high speed trains to control the dynamic movements of the bogie bolster and coach body.

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.

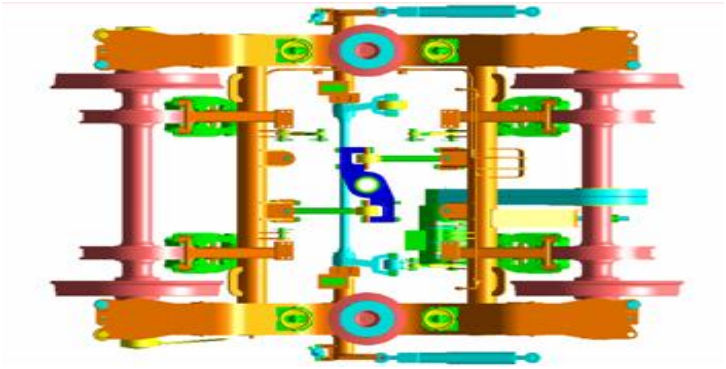
Since the brake forces are offered on the wheel tread by clasp brake, it could not give sufficient retardation during brake application which in turn increases the emergency braking distances. The life of the wheel is also reduced due to tread wear.

Technical parameters of FIAT Bogie

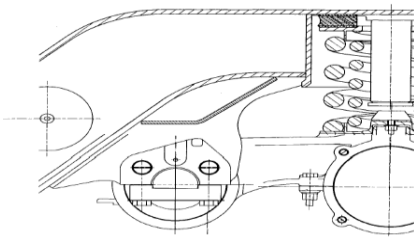
Bogie width	3030 mm
Bogie length	3534 mm
Bogie weight	6300 Kgs
Wheel base	2560 mm
Wheel diameter (New)	915 mm
Wheel diameter (Cond)	845 mm
Wheel distance	1600 +/- 1 mm



This is a two axle bogie with both primary and secondary suspension. The Bogie frame is made of two longitudinal solid welded component connected by 2 cross beams which also supports the brake units. This frame rests over the primary suspension and the weight of the coach body is taken by the bogie through the bolster beam and the secondary suspension.



Primary suspension is at 4 points over the axle-bearing box. Each unit has 2 coil springs (inner and outer) with a vertical damper and a control arm fitted with twin-layer elastic joints connecting the bearing to the bogie frame.



Secondary suspension enables lateral and vertical displacements and also bogie rotation with respect to body when negotiating curves. It is provided on both the bogie frame longitudinal. Each unit of suspension has 2 steel coil springs (internal and external), which carries the Bolster beam with a vertical damper and a lateral damper. 4 nos. of safety cables are connected between the bolster beam and the cross beam. 2 YAW Dampers are also connected between Bogie frame and the Coach Body.

Traction centre transmits both tractive and braking force between the body and the bogie. It comprises of a Traction Lever which is connected to the cross beam of the bogie frame by means of 2 Traction Rods diagonally with elastic bushed joint. For limiting the longitudinal and lateral displacement of the bolster beam, there are 2 Lateral and 2 Longitudinal Bump stops fitted on a support frame and the support frame is fitted to the Bogie Frame.

On two outer corners of the Bogie Frame nylon roller is fitted by a pin, which prevents excessive rotation of the bogie with respect to body. Anti roll bar is fitted between the bogie frame and the Bolster Beam to maintain the Coach body always parallel with the bogie, even while negotiating curves.

Dampers Used in the FIAT Bogies

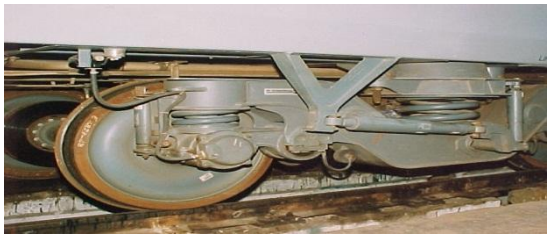
Dampers used in FIAT bogies are hydraulic shock absorbers (confirming to UIC 515-4) to damp the oscillations caused due to track irregularities.

Following dampers are provided on each bogie:

Four vertical dampers are provided in primary suspension between axle box and bogie frame for absorbing the shocks between the wheel and the bogie frame.

Two vertical dampers are provided in secondary suspension between bogie frame and bolster to cushion the vertical movement and one lateral damper is provided to cushion lateral movement.

Two numbers of Yaw dampers are provided between bogie frame and coach body to cushion the yaw and longitudinal movement.



The wheels are provided with Cartridge type tapered roller bearings. On each axle 2 discs (640 mm dia) are fitted between the wheels for brake application. Brake calliper assembly along with brake cylinders are fitted on the cross beam and brake pads are used to have contact with the discs for brake application. One end of each axle is fitted with speed sensor used for the Microprocessor input of Wheel Slip Protection device.

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.
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 is 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 with in 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 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 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.

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/cm^2 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/cm^2, 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 ± 0.1 kg/cm^2
	FP		6 ± 0.1 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 kg/cm^2)	175 ± 30 sec.(FTIL)
1.2	Charging time of CR (6.0 litre) (0 – 4.8 kg/cm^2)	60 to 120 sec.(KB)
1.3	BP Pressure	165 ± 20 sec.(FTIL)
1.4	CR Pressure	160 to 210 sec.(KB)
1.5	FP Pressure	5.0 ± 0.10 kg/cm^2 5.0 ± 0.10 kg/cm^2 6.0 ± 0.10 kg/cm^2
2.0	Sealing test (Allow the system to settle for 2 min. after charging BP & FP. Observe the rate of	
2.1	leakage). BP (Less than 0.1 kg/cm^2 in 5 minutes)	< 0.1 kg/cm^2
2.2	FP (Less than 0.1 kg/cm^2 in 5 minutes	< 0.1 kg/cm^2
3.0	Full Brake Application	Brake should apply with in 3 – 5 Sec.
3.1	Reduce BP from 5.0 to 3.4 kg/cm^2	Should not respond
3.2	Brake Accelerator	3.0 ± 0.1 kg/cm^2
3.3	Maximum BC pressure	< 0.1 kg/cm^2
3.4	Leakage in BC Pressure within 5 minutes	Should be Applied
3.5	All brake cylinders	Should show Red
3.6	Both side Brake indicators	

Item	Test Parameters	Specified value
4.0	Release after Brake Application	5.0 ± 0.1 kg/cm^2
4.1	Charge BP (up to 5.0 kg/cm^2)	Should be Released
4.2	All brake cylinders	Should show Green
4.3	Both side Brake indicators	
5.0	Over Charge Protection Check the overcharging of CR it should not be overcharged	Less than 0.1 kg/cm^2 in 10

	more than 0.1 kg/cm^2 in 10 second.	sec.
6.0	Emergency Application	
6.1	Reduce BP to 0 kg/cm^2	0 kg/cm^2
6.2	Brake accelerator should	blast of air
6.3	respond	3 – 5 Sec.
6.4	Charging time of brake cylinder (0 – 3.0 kg/cm^2)	3.0 ± 0.1 kg/cm^2
6.5	Max. brake cylinder pressure	Should be
6.6	All Brake Cylinders	Applied
	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
7.3	Both side Brake indicator window	Released 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.

Item	Test Parameters	Specified value
9.0	Test for Pressure switch for Anti skid device	
9.1	Charge the Feed pipe/Brake pipe* pressure	Ok
9.2	Anti skid device	Should get power supply at 1.8 ± 0.2 kg/cm^2
9.3	Anti skid device * For FTIL - FP & For KBI - BP.	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

10.5 10.6 10.7	Both side Brake indicators Again close the Isolating cock of bogie 1 & 2 one by one. Both side Brake indicators of bogie 1&2	corresponding to opening of isolating cock for bogies Should show Red Brake should Release Should show Green one by one
11.0 11.1	Sensitivity Test Reduce the BP pressure at the rate of 0.6kg/cm2 in 6 seconds.	 Brake should apply within 6 sec
12.0 12.1	Insensitivity Test Exhaust BP pressure at the rate of 0.3 kg/cm^2 Per minute	 Brake should not be applied.

Item	Test Parameters	Specified value
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 brake valve	Should exhaust
13.4	Indicator Lamp on out side the	Should glow
13.5	coach Both side Brake	Should show Red
13.6	indicators After resetting, check exhaust	Should stop
13.7	from emergency brake valve Both side Brake indicators shows Green	Green
14.0	Hand Brake test (Power car	
14.1	only)	Should work
14.2	Apply hand brake by means of	smoothly
14.3	wheel Both side Hand Brake indicators	Should show Red Should be Applied
14.4	Check Brake Cylinders provided	Yes
14.5	with hand brake lever Movement of flex ball cable	Should be proper Should work
14.6	Release hand brake by means	smoothly
14.7	of wheel Check the Brakes	Should release
	Both side Hand Brake indicators	Should show green

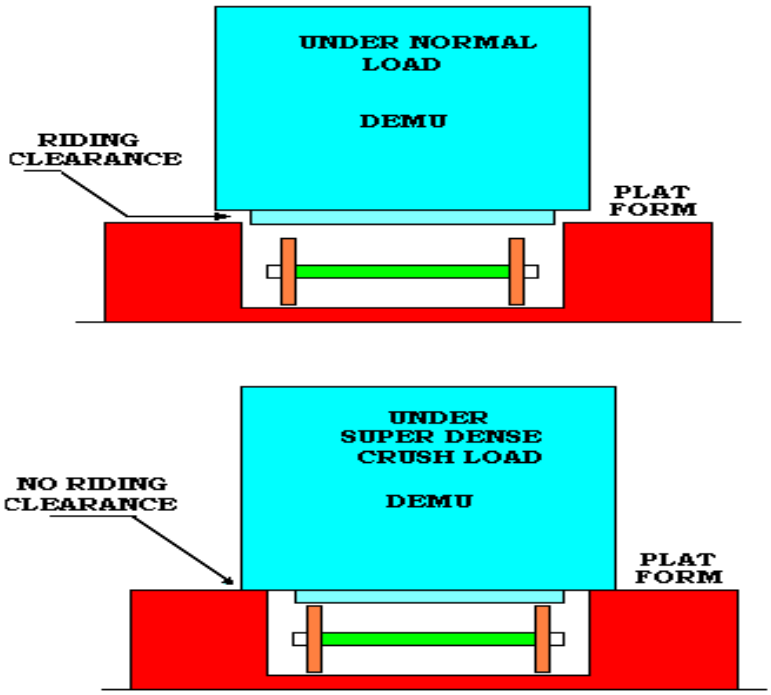
15.0	Emergency brake by guard van valve (Power car only)	
15.1	Drop BP Pressure by means of guard valve	Brake should Apply
15.2	Brake accelerator should	Blast of air
15.3	respond Both side Brake indicators	Should show red Should show green
15.4	Hand Brake indicators Reset guard van valve	Brake should releases

Item	Test Parameters	Specified value
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.	Should activate at 1.8 ± 0.2 kg/cm^2
17.3	Check the WSP Micro Processor	Should show code 99
17.4	Check the WSP Micro Processor code.	
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

14. DEMU AIR SUSPENSION

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.

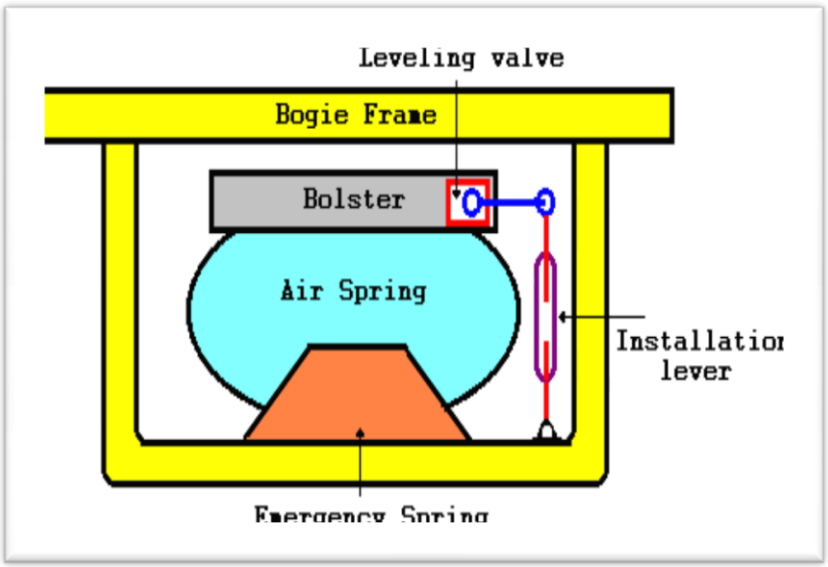
Due to the Super Dense Crush Load the bolster springs become solid, which in turn damages / breaks the Coil springs resulting in discomfort to the passengers.

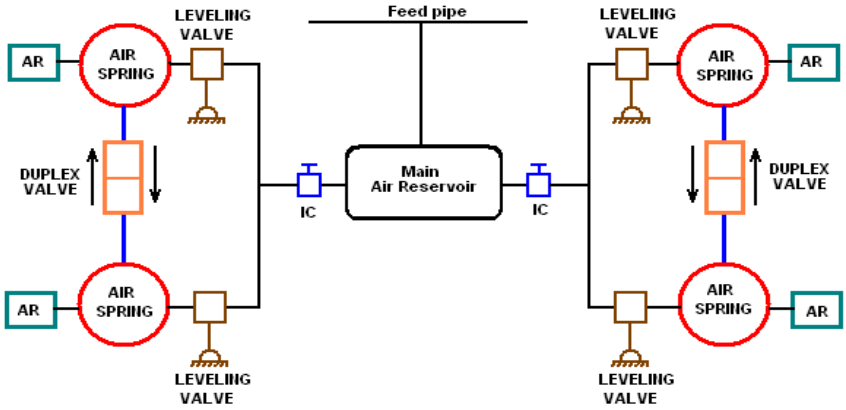


So to overcome the above problems an **Air Suspension** (Air spring) is introduced in the secondary suspension to maintain a constant buffer height irrespective of loaded conditions by varying the pressure of air inside the air spring.
Due to its excellent riding index the air springs are introduced in Duranto express.
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.

Air spring

1. Emergency spring
2. Leveling valve
3. Adjustable screw rod
4. Duplex Valve
5. Main Air Reservoir
6. Auxiliary Reservoir
7. Isolating Cock





Air suspension is a suspension where properties of air are used for cushioning effect (springiness). Enclosed pressurized air in a pre – defined chamber called air springs, made up of rubber bellow &emergency rubber spring, provides various suspension characteristics including damping. Air springs are height – controlled load leveling suspension devices. With changing loads, air springs react initially by changing the distance between air springs support and vehicle body. The leveling valve is in turn actuated, either taking the compressed air pressure to the air spring or releasing air pressure from it to the atmosphere. This process continuous until the original height is restored. This mechanism ensures a constant floor height on coaches provided with air springs, irrespective of loads.

15. Depot stores management

15.1 Material Management

Indian Railways is a vast organisation with different department for Running the trains. Hence there is huge involvement of materials for maintenance. To facilitate and ensure the availability of materials in time a separate department called stores department is available in Indian Railways

Stores department is involved in purchase of the materials for all the departments. It stocks some materials which are regularly required for day to day activities at convenient location, so that the procurement is made in bulk to get at economical rates.

Hence classification of materials at stores department is as below:

1. Stocked items: The materials stocked in the depot for supply.

2. Non-Stocked items: The materials not stocked in the depot, but purchased /manufactured from market and supplied on demand.

Further there is stores at each depot of C&W

All the materials in a depot are classified as;

Imprest Stores, Non-Imprest Stores, Tools & Plant stores, Uniform

Stationary (Books & forms), Surplus stores (Movable & Dead).

Object of Imprest stores

The object of the imprest stores is to make available a stock of materials for the day-to-day work in depots.

Object of Non-imprest stores

The object is to make available certain materials which are not required for the day to day work, but only occasionally to meet some urgent work.

Limit of stocking

Limit of stocking is based on the anticipated monthly requirements of materials, fixed on the basis of the trend of consumption over the past six months, modified to suit the planned changes in the rolling stock holdings/activities like introduction of additional trains, sick activities etc.

Maximum stocking limit

Maximum stocking limit for the imprest period is determined on the basis of the distance from the feeding stores depot and the means of transport available for collecting the materials.

Duration of the stocking limit

Stocking limit is normally for the imprest period of 2 months.

Master list

The Master list LM 211 is the monthly consolidated summary of receipts and issues of imprest stores.

P L number

The Part list No is an eight digit number with the first two numbers indicate the group, the second two numbers indicates the sub group, the third three numbers indicates the serial number of the item the last single number is the check digit.

Ledger/tally card

Ledger/Tally card has to be maintained for every individual item and it should contain;

The sanctioned quantity

P L number and description,

Receipts, issues and balance on hand.

Different forms used in stores.

Sl No.	Form Number	Purpose	Remarks
1.	S 1830	For recouping the imprest items.	Submitted directly to stores by the depot official. (5+1 Copies)
2.	S 1313	a. In excess of imprest quantity for stocked items. b.Recoupment of Non-Imprest stocked items.	Approval from DME/Sr.DME is required.(5+1 Copies)
3	S 1302	For recouping the Non -Stocked items if the value of item is less than Rs.50000.	Approval from DME/Sr.DME is required.(1+1 Copies)
4.	S 1302A	For recouping the Non stocked items if the value of item is more than Rs50000.	Approval from DME/Sr.DME is required.(1+1 Copies)
5	ST 47	Challan for transfer of materials from one depot to the other.	
6.	LM 171	Issue of materials from stores to specified work.	To be signed by the C&W Engineers.
7.	T – 136	For the supply of books and forms.	Approval from DME/Sr.DME is required.(1+1 Copies)
8.	LM 89N	For Repair and returrn	If the material is sent to shop directly from the depot. S-1302 should be used if transaction done through stores
09.	G 50 F	Condemning of all T & P items.	To be condemned by ADME/DME/Sr.DME

10.	S-1539	For Disposing the Scrap Items.	DS-8 also can be used.
11.	M.268	For condemning the Rolling Stock.	

Revision of imprest

Revision is based on the increase or reduction in workload or rolling stock holding. The higher and lower limits are fixed based on the review on the trend of consumption of items for the past six months with justification for increase or reduction. Periodical revision of imprest is done every year. The form to be used is T-409.

Compliance of stores

Based on the stock on hand and quantity supplied every month, the materials are to be treated as:

Less than 25% - Nil supply

26% to 75% - Half supply

76% to 100% - Full supply

Local purchase of materials

To meet the emergency demands, materials can be purchased locally either with the imprest cash of the depot or that of the DME/Sr.DME to a maximum extent of Rs.300/- for each item. Local purchase can be done through ACOS/DCOS duly placing the indent No. S-1302 (1+1 copies). Out of stock certification must be obtained before processing for local purchase of stocked items.

Budgetary Control

It is required for the financial discipline to ensure utmost economy in the usage of materials also to keep the consumption levels of materials as low as possible with good maintenance of rolling stock, to ensure that the overall expenditure is contained within the sanctioned budget limits under various demands for the depot.

ABC analysis

It is a tool used for the effective control of the materials and in turn the budget of the depot.

All the items are classified as:

Category A: All high value items, few in number, but costing about 80% of the total expenditure.

Category B: All medium value items costing about 10 to 12% of the total expenditure.

Category C : All low value items bulk of the items about 80% costing only about 8 to 10%.

Items are categorized on the basis of total annual cost of items and not on the numerical quantities.

Surplus Stores

The Surplus stores are classified into,

Dead surplus Stores – The items which are not used /Issued for the past 24 months not likely to be used in the near future.

Movable surplus Stores - The items which are not used /Issued for the past 24 months and likely to be used within next 12 months.

16. Role of Supervisors to minimize sick figures/coach detachment/ineffective%

A supervisor plays vital role to minimize sick figure, to avoid detachment and to control ineffective of coaches / wagons. In this regard, following points should be considered to meet the target:

1. Examination / maintenance of coaches / wagons should be ensured as per IRCA Part III & Part IV. It should be ensured that there are no any rejectable defects during departure of train.
2. All infrastructure and facilities should be available as per requirement
3. Use of non standard fittings should be avoided.
4. Staff should be counseled and they should be well aware about burning problems. Time to time, they should also be booked for attending different training courses.
5. Due and overdue ROH / IOH / POH coaches / wagons should not be allowed in train service.
6. Short cut methods for the purpose of maintenance should be avoided.
7. Required material should be available at the site of work place and it should also be planned for future requirements.
8. Distribution of work to staff should be according to their ability.
9. Time to time to motivate the staff for maintaining work culture.
10. Time to time maintenance instruction issued by RDSO / Railway Board / Zonal HQ concerned staff should be communicated and ensure their compliance.
11. All instructions related to safety should be followed.
12. To avoid re-occurrence of any failure, failure analysis should be carried out.
13. Must be Replaced items should be replaced in due time.
14. Better co-ordination should be maintained with sister departments.
15. Time to time inspection should be carried out by Inspectors to maintain the quality of work.