ORGANISATION OF INDIAN RAILWAYS

1.Indian Railways : Nation's Life Line:

Indian Railways have continuously influenced the social, economic, cultural and political life of the life of the people. Some of the important aspects of this influence are: increased mobility of the common man, bringing together people from all castes, communities and religions, growth of trade and commerce, development, rural development, help in spread of education, contribution to national exchequer, influence on literature, poetry, music, films etc. Thus, Railways have become Nation's life line.

2.The Biggest Organization:

Indian Railways are the biggest organization in out country with 14.71 lakhs of employees; 63,122 route kilometers traversing from Okha to Murkon Selek and Udhampur to Kanyakumari; 6,906 Railway station; a feet of 7,681 locomotives, 44,756 passengers and other coaches, 2,14,760 goods wagons; carrying 4,971 million originating passenger traffic and 542.7 million metric tones of originating goods traffic. It has a total investment of 77,915.78 crore rupees.

History of Railway: The first Railway in India was opened in 1853 from Bombay to Thane by great Indian Peninsular (GIP) Railway. The maiden trip of the first train took place on 16th April 1853 when it traversed a 21 Mile stretch between Bombay and Thane in about 4 hours time . Starting from this humble beginning, the Indian Railway system have grown up today into a giant network all over India.

The executive authority in connection with the Administration of the Railways vests with Central Government and the same has been delegated to the Railway Board as per the Indian Railway Act.

Corporate Mission : Indain Raiway's mission to make the Indian Railways a model system with sufficient capacity to met the country's transportation needs for both passenger and freight traffic based on an optimal inter model mix and to the society, while maintaining financial viability of the system.

Ministry of Railway (Railway Board): The responsibility of the administration and management of the Indian Railways rests with the Railway Board under the overall supervision of the Minister of Railways who is a Minister of Cabinet rank and is associated in this work by one or more Ministers who are of the status of Minister of State or Deputy Minister. The Rly.Bd is the Chief Administrative and Executive body assisting the Minister of Railways in the discharge of his functions. It was constituted by a resolution of Government of India dated 18th February 1905. It exercises the power of the Central Govt. in respect of regulation construction, maintenance and operation of the Railways.

Railway Board: Railway Board is the apex executive body which administers, directs and supervises the functioning of the Railway system. The Board functions under the Minister for Railways and is headed by the Chairman, who is equivalent to Principal Secretary to Government of India. The other member are:

1.Financial Commissioner
2.Member staff
3.Member Traffic
4.Member Mechanical
5.Member Engineering
6.Member Electrical

The Board has several directorates. Major directorates are handed by an Advisor. Health Services and RPF directorates have Director Generals. They are assisted by Executive Directors, Directors, Joint Directors etc.

Zonal Railways:

The Indian Railways were divided into 16 zones.

No.	**Name of the Railway**	**Formed on**	**H.Q**	**Route Kms**
1	Southern	14.04.1951	Chinni	5,231
2	Central	05.11.1951	Mumbai CST	3,766
3	Western	05.11.1951	Mumbai CG	6,559
4	Eastern	14.04.1952	Calcutta	2,383
5	Nothern	14.04.1952	New Delhi	3,398
6	North Eastern	14.04.1952	Gorakpur	3,398
7	North Eastern Frontier	01.08.1955	Calcutta	2,432
8	South Central	15.01.1958	Maligaon	3,951
9	North Western	02.10.1966	Secundrabad	5,753
10	East Coast	01.10.2002	Jaipur	5,453
11	South Western	01.10.2005	Hajipur	3,495
12	East Coast	01.04.2003	Bhuvaneswar	2,513
13	South Western	01.04.2003	Hubli	3,074
14	West Central	01.04.2003	Jabalpur	2,909
15	North Central	01.04.2003	Allahabad	3,101
16	South East Central	01.04.2003	Bilaspur	2,397

Each zones Railway is controlled by a General Manager. The General Manager is assisted by Principal HOD (Grade 22,000-525-24,500) namely: Addl. G.M, Sr.Dy.GM, Financial Advisor & Chief Accounts Officer, Chief Engineer. Chief Machnical Engineer, Chief Operating Manager, Chief Commercial Manager, Chief Electrical Engineer, Chief signal & Telecommunication Engineer, Controller of Stores, Chief personnel Officer, Chief medical Officer, Chief Security Commissioner.

Divisional Organization:

Each zonal Railway is further divided into Divisions headed by a Divisional Railway Manager who is assisted by ADRM (18,400-500-22,400) and Divisional Officers (14,300-400-18,300, 12000-375-16,500) namely : Sr. Divisional Engineer, Sr. Divisional Mechanical Engineer, Sr. Divisional Operating Superintendent, Sr. Divisional Commercial Super indent, Sr. Divisional Personnel Officer, Sr. Divisional Controller of Stores.

Reorganized Zonal Railway with their Divisions:

Western Railway : Mumbai central, Baroda*, Ratlam*, Rajkot*, Bhavnager, Ahamadabad**.

Central Railway : Mumbai CST*, Bhusaval, Nagper, Solapur*, Pune

Eastern Railway: Howrah, Sealdah, Asansol, Malda

Northern Railway: Delhi*, Moradabad, Firozpur, Lucknow, Ambala

North Eastern Railway : Izatnager*, Locknow, Varanasi

North Eat Frontier Railway : Katihar, Alipurduar*, Lumbding, Tinusukia, Rangiya

Southern Railway: Chennai, Palghat, Madurai, Trichi, Trivendrum.

South Eastern Railway: Kharagpur, Adra*, Chakradharpur*, Ranchi

South Central Railway: Secundrabad, Hyderabad*, Vijaiwada*, Guntakal*Guntur**, Nanded

East Coast Railway: Bhubaneswar, Kurdharoad, Waltair, Sambalpur

South Western Railway: Hubli, Bangalore, Mysore

West Central Railway: Jabalpur, Bhopal, Kota*

North Central Railway: Allahbad*, Jhansi*, Agra*

South East Central Railway: Nagpur, Bilaspur, Raipur**.

North Western Railway: Jodhpur, Bikanager, Jaipur, Ajmer.

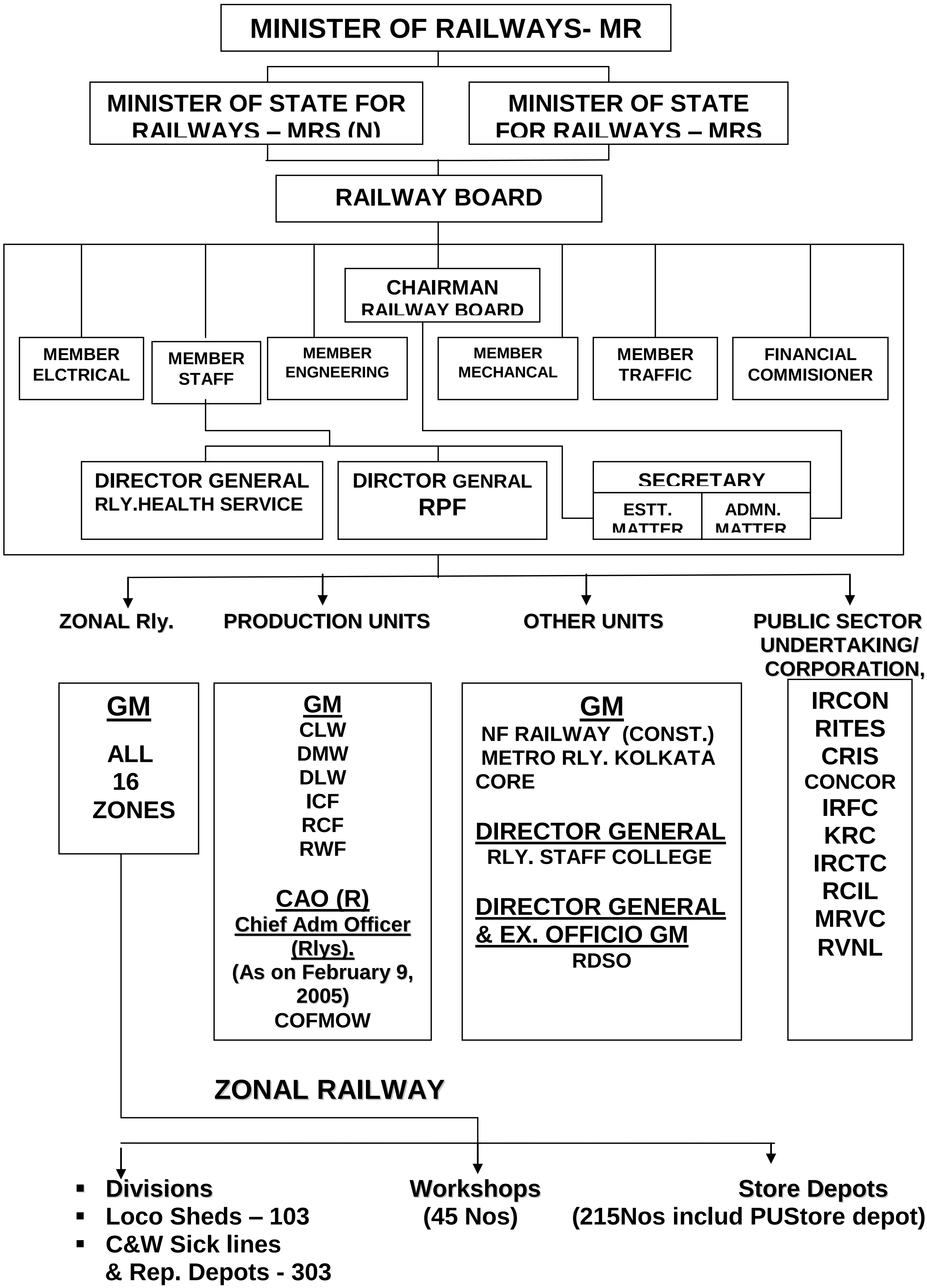
East Central Railway: Sonepur, Samstipur, Danapur, Mugalsarai, Dhanbad.

* Reorganized divisions and ** Newly created divisions.

Total No of Divisions = 59+8= 67

[Above noted zones recognized and created under notification No. 97/E&R/700/1/Notification, dated 04.07.2002 and divisions reorganized and new divisions created under Notification No. 98/E&R/700/1/Notification dated 04.07.2002]

ORGANISATION STRUCTURE



ORGANISATIONAL SET UP OF C&W DEPARTMENT

Organisational set up of Mechanical officers and Supervisors of C&W wing in a Division

Sr. Divisional Mechanical Engineer

DME (ROH Depot) | DME (Coaching Depot) | DME (Divisonal HQ)

AME | AME / CDO | AME(Divisional HQ)

Sr.SE(C&W) (Depot Incharge)

Sr.SE(C&W) SE(C&W) JEI(C&W) JEII(C&W)

Sr.SE(C&W) (Depot Incharge)

Sr.SE(C&W) SE(C&W) JEI(C&W) JEII(C&W)

Sr.SE(C&W) Work as a C&W Inspector | Sr.SE(C&W) Work as a C&W Controller | Sr.SE(C&W) Work as a Material Chaser | Sr.SE(C&W)* (Work as a Safety Counsellor (C&W)

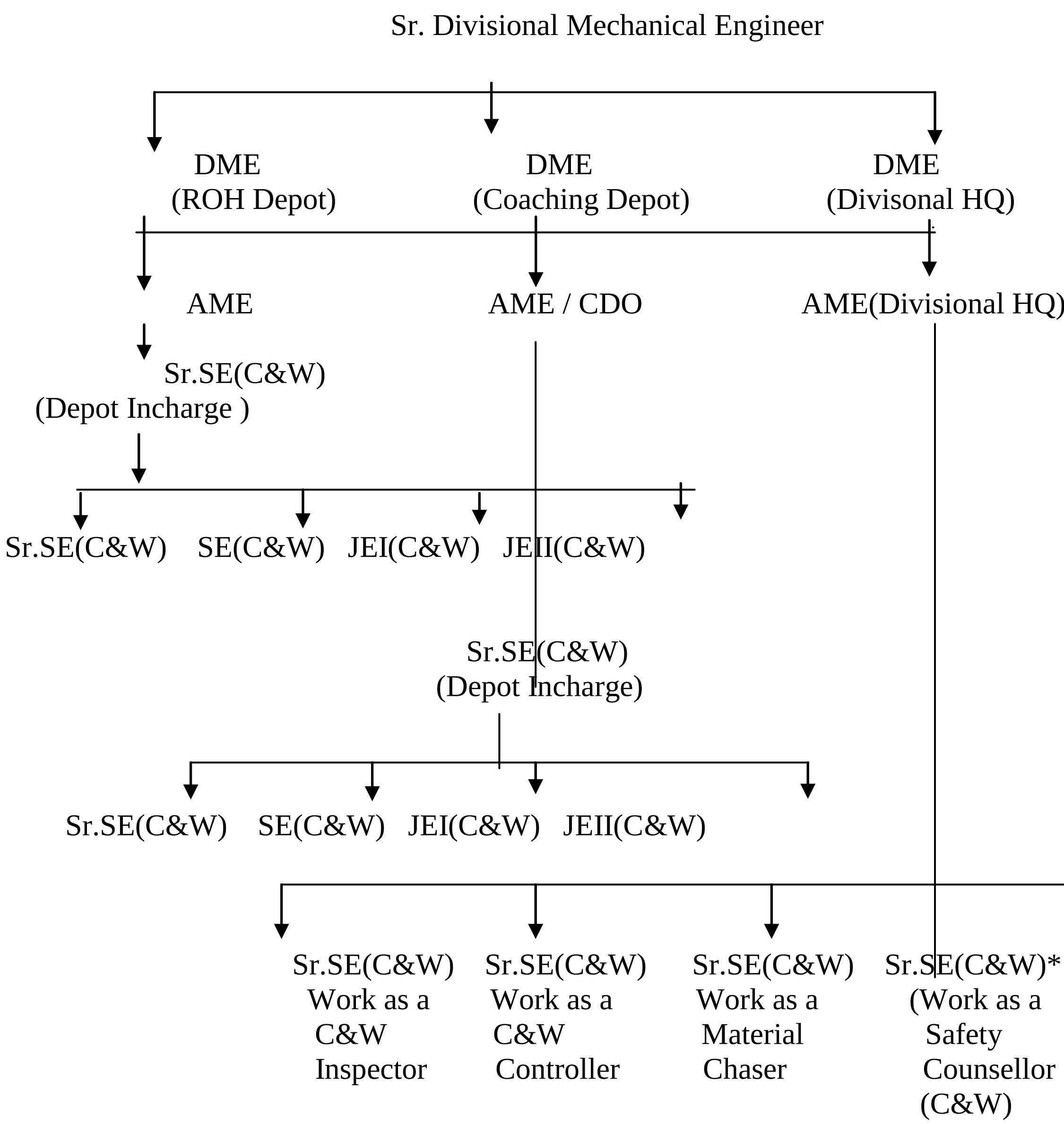
- This SSE (C&W) is under the administrative control of the Divisional Safety Officers, but is responsible to DME (C&W) for all technical matters concerned with the safety of Rolling stocks.

Important general information for maintenance in open line Depot

- C&W organisation set-up in a Division.
- Codification and Numbering of Coaches.
- Ineffective percentage.
- Yard Stick.
- Nomination of a Depot.
- Concept of a Block Rakes.
- Indication and Destination Boards.
- Fire Extinguishers.
- Brake Van Equipment.
- Integrated Maintenance.
- Rake link
- Working Timetable.

ORGANISATIONAL SET UP OF C&W DEPARTMENT

Organisational set up of Mechanical officers and Supervisors of C&W wing in a Division



- This SSE (C&W) is under the administrative control of the Divisional Safety Officers, but is responsible to DME (C&W) for all technical matters concerned with the safety of Rolling stocks.

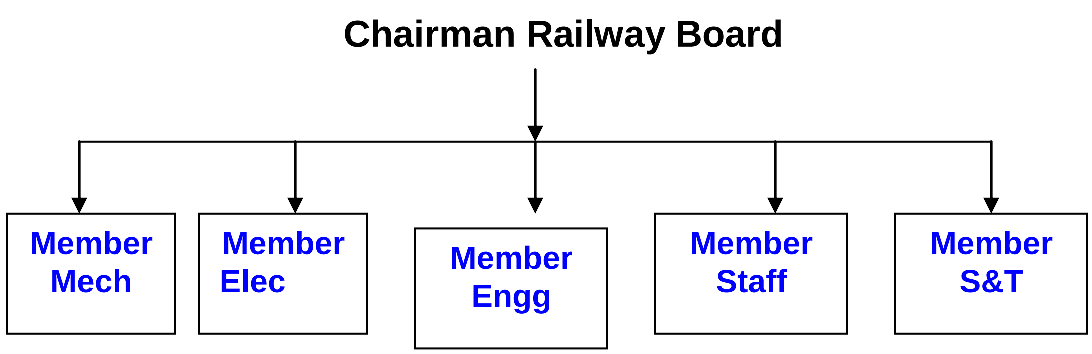
Railway Organisation for its effective control in working of trains, has an organizational setup at different levels. It can be classified into various levels as;

- Railway Board Level

- Zonal Level
- Divisional Level
- Depot level.

Sl No	Name of the Railway	Head Quarters
1	Central Railway	Mumbai
2.	Eastern Railway	Kolkota
3.	Northern Railway	New Delhi
4.	North Eastern Railway	Ghorakpur
5.	North Frontier Railway	Maligon
6.	Southern Railway	Chennai
7.	South Eastern Railway	Kolkota
8.	Western Railway	Mumbai
9.	South Central Railway	Secundrabad
10.	East Central Railway	Hajipur
11.	North Western Railway	Jaipur
12.	East Coast Railway	Bhuvaneshwar
13.	North Central Railway	Allahabad
14.	South East Central Railway	Bilaspur
15.	South Western Railway	Hubli
16.	West Central Railway	Jabalpur

2. The organizational set up at the Railway Board level is as follows;



The Security and Medical department are under a separate directorate.

To have better control over the entire Indian Railways, it is divided into zones as follows;
Further each zone has the Organisational set up as;

General Manager

Addl General Manager

CME COM CCM CPO CSO CSC CE CEE CSTE

CRSE - Chief Rolling Stock Engineer
CMPE - Chief Motive Power Engineer
CWE - Chief Workshop Engineer

The Mechanical Department is divided based on the activities as ;

- **Carriage & Wagon**
- **Locomotive (Running)**
- **Workshops**

C & W Organisation functions under the control of CME of the Zonal Railway assisted by CRSE for open line –C&W functions and CWE for Workshops – Maintenance repair of Carriage & Wagons

Functions of C & W Organisation:

i) To maintain the coaches and wagons in good fettle
ii) Ensuring availability of coaches and wagons as and when required by the traffic department.
iii) Undertaking the different repairs that can
iv) Planning for the future requirements in terms of rolling stocks, infrastructure, manpower etc.

The zones are further divided into divisions.
The total number of divisions in Indian Railways is 67 in number.

The organizational set up in the Division is as follows;

Divisional Railway Manager

Addl Divisional Railway Manager

SrDCM Sr.DOM SrDME DPO DSO DSC Sr.DEN DEE DSTE

ADME (Coaching) ADME (Wagons) ADME (Running)

Each division will have one or more Carriage & Wagon depots depending on the holding of rolling stock. The Carriage & Wagon depots are classified as;

- Super Mega depot (1000 coaches and above) headed by Sr.CDO, DME, ADME, ADEE and ACOS.
- Mega depot (500 to 1000 coaches) headed by CDO, ADME, ADEE.
- Medium depot (250 to 500 coaches) headed by ADME

In any Major Carriage & Wagon Depot, the typical organizational set up is as follows;

Depot In-charge
(Sr.DME/DME/ ADME)

↓

ADME

↓

SSE
SE
JE I
JE II
Sr Technician
Technician Gr I
Technician Gr II
Technician Gr III
Helper I
Helper II

The major areas of work involved in a depot are divided into smaller areas and a Supervisor will head each. Based on the size of the depot and availability of supervisors, the rank may vary from place to place. For Example;
SSE – ***Co-ordination***
SSE – ***Stores***
SSE – Maintenance
SSE - ***ART***
SSE – ***IOH, sick line and so on*****.**

Activities of Coaching Depot:

i. Maintenance of Coaches:

There are different types of maintenance like primary, secondary and turn round. The depot to which the rake has been allotted is termed as primary maintenance depot where the trains are examined and certified fit in all respects. In secondary maintenance, at the terminal station the trains are checked and certified fit for its return trip and in turnaround maintenance, the necessary attention will be given at the platform itself.

ii. Repairs to the defective coaches:

During service, due to wear and tear, varying load conditions and so many other factors, defects are likely to arise in a coach. Whenever a coach is diagnosed with a defect, it needs to be repaired so that the coach is made fit for traffic use. For this purpose, a sick line with sufficient infrastructure will be provided..

iii. Reception and dispatch of Trains:

The trains which have been maintained and kept ready for movement needs to be dispatched and trains, which are reaching the terminating, stations needs to be received for further work. All these activities will be undertaken in the platform.

iv. Stores:

For supplying all the spares, consumables and other items needed to maintain the rakes, a Stores with all the requisite materials are always kept ready for disposal.. As and when materials are required, they are drawn from the stores and the material is charged against that activity. As and when, the material has come to the minimum level; the stores personnel again recoup the same. The depot also has various Machineries and Plants required to undertake the different repairs in

the coaches. Periodical maintenance, repairs and replacement of these are taken care of by the stores department.

I. IOH:

Coaches which are covering more than 1.25 lakh kms in 6 ½ months must undergo Intermediate overhaul in the nominated depots which involves work like running out the bogies, overhauling all the components in the bogie, buffers, screw couplings, repairs to the interior components, overhauling and testing of the brake system, wheel reprofiling etc.

vi. ART – Accident Relief Train:

In case of any accident for faster and quicker restoration work Accident relief trains are situated at various locations in each Railway. An ART may comprise of Medical Relief Van, MFD and Crane. Depending upon the seriousness of the accident and the assistance required any of the 3 could be pressed into service. A Senior supervisor assisted by many supervisors and staffs are always kept in readiness to rise to the occasion.

vii. Data Base Management:

In every depot the data pertaining to the Coaches of their holding will be maintained. For this purpose, a history card is being maintained for each and every coach which gives the complete history of the trains in which the coach has run, when and for what reason a coach was marked sick and the different repairs which has been undertaken on the coach. The other maintenance requirements such as coaches due for different schedules, rake disturbance in enroute and at the destinations, coaches marked sick within 100 days of POH can be obtained for investigation purposes.

The different documents to be maintained in a depot are;

Register	Details
RS 1	Repairs carried out on a rolling stock
RS 2	Oiling Register
RS 3	Repacking register
RS 4	Vacuum testing and repair register
RS 5	Incoming driver's report on brake power
RS 6	Brake power Certificate
RS 7	TXRs' Dairy
RS 8	Hot Box register
RS 9	Wheel Transaction register
RS 10	POH register
RS 11	Repairs carried out on the interior components
RS 12	Leaky Wagon Register
RS 13	Fire Extinguisher Maintenance
RS 14	Passenger Emergency Tool Box
RS 15	TXRs' Hand Book
RS 16	Sick Memo
RS 17	Fit Memo
RS 18	Deficiencies in Rolling stock
RS 56	DRS Card
RS 66	Sick Label

Activities of Wagon Depot:

The different activities undertaken in a Wagon depot are;

- **Reception and dispatch of wagon stock**
- **Repairs to the sick Wagons**
- **Routine overhaul of wagons (ROH)**
- **Special repairs and modifications as prescribed by each railway.**
- **Analysis of sick stock**
- **Enroute detentions**

Reception and dispatch of wagon stock:

As per the traffic requirements, the empty wagons will be formed into a formation and offered to the train examiner for certification. After checking each and every wagon for all the components for their correct functioning and ensuring sufficient brake power, the train examiner issues the brake power certificate to dispatch the train from the yard to the loading point.

Repairs to the sick wagons:

During the course of checking of wagons, if any such repairs are found which cannot be attended in the yard, the wagon would be marked sick and sent to sick line for necessary attention. Wagons will be attended in the sick line for the defects and certified fit for use. For this, sufficient facilities and infrastructure would be made available in the wagon depots to undertake all kinds of repairs.

Routine Over Haul (ROH);

The periodicity of POH of wagons are long and it varies from one type of wagon to another. The wagons undergo routine over haul over a period of time at the nominated depots, where the wagons will be lifted, bogies are run out and all the necessary repairs in the running gear, brake gear, draw and buffing gear are attended to. The wagons undergo ROH over a fixed interval of time.

Special Repairs and modifications:

Special repairs and modifications if any, as per the railway requirements would also be undertaken in the depots as and when the need arises. This could be undertaken as per the CME's orders for their local requirements also.

Analysis of sick wagons:

Wagons, which are sick marked, are analyzed and necessary action is taken to improve the quality of work. Whatever modifications are necessary, are advised through the depot in charge to the divisional head and to head quarters also.

Enroute detention:

Wagons, which are sick marked in enroute due to mechanical defects, are attended to. For this purpose, a group of staff with necessary tools and spares will reach the place where the wagons are detained by the first available means and necessary attention is given so that the wagon can continue its course of journey to its destination. If for some reason, the defect is such that, it cannot be attended then the wagon would be moved to the nearest wagon depot with restricted speed along with accompanying staff and there after the wagon is repaired and made fit for traffic use.

Railway Workshops:

The purpose of having Railway workshops in each railway is to undertake the Periodical Over Haul (POH) of Rolling stocks both coaches and wagons and also overhauling of locomotives. Based on the work carried out, each workshop is given with a code for its identification.

Each division has its nominated workshop whichever is near by who is going to undertake the POH repairs. The POH arisings are given by each division to the workshop, which is catering to their requirements. Based on this, the individual workshop plans for the various activities it should under take. They also carry out different modifications, retro fitments which are given from time to time.

The planning activities must be so good, that the POH cycle time should not get affected by more/less arisings and also the division should not starve for want of coaches.

The Workshops also undertake NPOH on rolling stock for those vehicles for which the repair cannot be undertaken in the sick lines of the depots, like rolling stock involved in derailments or accidents.

They also undertake manufacture of certain special type of coaches/wagons and rolling stock components required for them and also for the divisions, which has asked for a specific component.

The stocks, which are POHed in workshop, are checked by Neutral Control Train Examiners and certified fit.

The organizational set up at the workshop could be;

Workshop In-charge (CWM)
↓
Dy. CME
↓
WM
↓

APO | **AWM** | **APE**

AWM
SSE
SE
JE I
JE II
Sr Technician
Technician Gr I
Technician Gr II
Technician Gr III
Helper I
Helper II

Historical Development - Passenger Coaches

- First generations coaches
- - Fully from Timber
- - Serious consequences in accidents
- 1948- 50 Hindustan Air Crafts Ldt Banglore
- started Steel bodied coaches
- 1955 ICF Was Set - Collaboration with Swiss Car & Elevator Manufacturing Corporation, Zuric, Switzerland for integral design.
  - Fabricated bogie Coil primary springs
  - Laminated secondary springs
  - Speed potential of 96 km/h

Historical Development - Passenger Coaches

- Length of bolster hanger increased to 410 mm in place of 286 mm
- Secondary suspension modified to Coil springs
- Side bearers to transfer body weight in place of centre pivot
- 16t bogie for AC coaches
- Adoption of Air brakes
- Bogie mounted air brake system
- Composition brake blocks in place of Cast Iron

Historical Development - Passenger Coaches

- RCF set up at Kapurthala to make coaches to ICF design
- Variants developed like:
  - AC self-generating and End-on-generating
  - MG versions
  - 2-tier AC, AC chair cars, 3-tier AC

ICF coach - Speed Upgradation

Speed	Year	Remarks
96	1955	Original design of Schlieren
105	1965	All coil spring, weight transfer through side bearer
120	1969	Improved track standards to C&M 1(Vol 1)
130	1971	Trials - Introduction of Rajdhani
140	1988	Trials - Introduction of Shatabdi

Design Objectives

- Corrosion Control
- Weight Reduction
- Increase in speed potential
- Increased Payload
- Increased train length
- Passenger amenity
- Safety and Maintainability

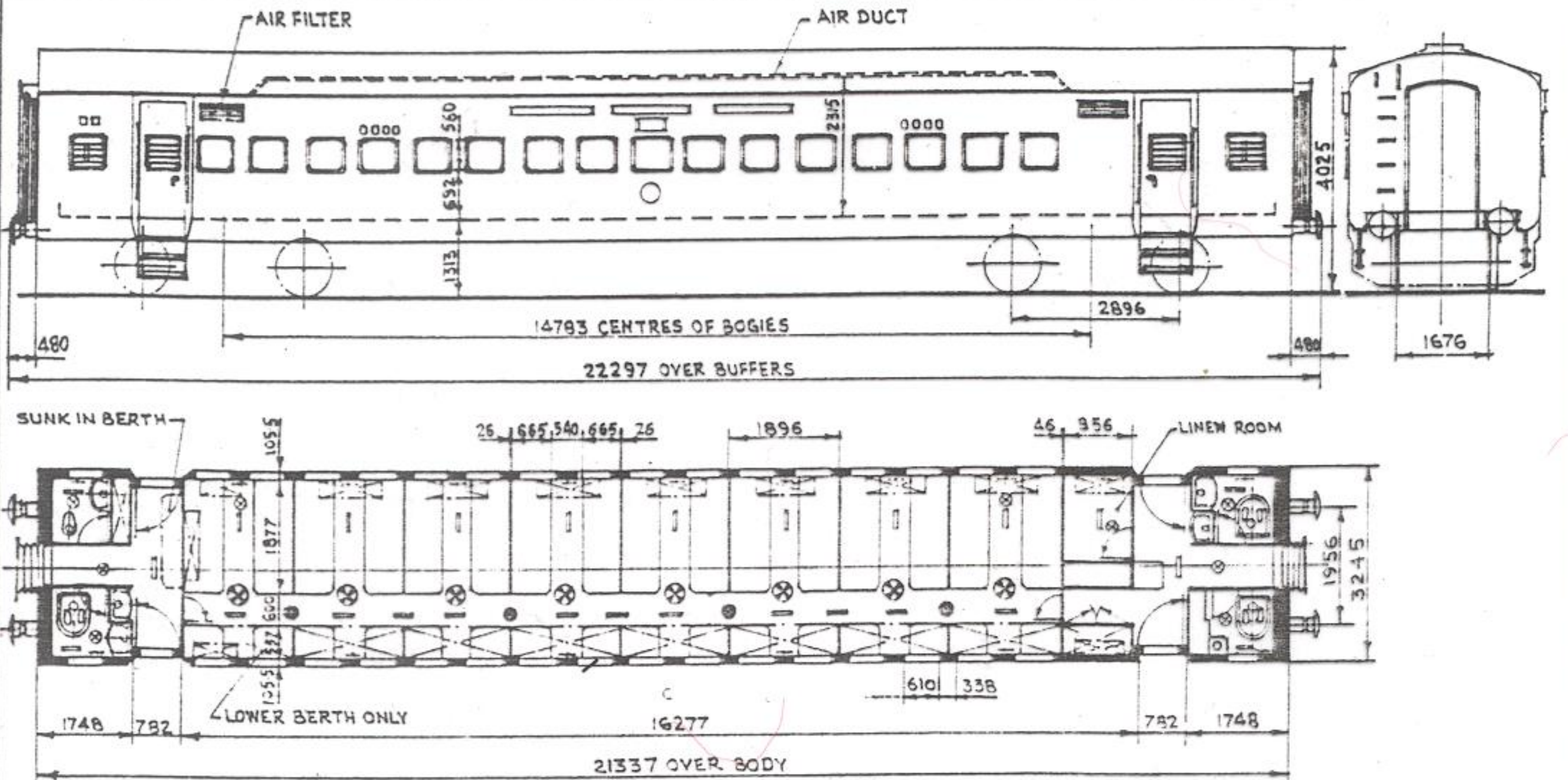
SALIENT FEATURES- ICF COACHES

- **ALL METAL**
- **ALL WELDED**
- **INTEGRAL DESIGN, SKIN STRESSED**
- **LIGHT WEIGHT**
- **ANTI TELESCOPIC**
- **BETTER BOGIE DESIGN**
- **ANTI-TELESCOPIC**
- **REDUCED WHEEL DIA**
- **REDUCED FIRE HAZARD**
- **BETTER INTERIOR**
- **STANDARDISATION**

1. No. OF PASSENGERS TO SEAT ———— 46
2. No. OF PASSENGERS TO SLEEP ———— 46
3. No. OF DOORS ASIDE ———— 2
4. No. OF LAVATORIES ———— 4
5. No. OF PASSENGERS PER DOOR ———— 23
6. No. OF PASSENGERS PER LAVATORY ———— 12

NOTE :-

1. COACH PROFILE & MAX. MOVING DIMENSIONS TO SKETCH-66064.
2. EXTERIOR MARKING TO DRG. No. CSC 970.



APPROVED VIDE RAILWAY BOARD'S LETTER No. 75/M(C)139/1
DATED 25-5-76 (R.D.S.O. FILE REF. MC/CB/SC/BG, S.No. 714)

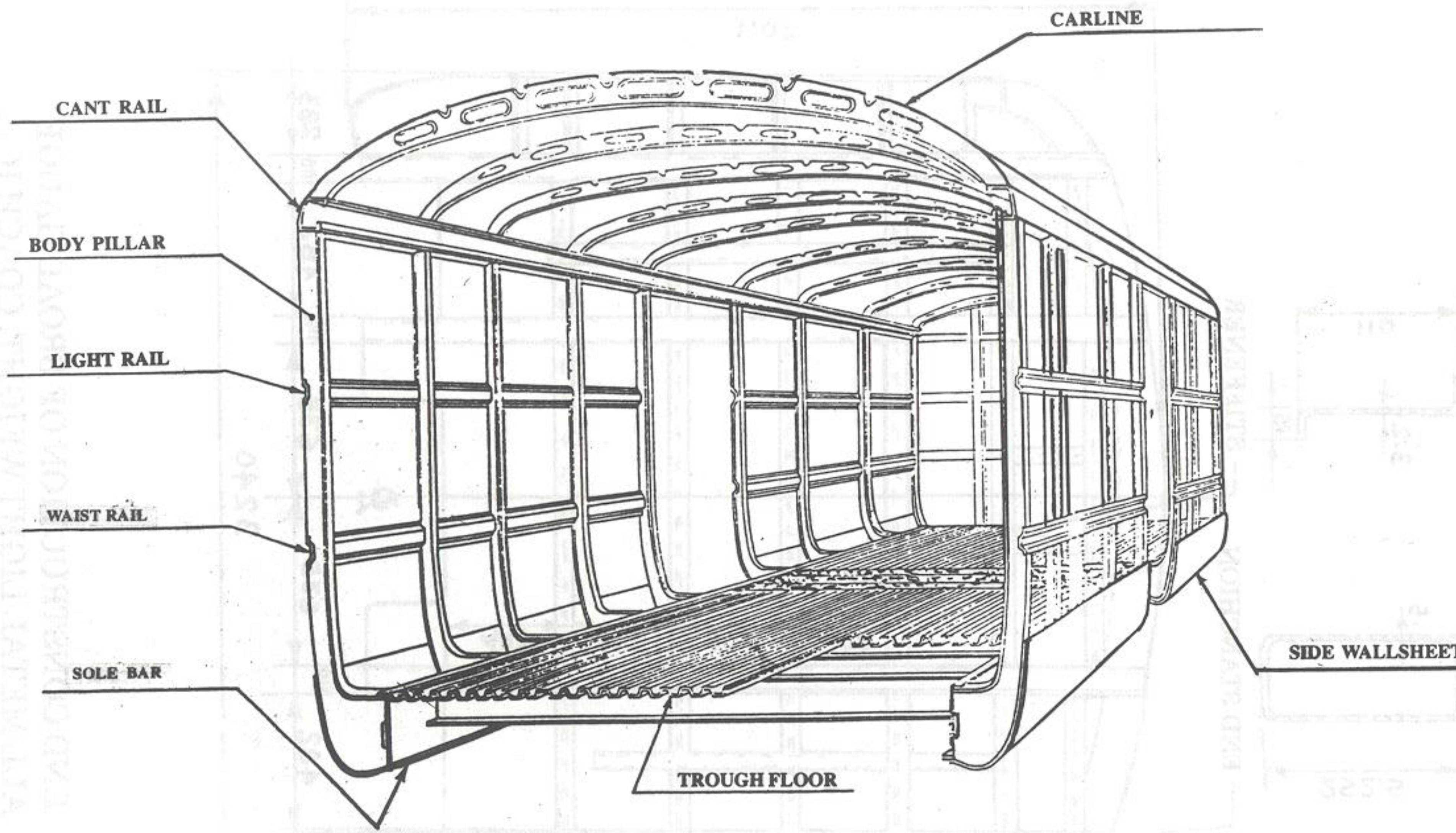
DRAWN BY	SUSHIL	LAYOUT OF SELF GENERATING A/C SLEEPER CAR I.C.F. COACHES	CODE WGACCW	B.G.	CSC 1617
CHECKED BY	[illegible signature]				
APPROVED BY					

Construction of ICF Coach

- Coach
  - Shell - Coach Body
  - Running Gear
    - Bogie
    - Braking
  - Furnishing
  - Train Lighting & Air conditioning

Design & construction

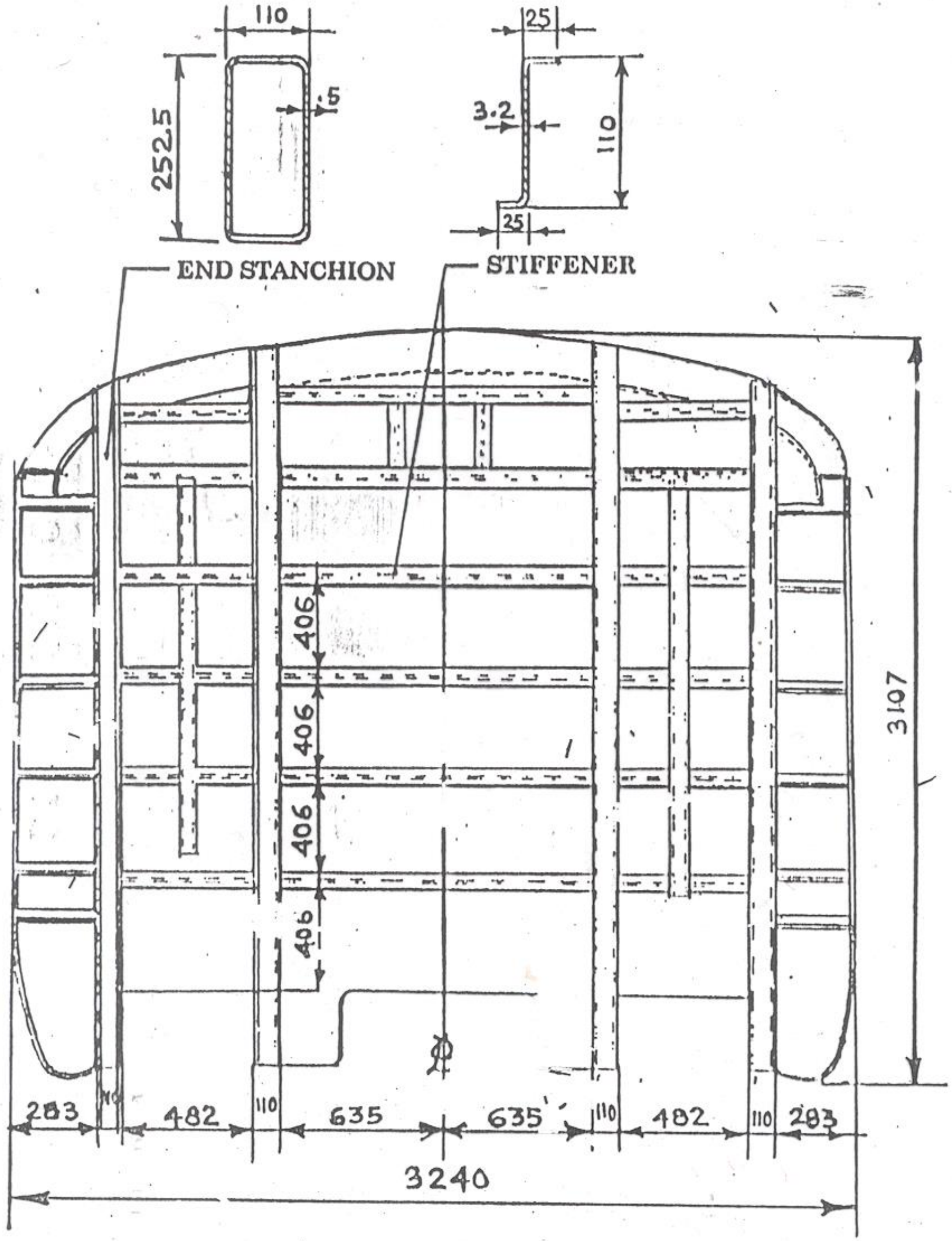
- Static tubes- formed of
- - side wall
- - Under frame
- - Roof - similar to hollow tube
- Bracing to the tube by a series of hoops made of
  - Side Pillars
  - Carlines
  - Floor cross bearers
- Hoop rings are connected together by sole bar, waist rails, cant rail, and stiffeners longitudinally
-



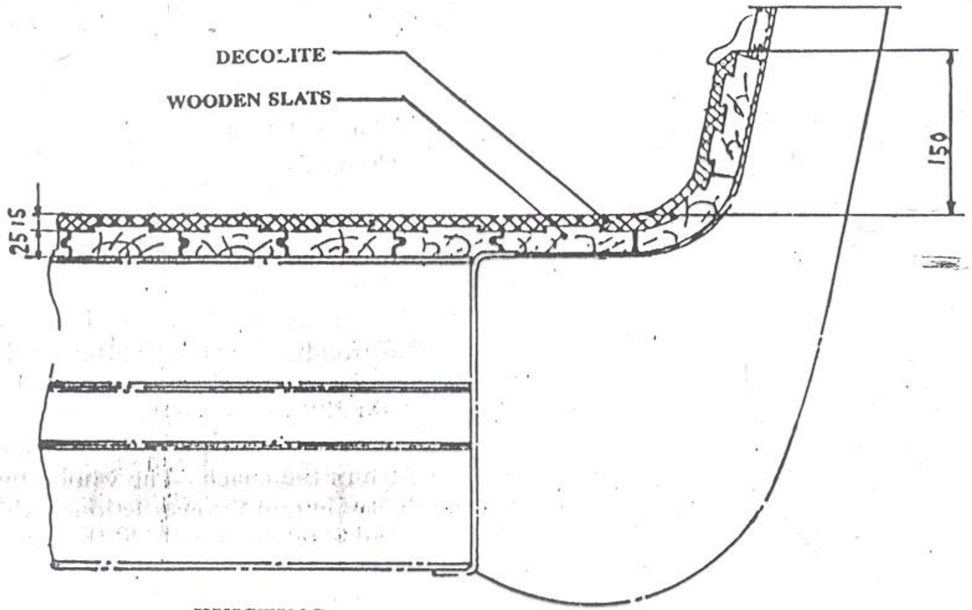
SHELL FOR ICF COACHES
(CROSS SECTIONAL VIEW)

Design & Construction - ICF shell

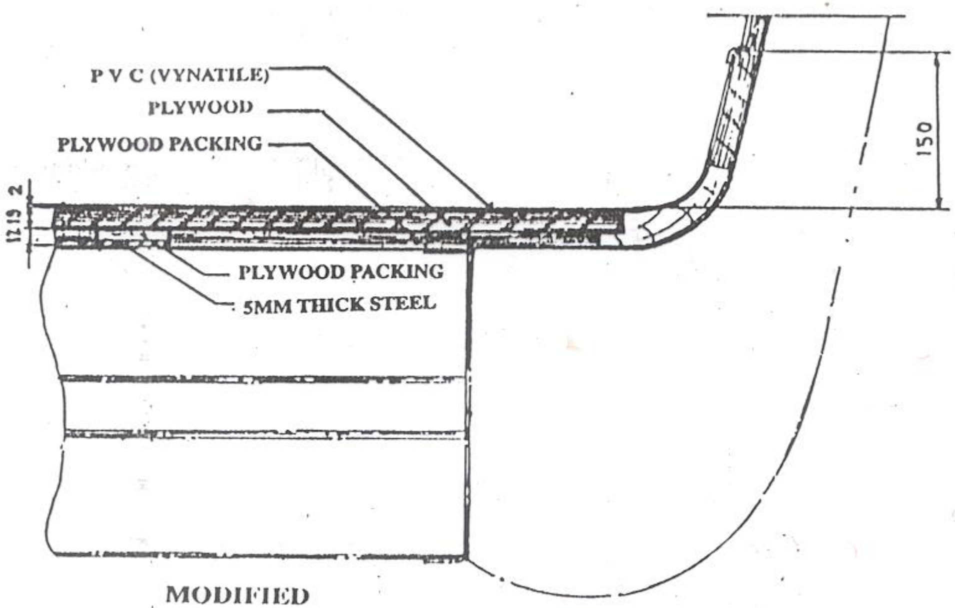
- Anti telescopic - end wall box structure to absorb major portion of the collision energy
- destructive tubular structure is added between Trough floor and head stock to have a comp. Weaker section.
- Trough floor made of corrugated sheet to absorb a large portion of buffing forces



END CONSTRUCTION OF BROAD GAUGE
ALL METAL LIGHT WEIGHT. COACH ICF.



EXISTING



MODIFIED

FLOORING WITH PVC SHEET ON PLYWOOD

BASIC ASSUMPTIONS OF INTEGRAL SHELL

TARE & PAY LOAD ARE EQUQLLY DISTRIBUTED OVER THE BODY SHELL

WEIGHT OF THE SHELL IS DISTRIBUTED OVER THE ENTIRE PHERIPHERY OF THE SHELL

WT OF THE EXTRA FLOORING & PAYLOAD IS CARRIED BY THE FLOOR & LOWER PORTION OF THE SIDE WALL

HORIZONTAL SQUEEZ LOAD AT THE BUFFER CENTRE LINE TAKEN BY THE TROUGH FLOOR & SIDE LONGTUDINAL

SHELL TREATED AS **THIN WALLED HOLLOW GIRDER.**

Advantages of Integral Design

- Ability to withstand higher dynamic force, hence greater safety in an accident
- Weight 20 % less than ordinary steel shell & 25 % less than timber coach, hence less operating cost
- Superior Resistance against torsion & Bending stress
- Extra-ordinary compression rigidity
- less fire hazard
- more amenable to mass production

Design Characteristics- coach Body

- Adequate resistance to Horizontal Shearing forces – Connection between SW & UF

- End Wall to Absorbs to collision energy before any other part of coach body are deformed.

- No resonance Under all loading conditions -

INTERNATIONAL STANDARD FOR LOADS FOR COACHES UIC - 566

- The coach body load should with stand the following test loads without permanent deformation and without exceeding the permitted stress:
- **A - STATIC COMPRESSIVE LOEDS**

At buffer level	200 t
Diagonally at buffer level	50 t
At 350 mm above buffer level	40 t
At centre Rail	30 t
At cant rail	30 t

INTERNATIONAL STANDARD FOR LOADS FOR COACHES

- B. uniformly distributed load

- P =k (P1 + P2)
- where k = 1.3 (a coefficient of Dynamic augment)
- P1 = wt of body in tare condition
- P2 = 2 X no of seats x 80 kg

Crashworthiness

Crashworthiness of rail coach body is its characteristic to absorb the collision energy in controlled and predictable manner such that maximum safety is imparted to traveling passengers

Crashworthiness- ICF SHELL

- Anti-telescopic shell of Schileren design
- Energy absorption capacity of 10 kJ per side buffer
- Squeeze load up to 102t at each side-buffer level
- Vertical load of 2.165t per meter run, uniformly distributed
- Squeeze load of 60t at height of 305 mm above buffer center line
- Horizontal load of 31t uniformly distributed over entire over end wall

Crashworthiness- ICF SHELL

At reaction of 203 t – 10 g acceleration developed

Higher acceleration > more injury to passenger

Design to aim for controlled Deformation keeping force below 2000 kN

Crashworthiness- Improvement & Design Considerations

- CBC coupler with tight lock & anti climbing features
- Energy absorption capacity 30 KJ in LHB, now being increased to 45 KJ
- **45 KJ provide protection for impact speeds up to 9.5 Kmh**
- **Stainless shell shell for better energy absorption capability**.

Crashworthiness-Improvement & Design Considerations

Design Considerations:

- Managing collision energy
- Collapse & occupants zones
- Buckle imitators
- Anticlimbing
- Train Impact Simulationn

DESIGN OF

LHB SHELL

CAR BODY SHELL

DESIGN FEATURES

1. LIGHT WEIGHT
2. SPEED : OPERATIONAL SPEED = 160 KMPH

   TEST SPEED = 180 KMPH
3. DIMENSIONS :

\# TRACK GAUGE : 1676 mm

\# OVERALL MOVING DIMENSIONS AS PER

RDSO DRAWING NO. EDO 590

\# DIMENSIONS RELATED TO S.O.D. – 1939

\# SHARPEST CURVE – 175 MTRS. RADIUS

\# SUPER ELEVATION - 165 mm

\# CLEARANCE ABOVE RAIL LEVEL – 102 mm

BODY SHELL

THE BODY SHELL BE OF INTEGRAL LIGHT WEIGHT CONSTRUCTION CONSISTING OF SEPARATE ASSEMBLY GROUPS FOR U/F, SW, ROOF & END WALL.

WHOLE CAR BODY SHELL CONSISTS OF THREE TYPES OF STEEL.

THE INDIVIDUAL ASSEMBLIES ARE JOINED TO EACH OTHER BY WELDING

OVERALL DIMENSIONS OF THE COACH

A	LENGTH OVER BODY	23540 mm
B	BUFFER CENTRES	1956 mm
C	MAXIMUM WIDTH OVER BODY	3250 mm
D	HEIGHT OF CENTRES OF COUPLER FROM RAIL LEVEL	1105 mm
E	HEIGHT OF COMPT. FLOOR FROM RAIL LEVEL	1303 mm
F	MAX. DIST. BETWEEN INNER WHEELS	12345 mm
G	MAX. HEIGHT OF CENTRES OF BUFFERS ABOVE RAIL LEVEL	1105 mm

TYPES OF STEELS USED IN LHB SHELL

S. No.	TYPE OF STEEL	APPLICATION
1.	1.4301(Austenitic) 1.25 mm X5 Cr Ni 18 10	Trough floor & roof sheet
2.	1.4003(Ferritic) Carline –2mm. Roof beam -2mm. Side wall -2mm. Window Sill -2.5mm. Body Pillar -2.5mm. Cant Rail - 4mm.	Restructure including carlines, roofbeam, body pillar, end wall structure, side wall sheets, etc.
3.	Corten-A	All Parts of under frame except trough floor including Sole Bar.

SIDEWALL

- TIG WELDING OR LASER WELDING OF SIDEWALL SHEETS
  - LOW HEAT INPUT
  - LESS DISTORTION
  - NEGLIGIBLE SHRINKAGE

SIDE WALL

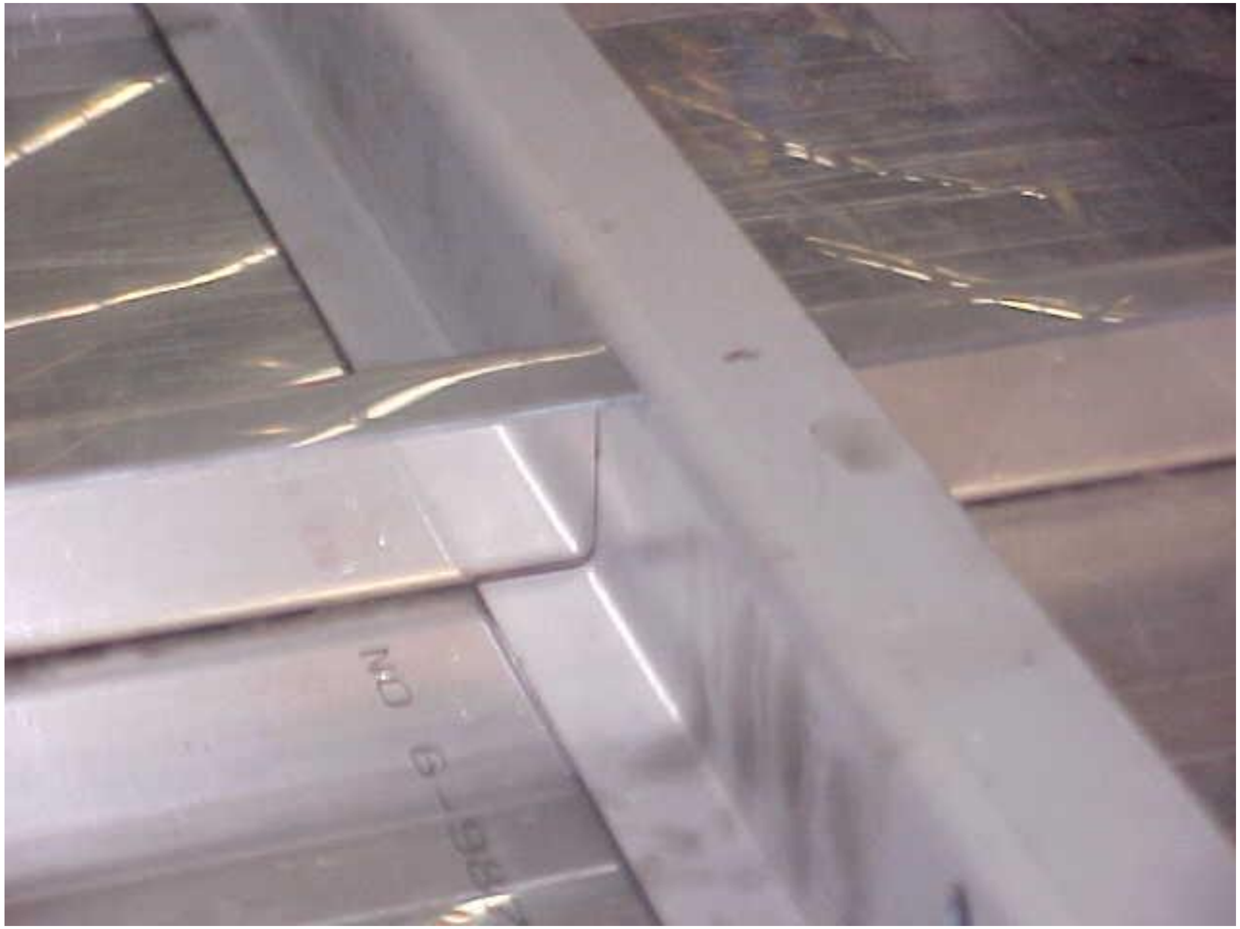
THICKNESS OF SIDE WALL : 2mm

LASER CUT, BUTT JOINT TIG WELDING OR LASER WELDING, SPOT WELDING

DOOR FRAMES IS A PART OF SUB ASSEMBLY OF SIDE WALL, BUT FABRICATED SEPERATELY

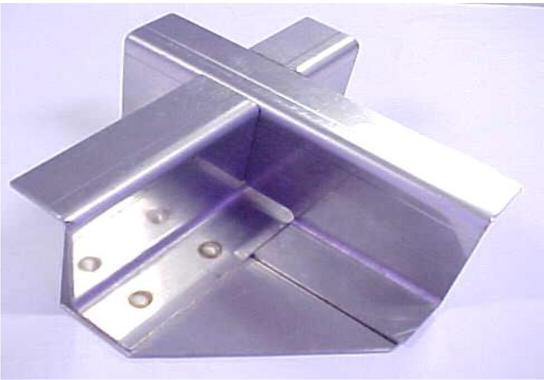
THICKNESS OF DOOR FRAME : 4mm

DOOR FRAMES ARE DESIGNED IN A MANNER TO ENABLE THE COMPENSATION OF TOLERANCES IN WHOLE SIDE WALL

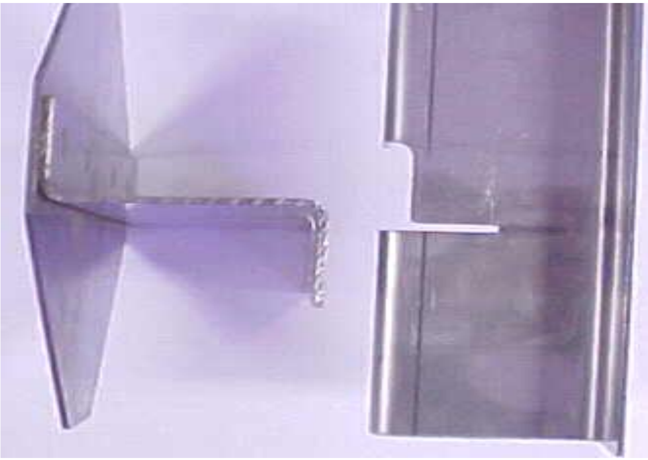


- POSITIVE INTERLOCKING BETWEEN ALL HORIZONTAL AND VERTICAL MEMBERS
  - BETTER STRENGTH,
  - REDUCTION OF SIDE WALL THICKNESS TO 60MM FROM 90 MM,
  - BETTER GEOMETRICAL INTEGRITY

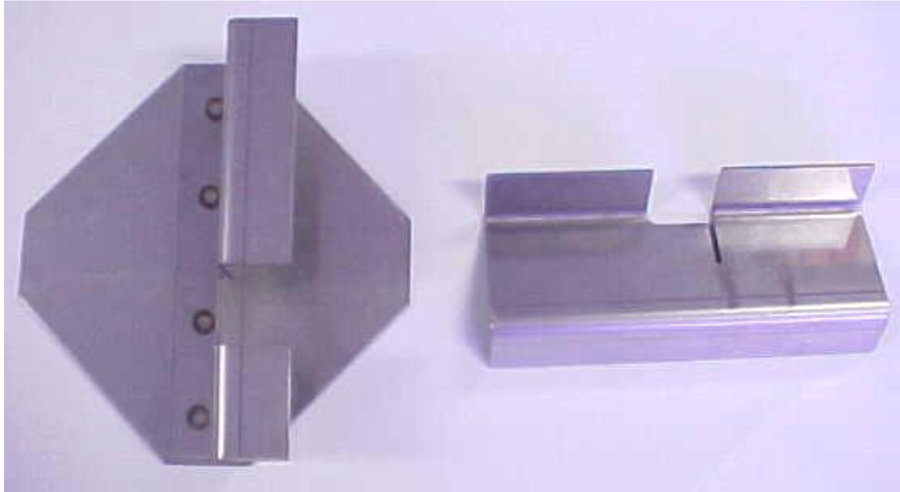
Sidewall-Interlocking



- Interlocking between the horizontal and vertical stiffening members of sub-assemblies like sidewall, endwall, underframe, etc.



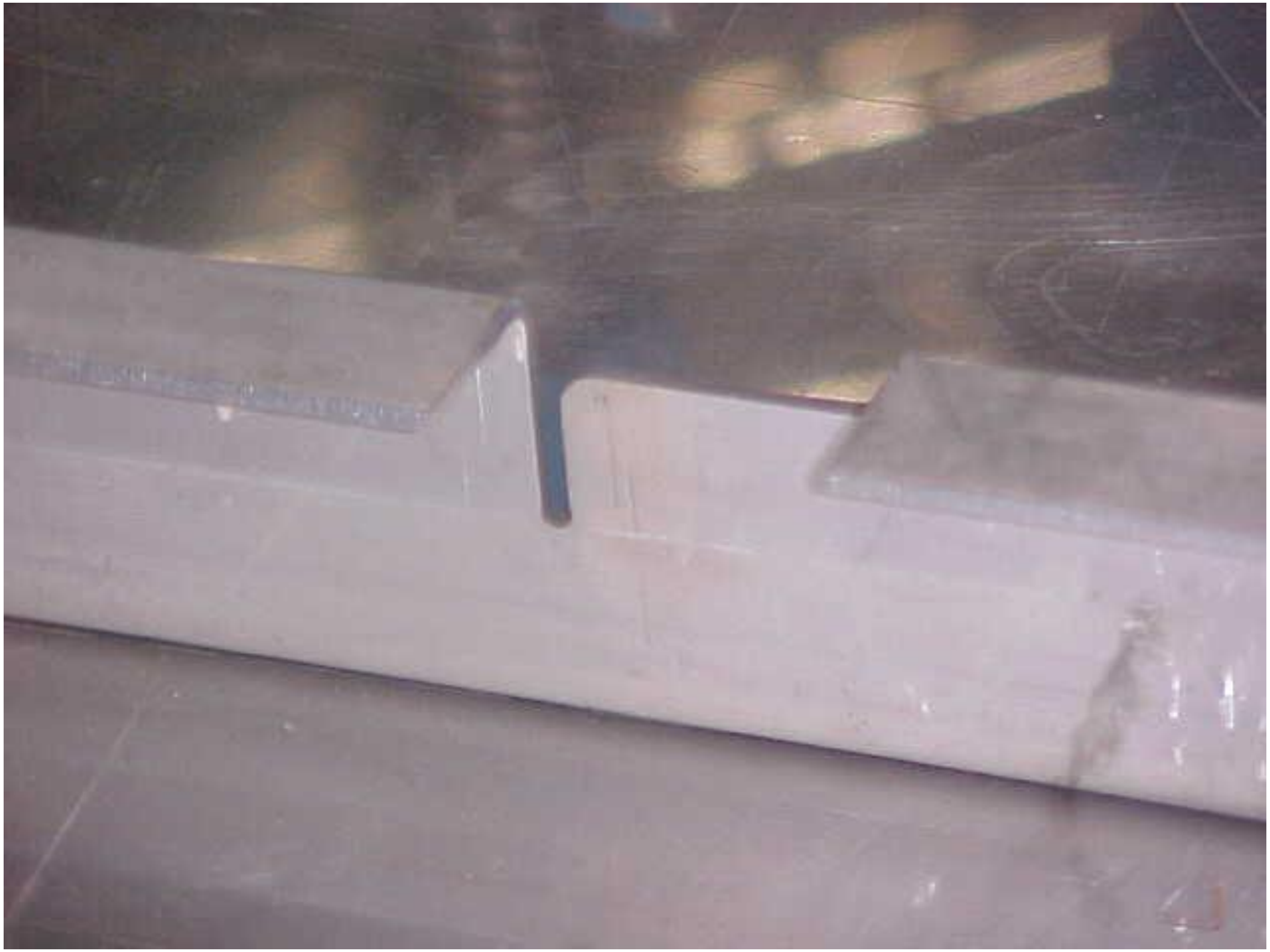
- Aligned stress flow
  - Better strength



- Reduction of side wall width from 90 mm to 60mm

SITUATION BEFORE INTERLOCKING TECHNIQUE

IN THE PAST, A LOT OF ROLLED PROFILES HAVE BEEN USED IN FRAME WORK OF SIDE WALL, END WALL AND UNDER FRAME, WHICH RESULTS A LOT OF WELD JOINTS, STRAIGHTENING AND REWORKING. THIS CAUSED A QUALITY REDUCTION AND INCREASE OF COST.

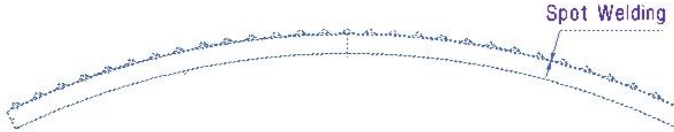


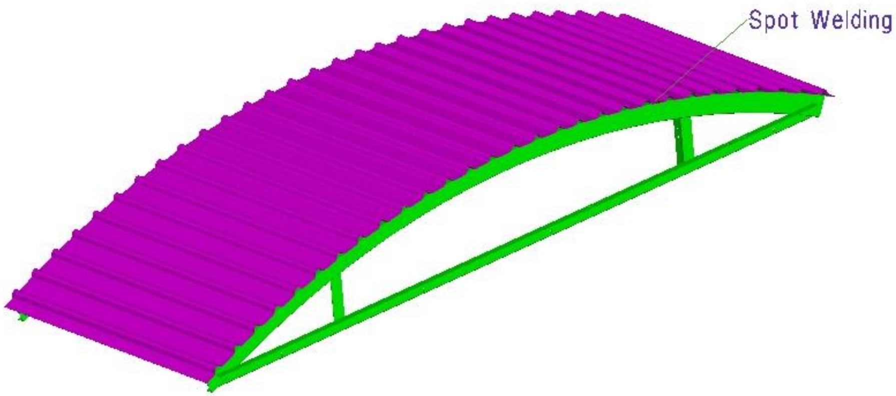
CUT PROVIDED IN S/W MEMBER FOR INTERLOCKING

COMPLETE SIDEWALL

- CARLINE (CANT RAIL IN CONV. COACHES) IS PART OF THE SIDE WALL, UNLIKE CONV. COACHES WHERE IT IS A PART OF ROOF
  - BETTER RIGIDITY OF SIDE WALL
  - POSITIVE LOCATION OF ROOF

Roof





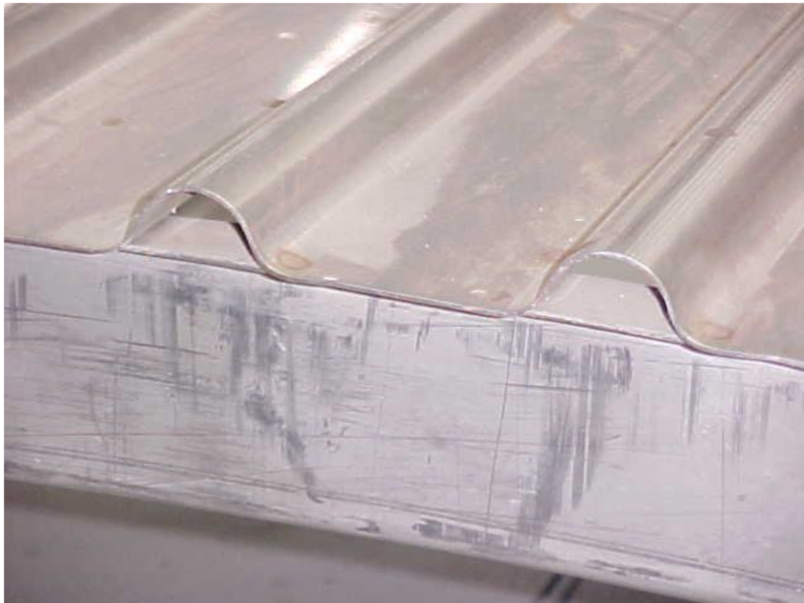
- ❑Corrugated roof sheet spot welded to z-section roof arches
- ❑Uniform height of arches along it's length
- ❑Roof weighs only about 1000kg
- ❑Spot welded austenitic steel cladding
- ❑Pocket free

END WALL

HOLES PROVIDED IN ALL STIFFENERS OF END WALL TO REDUCE WEIGHT

ROOF

- CORRUGATED ROOF SHEET SPOT WELDED TO Z-SECTION ROOF ARCHES
- UNIFORM HEIGHT OF ARCHES ALONG IT’S LENGTH
- ROOF WEIGHS ONLY ABOUT 1000KG



ROOF

- **MIDDLE PART:**
- CORRUGATED SHEET 1.25 mm THICK AUSTENITIC STAINLESS STEEL
- # ROOF ARCHES : Z SECTION 30x80x30x2
- # HORIZONTAL CROSS BRACES : Z SECTION 30x50x30x2
- **END PARTS :** THESE ARE PREPARED FOR MATCHING THE TAPERING AT ENDS

UNDERFRAME

UNDERFRAME FRONT PART IS MADE BY JOINING TOGETHER HEAD STOCK…

…AND BODY BOLSTER

UNDER FRAME

MAIN COMPONENTS OF UNDER FRAME

TWO SIDE SILS (SOLE BAR) W SECTION 220x65x8

TWO MAIN CROSS MEMBERS - BOX TYPE 6 mm THICK SITUATED IN A REGION OF BOGIES

FRAME WORK – CROSS MEMBERS MADE OF FOLDED CHANNEL SECTIONS 140x50x4 FORM THE MAIN PART OF THE FRAME WORK OF U/F

FRONT PART – IT IS HEAD STOCKS CONSISTS OF SHEETS WITH THICKNESS OF 10mm, 6mm & 4mm

FLOOR – IT CONSISTS OF CORRUGATED SHEETS OF 1.25 mm THICK

- UNDER FRAME CORRUGATED TROUGH FLOOR IS PLUG WELDED FROM TOP WITH THE CROSS MEMBERS
- ALUMINIUM BASED WELDABLE PRIMER USED FOR WELDING CORTEN STEEL TO SS TO PREVENT BI-METALLIC CORROSION

PROVISION FOR CBC AS WELL A SIDE BUFFER MOUNTING IN HEAD STOCK

FLOORING SUPPORT MEMBERS ON UNDERFRAME

WATER TANK MOUNTING BRACKETS WELDED ON THE UNDER FRAME

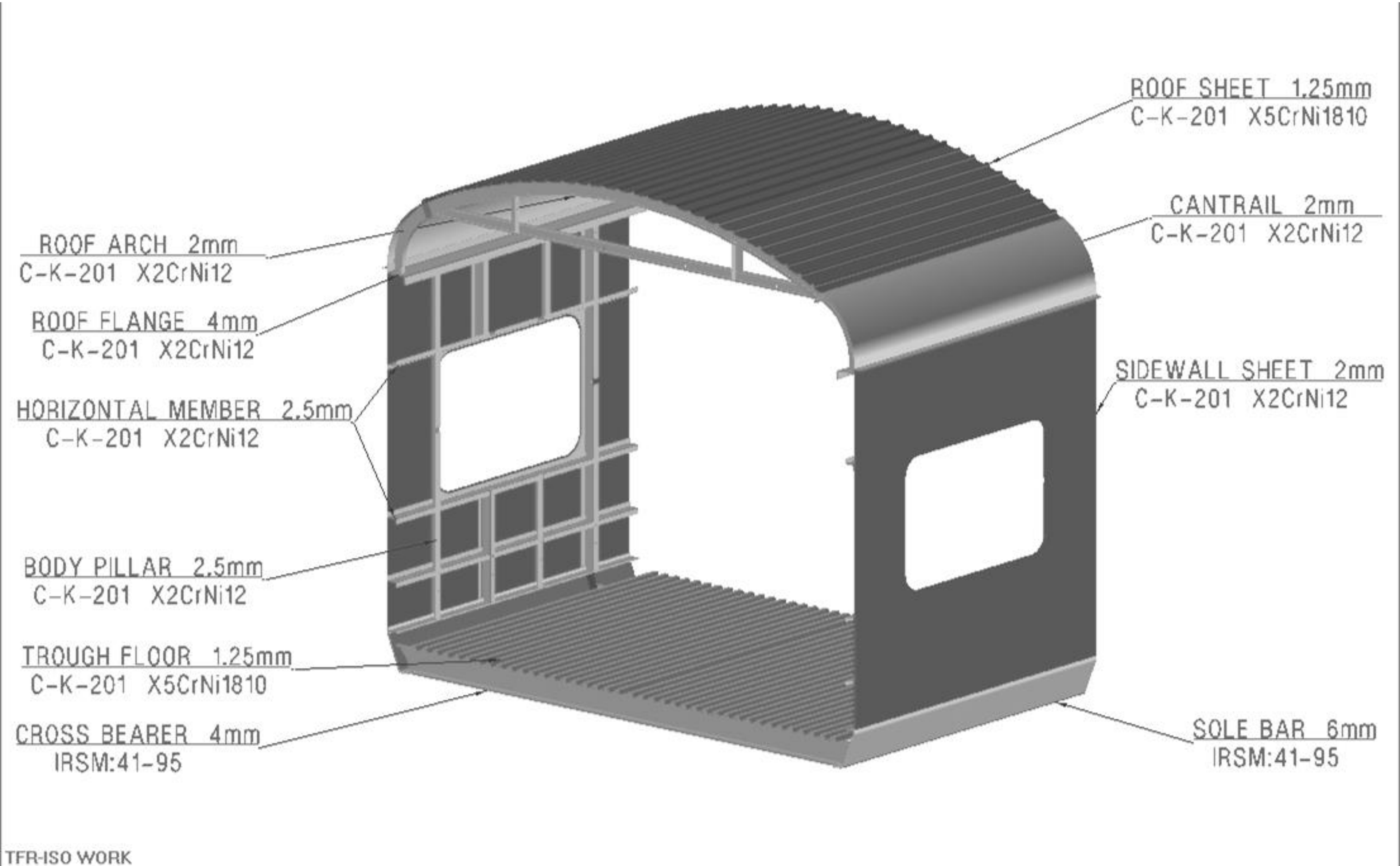
YAW DAMPER (CONNECTED BETWEEN UNDERFRAME AND BOGIE FRAME) BRACKETS WELDED ON THE UNDERFRAME

Steels used in LHB Coach Shell

Shell Assemblies	Steels used and their %age compositions	UTS N/mm^2	Yield Stress N/mm^2
Side wall, End wall and Roof structure	X2 Cr8 Ferritic Steel (SS 409M) (C < .03%, Cr 10-12%, Si 1%, Mn 1.5%)	450-600	320
Roof sheet and Trough floor	X5 CrNi 18 10 Austenitic Steel (SS 304) (C < .07%, Cr 18%, Ni 10 % Si 1%, Mn 2%)	700-850	235
Underframe	IRS M-41 / CortenSteel (C < .01%, Cr .35 -.6%, Ni .2 - .4% Cu .3 - .6% Si .3 - .7%, Mn .25%)	440-480	320

SS 409M is a modified version of SS 409 offering higher strength abrassion resistance and weldability

Shell structure



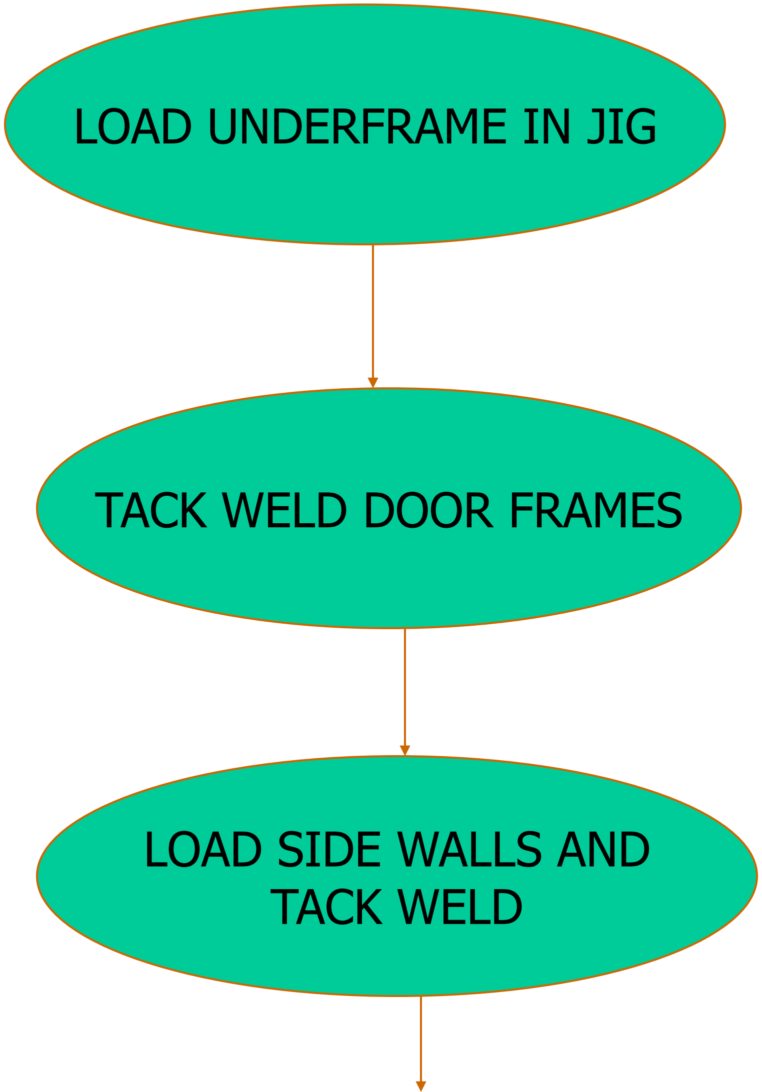
Manufacturing Techniques

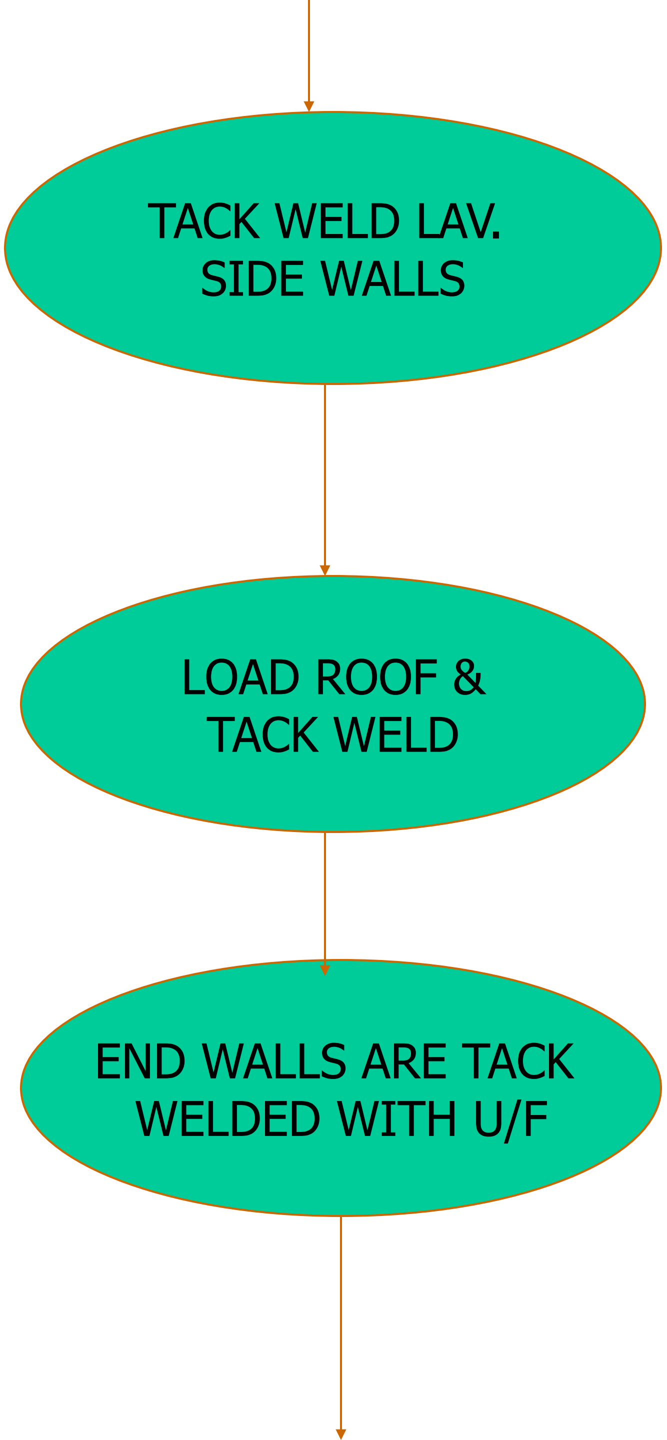
- ❑ Laser Profile Cutting Of Components
- ❑ Sidewall/Roof Spot Welding
- ❑ Magnetic Skin Tensioning Of Shell

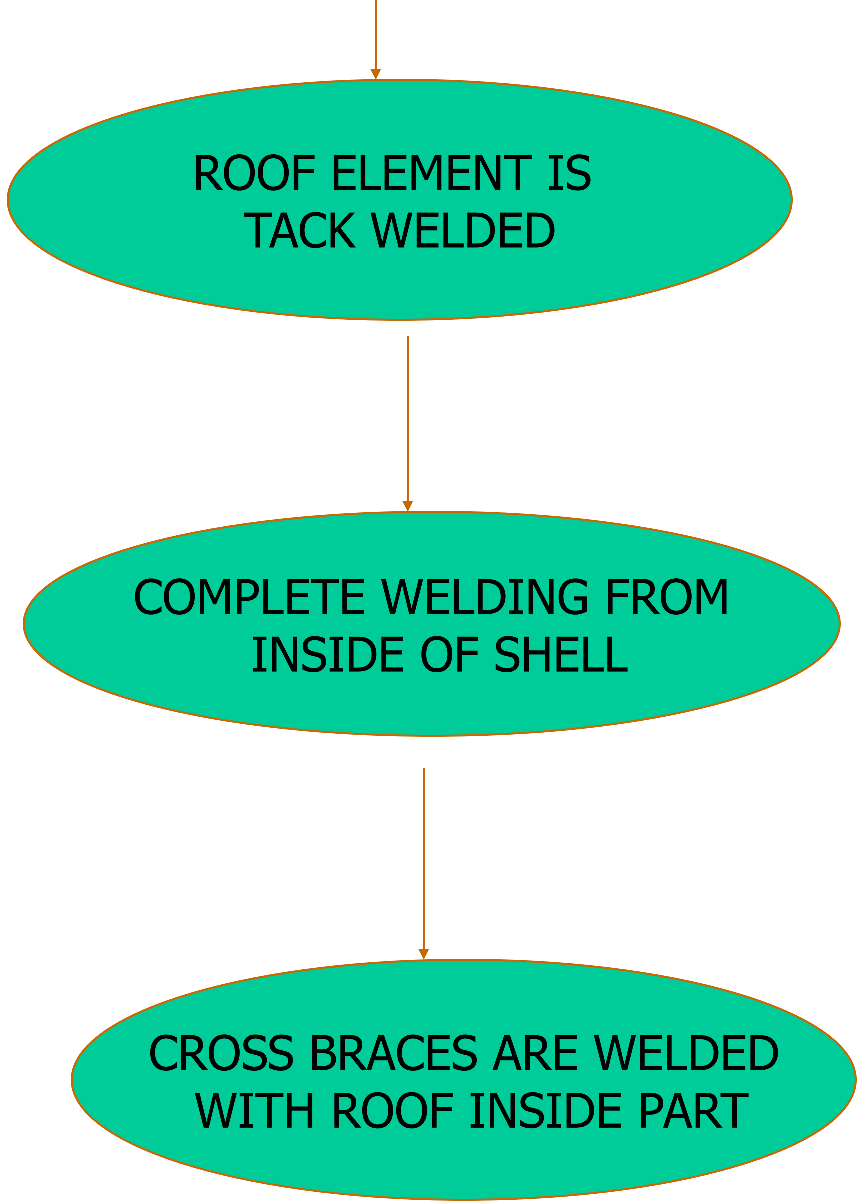
JIGS & FIXTURES

S.NO.	*DESCRIPTION*
1.	*BODY SHELL ASSEMBLY JIG*

PROCESS CHART
STAGE 1




TACK WELD LAV. SIDE WALLS
LOAD ROOF & TACK WELD
END WALLS ARE TACK WELDED WITH U/F

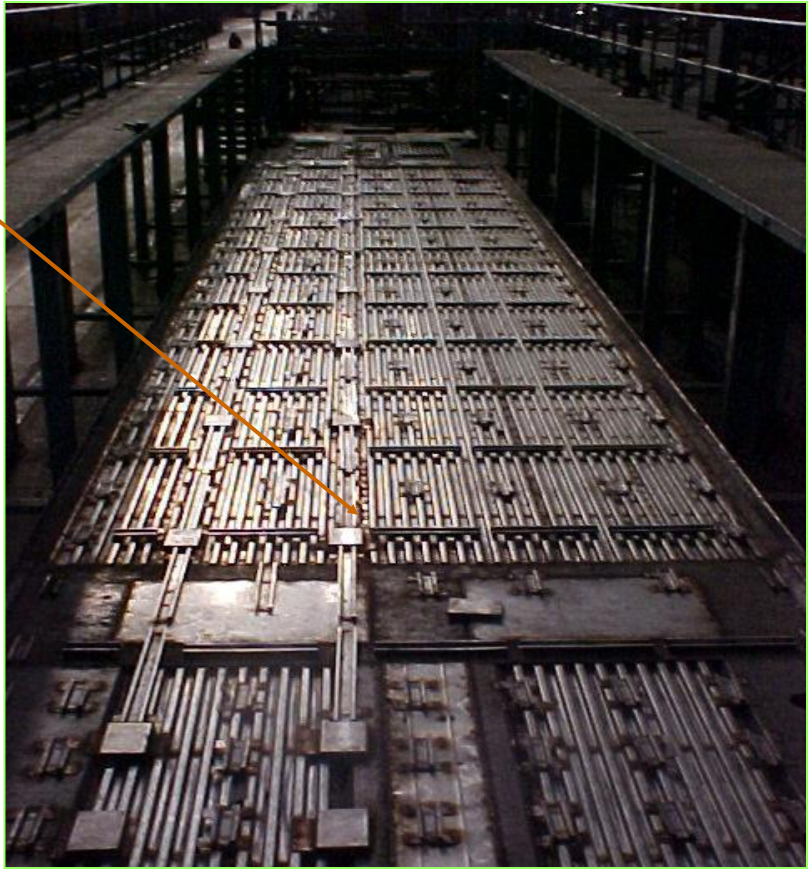

ROOF ELEMENT IS TACK WELDED
COMPLETE WELDING FROM INSIDE OF SHELL
CROSS BRACES ARE WELDED WITH ROOF INSIDE PART

PROCESS

STAGE -1

CONTD…

1. *CLEAN THE JIG FROM SPATTERS AND LOAD UNDER FRAME ON IT. CENTRE THE UNDERFRAME AND CLAMP IT.*



CONTD…

2. DOOR FRAMES ON ONE SIDE ARE LOADED AND TACK WELDED.

TIE RODS

CONTD…

3. *SIDE WALLS ARE LOADED IN THE JIG ON BOTH SIDES AND TACK WELDED. INTERNAL DIMENSIONS ARE MAINTAINED.*

CONTD…

4. AGAIN DOOR FRAMES ARE LOADED ON THE OTHER END OF UNDERFRAME. TIE RODS ARE USED TO MAINTAIN THE INTERNAL DIMENSIONS.

CONTD…

5. *LAVATORY SIDE WALLS ARE LOADED AND TACK WELDED WITH UNDERFRAME AND DOOR FRAMES.*

CONTD…

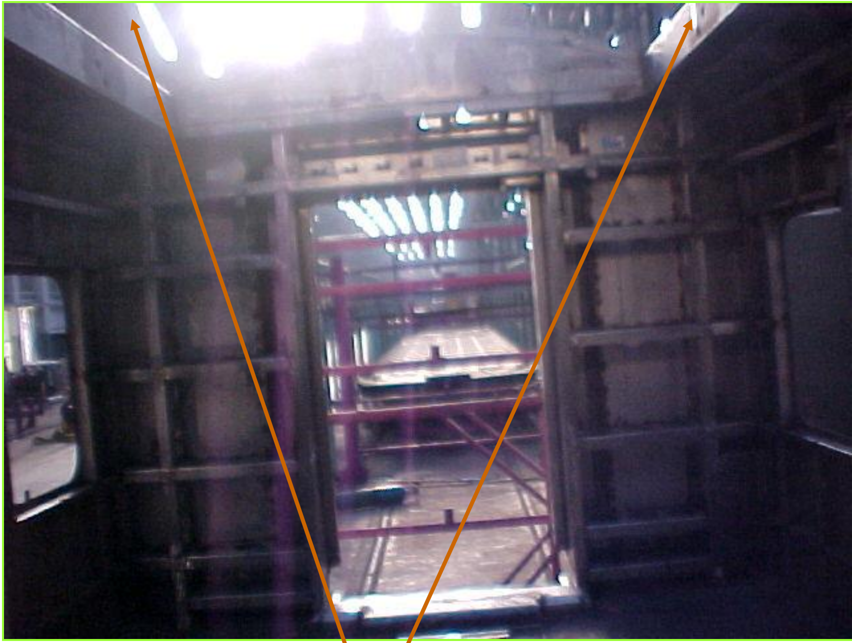
6. *ROOF IS MOUNTED OVER SIDE WALLS AND TACK WELDED.*

CONTD…

7. *END WALL ASSEMBLIES ARE LOADED ON THE HEAD STOCK OF THE UNDER FRAME AND TACK WELDED.*

CONTD…

8. *ROOF ELEMENT IS LOADED OVER LAV. SIDE WALLS ON BOTH SIDES AND TACK WELDED. IT IS USED FOR FITTING OF AIR CONDITIONER ASSEMBLY.*



ROOF ELEMENT

CONTD…

9. *COMPLETE WELDING OF FOLLOWING PARTS IS DONE FROM INSIDE.*

(i) *ROOF WITH SIDE WALL.*

(ii) *SIDE WALL WITH UNDERFRAME.*

(iii) *SIDE WALL WITH DOOR FRAME.*

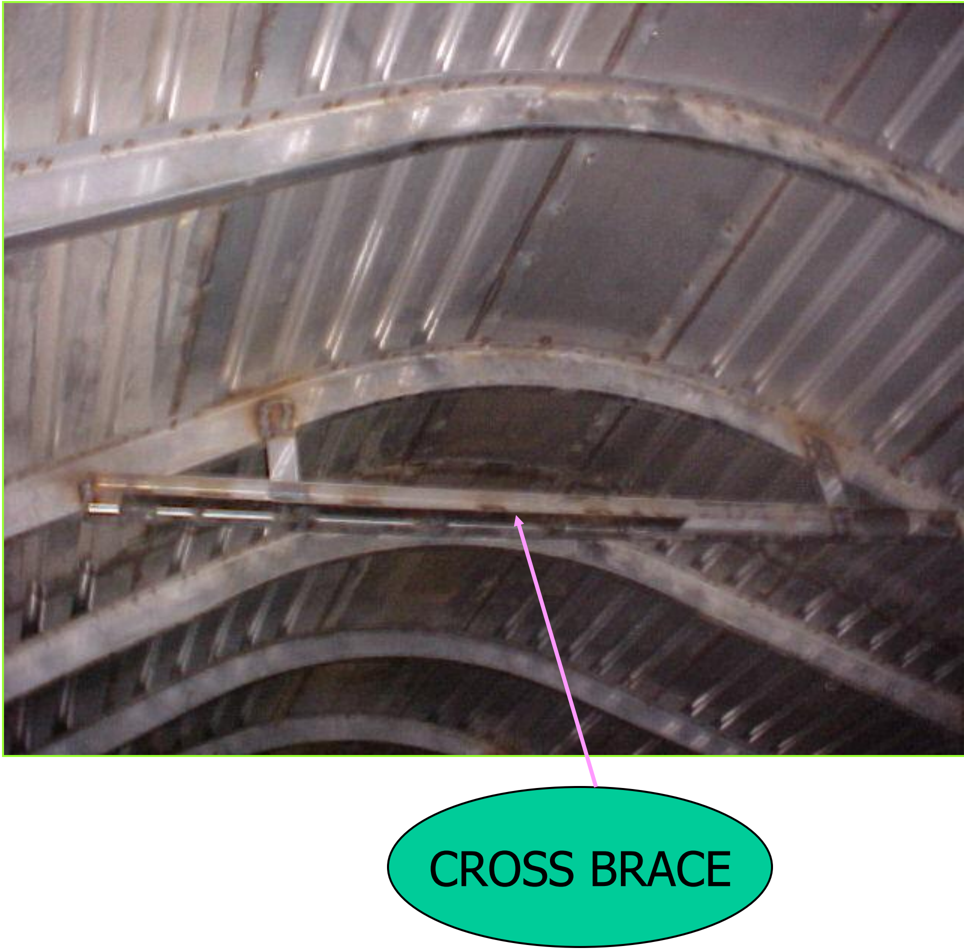
(iv) *LAV. SIDE WALL WITH END WALL.*

(v) *ROOF ELEMENT WITH DOOR FRAME.*

(vi) *UNDERFRAME WITH END WALL.*

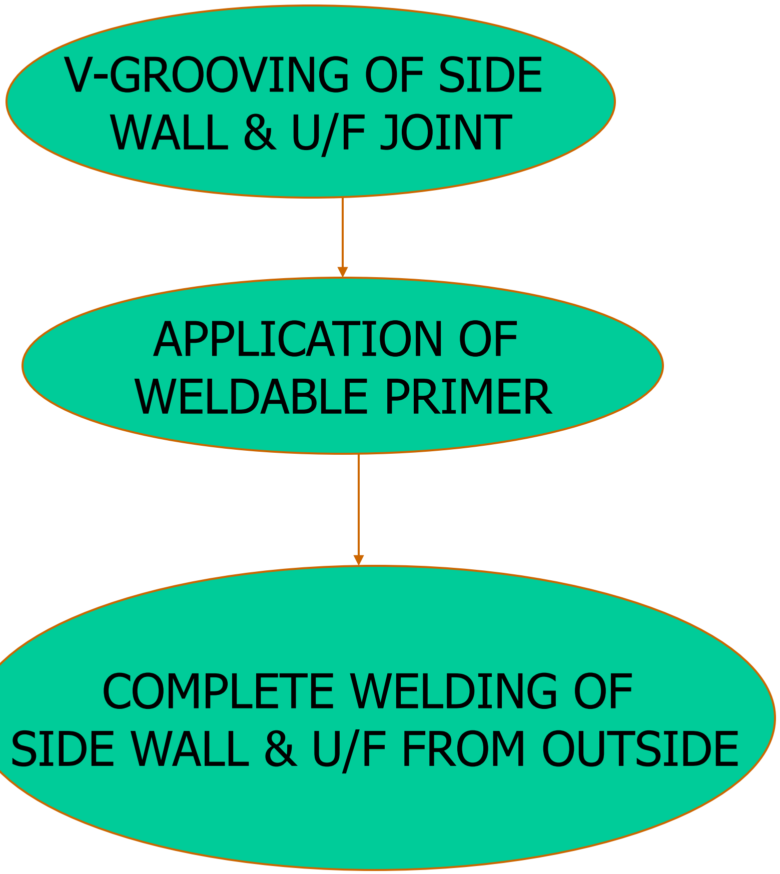
CONTD…

10. CROSS BRACES ARE WELDED WITH ROOF INSIDE SHELL FOR AIR CONDITIONER'S DUCT. THEN THE SHELL IS MOVED TO STAGE 2.



STAGE II

PROCESS CHART
STAGE 2



1. *V- GROOVING OF UNDERFRAME SOLE BAR WITH SIDE WALL JOINT IS DONE FROM OUTSIDE THE SHELL BY USING ANGLE GRINDER ON BOTH SIDES OF SHELL.*
2. *'META COT 'SILVER GREY WELDABLE PRIMER IS APPLIED TO AVOID BIMETALLIC CORROSION.*

CONTD….

3. *SOLE BAR AND SIDE WALL ARE WELDED FROM EXTERIOR OF SHELL USING MAGNETIC TRACK WELDING MACHINE.*
4. *GRINDING OF WELDED JOINTS OF SOLE BAR AND SIDE WALL IS DONE.*

WELDING JOINT

WELDING PARAMETER FOR MAG CO2 WELDING

MAT. THICKN-ESS	NO. OF LAYERS	WIRE DIA mm	WELDING CURRENT (AMP)	ARC VOLTAGE	WIRE FEED M/MIN	TRAVEL SPEED CM/MIN	THROAT THICKN-ESS (a mm)
1.6*1.6	1	0.8	100-120	22-24	5.0	50	1.2
2.0*2.0	1	0.8	100-120	22-24	5.0	45	1.6
2.0*5.0	1	1.2	100-120	22-24	5.0	45	2.5
5.0*5.0	1	1.2	200-220	26-27	6.5	40	3.2

STAGEWISE ACTIVITIES OF SHELL ASSEMBLY

SAS-I

ACTIVITIES :- CLAMPING OF U/F BY CLAMPS.

ALIGN WITH PIANO WIRE AT THREE LOCATIONS

LOADING OF 5 INTERNAL JIGGING FRAME

DOOR FRAME FITMENT

MIDDLE SIDE WALL FITMENT

TACKING OF SIDE WALL SHEET TO U/F FLANGE

STRAIGHTNESS IS CHECKED WITH PIANO WIRE

PLACEMENT OF ROOF

ROOF CROSS BRACES FITMENT

PLACEMENT OF FINAL ROOF ELEMENT

END WALL FITTING

STAGES OF SHELL ASSEMBLY

SAS-II

WELDING OF SIDE WALL WITH SOLEBAR BOTH SIDES FROM OUTSIDE WITH TRACTOR WELDING. GRINDING OF ALL THE HORIZONTAL & VERTICAL WELDING JOINTS FOR PROPER OUTER FINISH

STAGES OF SHELL ASSEMBLY

- **SAS-III**
- SENDER GRINDING TO REMOVE HIGH SPOTS
- COLD STRAIGHTENING THE SIDE WALL & END WALL
- SKIN TENSIONING BY HEATING OF SIDE WALL FROM INSIDE THROUGH PERFORATED PLATE HOLES WITH MULTI HEAD TORCH BY USING OXY ACETYLENE SET.
- CHECK THE SURFACE FINISH BEFORE & AFTER SKIN TENSIONING.
- PIN WELDING ON ROOF (660 Nos) BY PIN WELDING MACHINE TO HOLD GLASS WOOL.

STAGES OF SHELL ASSEMBLY

SAS-IV

FITTING OF PARTITION FRAME WHERE REQUIRED

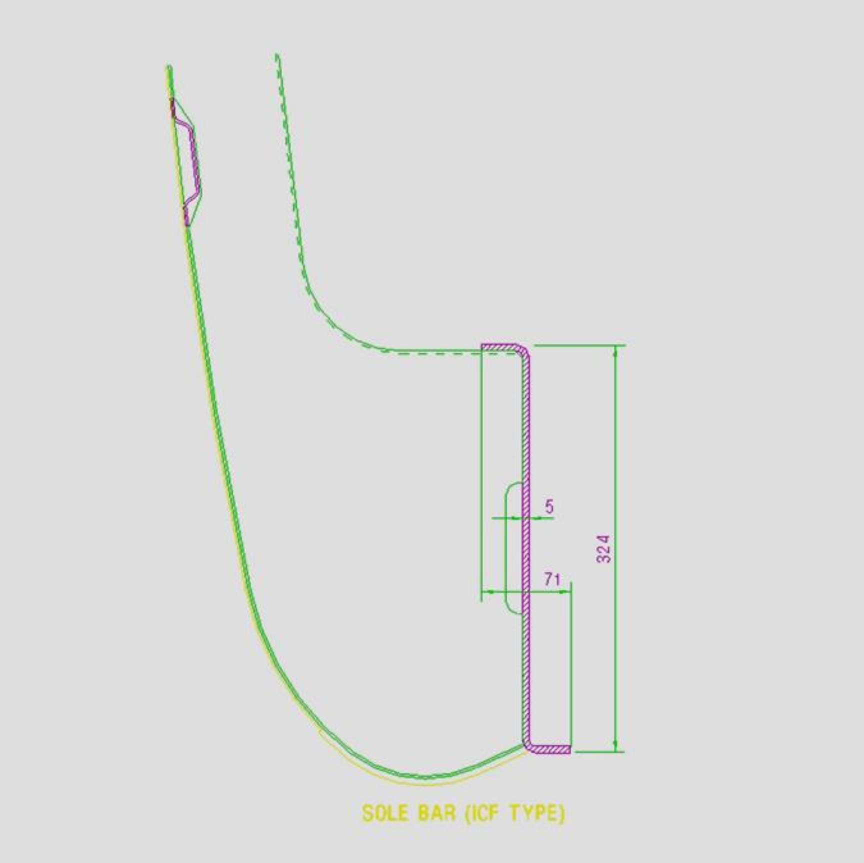
WELDING PARTS CAR BODY SHELL PP END & NPP END

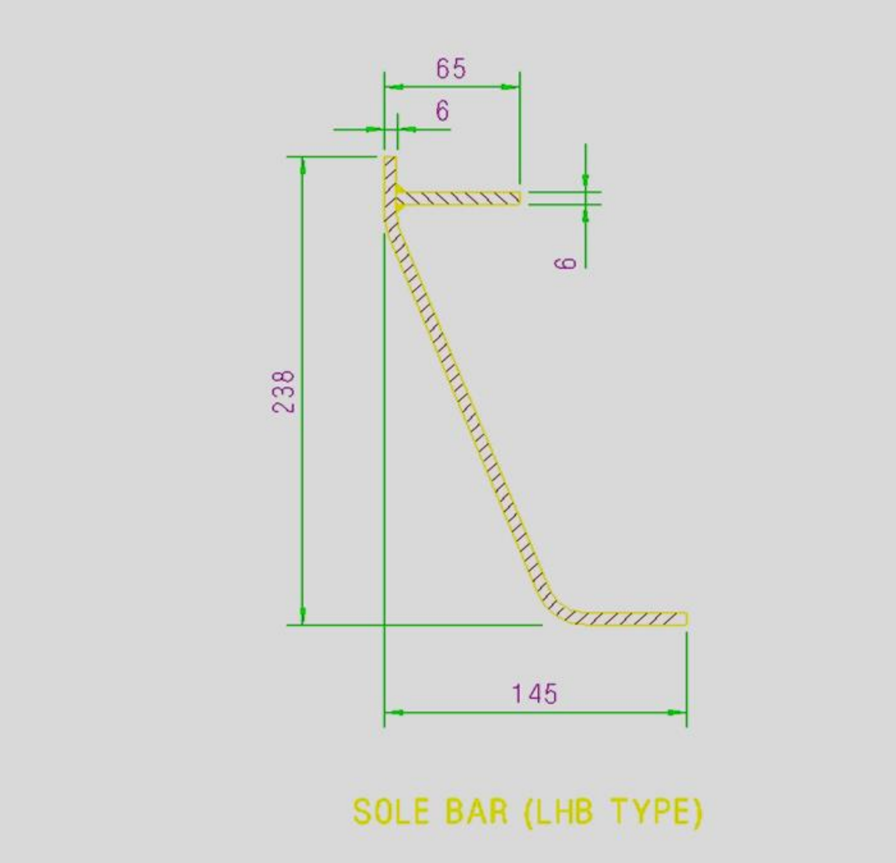
CBC FITMENT

STAGES OF SHELL ASSEMBLY

- CHECKING & INSPECTION
- # ALL DIMENSIONAL INSPECTION OF THE SHELL
- # DPT TEST FOR SIDE WALL JOINTS
- # TWIST CHECK
- # PLACING ON DIPLORY FOR SHIFTING TO NEXT STAGE

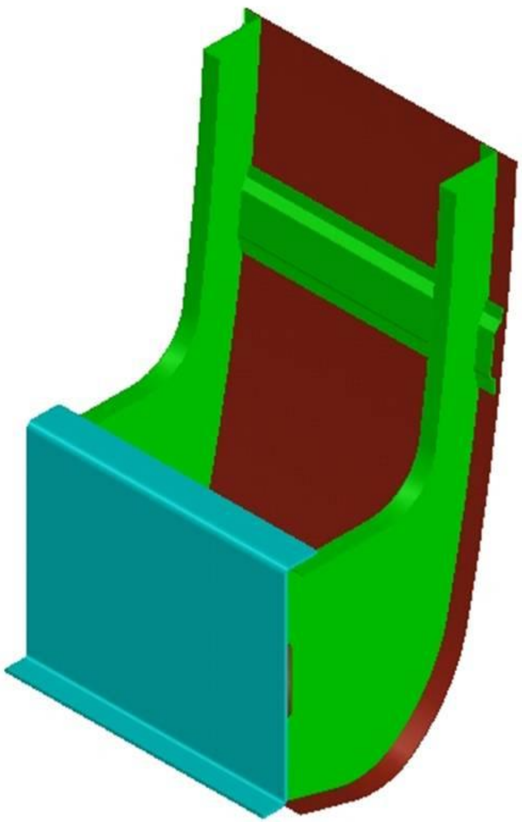
COMPARISION

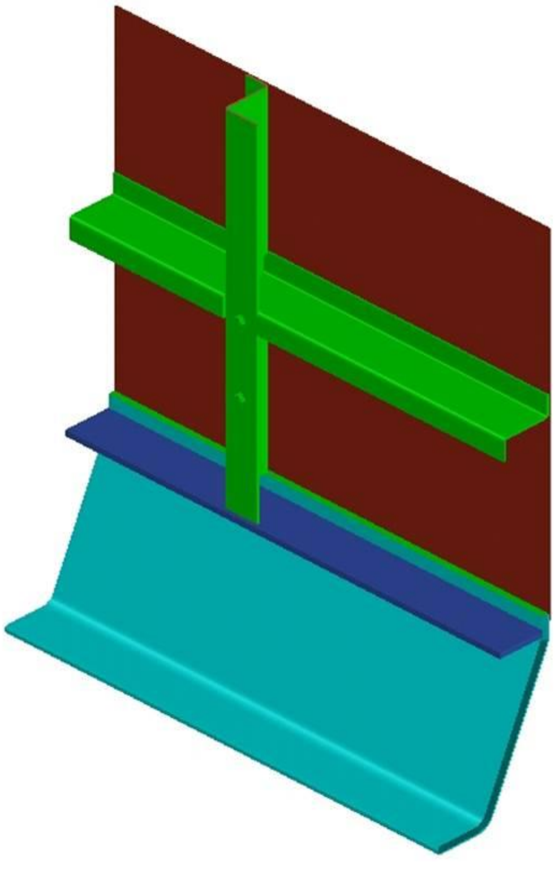




- TURN UNDER HAS BEEN ELIMINATED
- CLEAR APPROACH FOR SAND BLASTING AND PAINTING
- NO ACCUMULATION OF WATER AND MUCK
- PILLAR RESTS ON SOLEBAR AS COMPARED TO LOAD TRANSFER THROUGH A VERTICAL WELDED JOINT IN CONV. COACHES

SIDEWALL TO UNDERFRAME JOINT, CONV. VS.LHB





END WALL OVERHANGS BEYOND HEAD STOCK

-RELEASING MORE SPACE INSIDE

-REDUCING SPACE AND HENCE WIND RESISTANCE DUE TO TURBULENCE BETWEEN COACHES.

-GAP BETWEEN END WALLS OF TWO COUPLED COACHES IS 300 MM ONLY

SEPARATE DOOR FRAME FITTED BEFORE SIDEWALLS IN LHB, NO PROBLEM OF DOOR SIZE/SQUARENESS ETC.

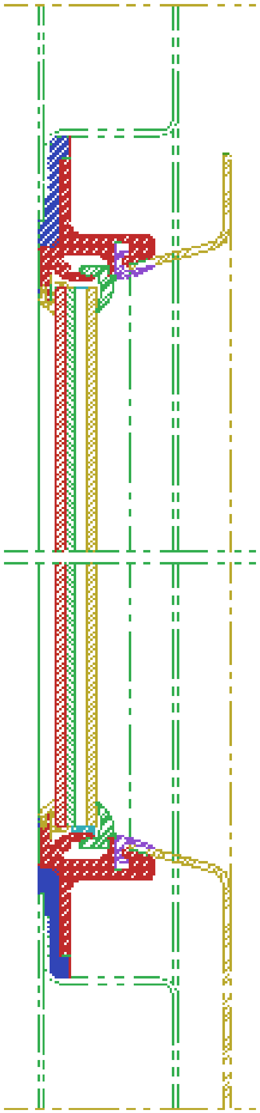
NO DOOR FRAME, DOOR OPENING SQUARENESS MAINTAINED BY FITTING ONE SIDE’S DOOR CORNER SHEET AFTER SIDE WALL

- **WEIGHT PER METER LENGTH OF LHB COACHES IS APPROXIMATELY 10% LESS THAN THE CONVENTIONAL COACHES. BETTER PAYLOAD TO TARE WT RATIO.**
- **NO CHANGE REQUIRED IN SHELL DESIGN FOR SPEEDS OF 200KMPH**
- **DIMENSIONAL COMPARISON**

DIMENSIONAL COMPARISON	ICF	LHB
LENGTH OVER BODY	21770	23540
LENGTH OVER BUFFER	22280	24700
WIDTH OVER BODY	3245	3240
INNER WIDTH	3065	3120
WINDOW OPENING (ac sleeper)	1220x610	1180x760

WINDOWS

Sealed window Glass Units



- The window glass unit characteristics are:
  - –K value not lass than 1.6 W/M^{2}K
  - –Transparency > 39 %
  - –Reflection > 40
  - –Total energy absorption < 21%
- The sealed window units consists of 8.4 mm outer laminated and 4 mm tempered inner glass with 6 mm Krypton/Argon gas filling
- Window glass is secured to Al extrusions by rubber profiles
- The Al frame is glued to the car body with the help of PU, elastic gap filling structural adhesive (Sikaflex-264 T & eq.). Capable of withstanding high dynamic stresses

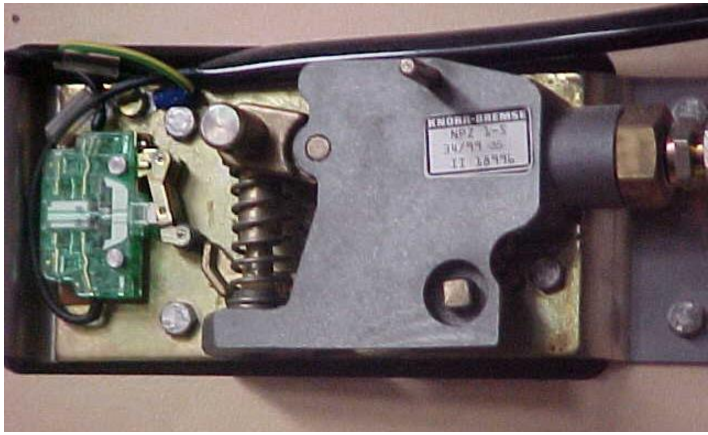
Emergency openable window

- It is similar to the fixed unit
- Four units are provided each coach to allow emergency evacuation of passengers
- A handle connected to the rubber profile opens the glass unit of the emergency window

HOPPER WINDOW FOR LAVATOTRY

Passenger Emergency Alarm

- 5 passenger emergency alarms per coach in chair car have been provided at following locations:
  - 2 in passenger compartment
  - 3 in lavatories
- There is no mechanical linkage like a chain and these handles directly operate a valve venting the brake pipe
- Designed to stop the train not just warn the driver




THANK YOU

Wheel Shelling

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

Guidelines for wheel inspection in open line depots (Ref RDSO CMI-K003)

For this purpose, following shelling limits need to be followed.

1. Depth of shelling marks has reached to 1.5 mm.
2. Length of shelling marks has reached to 40 mm.
3. Depth of hollow tyre reached to 3 mm.
4. This limit of 3 mm is kept to study the effect of wheel shelling and service life of wheels.
5. The rejectable limit of hollow tyre will continue as more than 5 mm as specified in IRCA part IV.

Following major causes have been identified For wheel shelling:

- Non-optimal choke sizes of Dump Valves.
- Obstructions in air-brake piping between dump valves and brake cylinders.
- Wrong / Loose electrical connections of WSP system.
- Jamming of Brake Calipers / Actuators.
- Poor design of Junction Box prone to dust/water ingress.

Item wise consolidated list of instructions issued by RDSO (2018-19):

1.Brake Cylinder Pressure

(Ref: RDSO letter no. MC/LHB/Brake dated 20.04.2018 to PCMEs All Zonal Rlys and PUs)

Zonal Railways / PUs should not resort to alteration in Brake Cylinder pressure of LHB Coaches from the specified value of 3.0+0.1kg/cm2 .

2.Dump Valve Chock Size

(Ref: RDSO letter no. MC/LHB/Brake dated 27.09.2018 to PCMEs All Zonal Rlys and PUs)

Dump valve chock size should be ensured as under.

Brake system Make/model	Exhaust chock size	Charging chock size
KBIL (Model MGS2)	Remove existing 7mm chock	Replace existing 5 mm chock with 9mm chock
FTRIL (Model SWKP AS20R)	Remove existing 9mm chock	Replace existing 6 mm chock with 9mm chock
Above modification should be ensured in all newly manufactured as well as existing LHB coaches		

3.Modification in air brake pipeline & associated fittings in LHB Coaches.

Ref: 1)RDSO letter no.MC/LHB/Brake dated 08.03.2019 to PCMEs/RCF,MCF,ICF

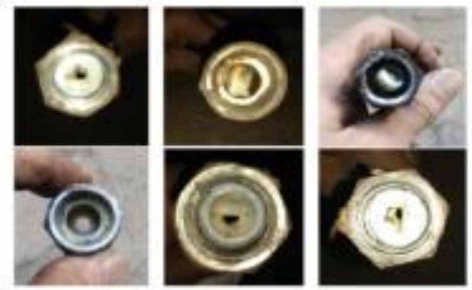
2)Presentation on wheel shelling by Bengaluru Division/SW Railway in 18th CMG

3) RDSO letter no.MC/LHB/Brake dated 12.04.2019 to PCMEs/All Zonal Rlys and Pus

1. Flexible Air Hose (600mm) for Bogie

During the field studies by RDSO at BCT/WR & SBC/SWR;

- Problems are observed with the existing hose results in restriction in smooth air flow in pipe line.
- Ultimately affects the performance of brake system which may leads to Wheel Shelling in case of wheel slip.

S.No.	Observations	Causes	Photographs
i.	***Less inner diameter***	Insufficient air flow passage	
ii.	***Washers***	The Nylon/Teflon washers provided inside the hose gets perished/shrink due to over tightening or during in service of the coach, which results in blockage of the air passage and thus to inoperativeness of brake cylinders.	
iii.	***More nos. of pipe joints/fittings***	Restriction in air flow & more chances of occurring leakages.	

To overcome above issues, RDSO has developed a standardized design of flexible hose

d. Details of standardized flexible hoses:

S.No.	DRAWING/PART NO.		
A.	M/s Knorr-Bremse	M/s Faiveley Transport	M/s Escorts
	Flexible Hose (650mm) – for body to bogie		
	KP0274893	FT0052512-001	1J112000031
B.	Flexible Hose (500mm) – for Brake Actuators		
	KP0313153	FT0052512-002	3EB9942

Note: *The upgraded flexible hose should only be procured from RDSO approved sources for Axle Mounted Disc Brake system to ensure quality of this critical item.*

The upgraded flexible air hose for bogie has following advantages:

Bigger Inner diameter: Sufficient air flow passage -The diameter of hose was increased from 9mm to 12mm.

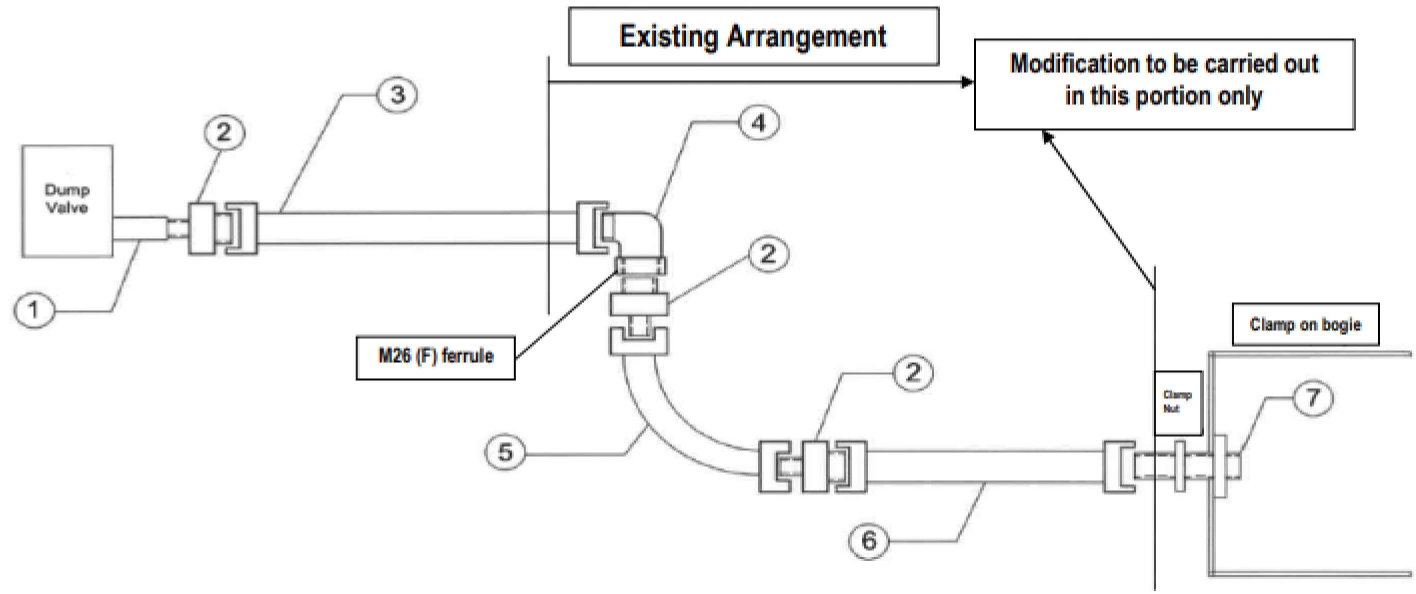
No washers: Avoids blocking of air passage and increase smooth operation of brakes- The new hose eliminates the use of washers and have ferrule arrangement at both ends.

Less pipe joints/fittings: Avoids air flow restriction & leakages- By the use of upgraded hose associated joints/fittings for air connections were reduced from 9 to 6nos.

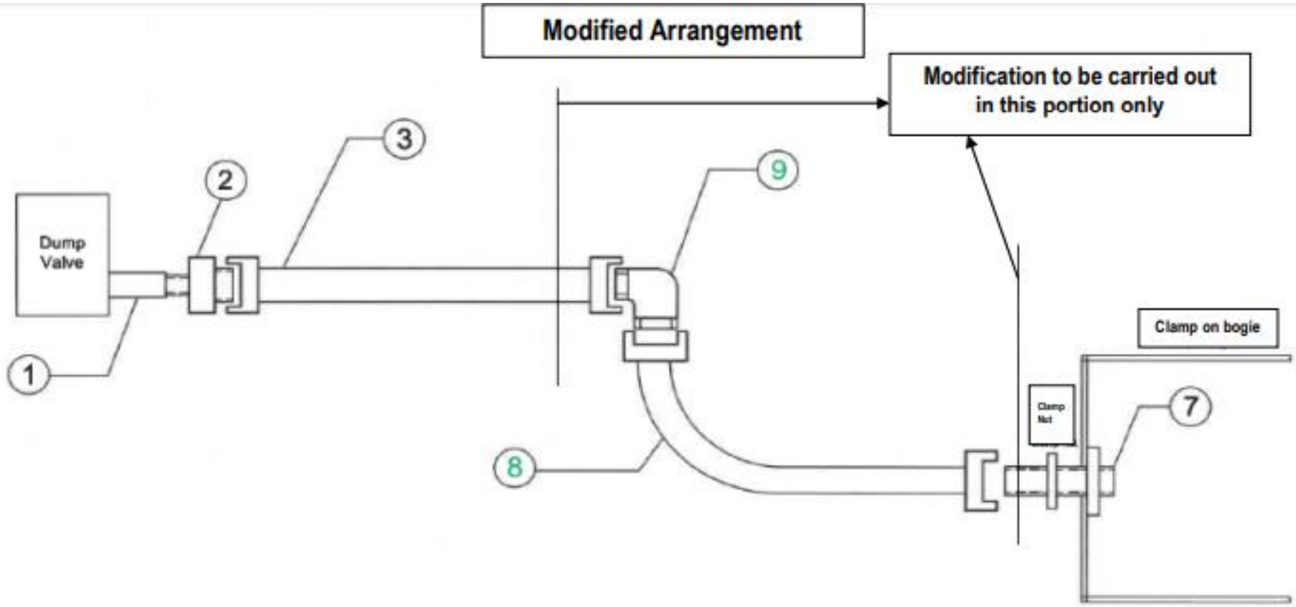
Increase in hose length: Avoids stretching & rupture- The length of upgraded hose was increased from 600 to 650mm, as in original Alstom design and also to avoid stretching & rupture of the hose.

Existing piping arrangement

Modified piping arrangement with reduced joints and modified hose



LEGEND		
S.No.	Description	Quantity
1.	Adopter	01
2.	Ferrule Stud ½" (M) X M26 (M)	03
3.	18 OD Pipe with M26 ferrule fittings	01
4.	Elbow M26 (M) X M26 (F) ferrule	01
5.	Hose ½" with ½" BSP (F) both sides	01
6.	18 OD Pipe with M26 ferrule fittings	01
7.	Stud M26 both sides	01
	Total Quantity	**09**



LEGEND			
S.No.	Description	Quantity	Remarks
1.	Adopter	01	--
2.	Ferrule Stud ½" (M) X M26 (M)	01	Quantity reduced from 3 nos. to 1 nos.
3.	18 OD Pipe with M26 ferrule fittings	01	--
4.	Elbow M26 (M) X M26 (F) ferrule	00	Replace with S.No.9
5.	Hose ½" with ½" BSP (F) both sides	00	Replace with S.No.8
6.	18 OD Pipe with M26 ferrule fittings	00	Eliminated
7.	Stud M26 both sides	01	--
8.	Hose 5/8" with M26 (F) both sides	01	To replace with S.No.5
9.	Elbow Male Connector M26 (M)	01	To replace with S.No.4
	Total Quantity	**06**	

Note: Items at S.No.4, 5 & 6 (in Red) to be deleted and at S.No.8 & 9 (in Green) to be added.

4.Self Lubricating Bushes for Brake calipers /Actuators

(Ref: RDSO letter no. MC/LHB/Brake dated 06.09.2018

1.Only Self lubricating bus.hes should be fitted in Brake calipers /Actuators.

2. Practice of oiling with self lubricating bushes needs to be stopped .

3. Due to use oil, the grease film of self lubricating bushes gets damaged and these bushes no longer function as designed.

4.Also dust gets accumulated in form of muck which may obstruct freeness of caliper and can affect brake releasing and application timing.

5.Ensuring Integrity of Electrical connections of WSP System and Free movement of Brake calipers

(Ref: RDSO letter no. MC/LHB/Brake dated 27.09.2018 to PCMEs All Zonal Rlys and PUs)

Integrity of Electrical connections of WSP System and Free movement of Brake calipers during Brake application/release is absolutely vital in reducing wheel shelling.

चक्के से सम्बन्धित दोष और परिचालन में यान की स्थिरता पर उसका प्रभाव

डीप फ्लैन्ज

बीजी में 28.5 तथा एमजी में 25.5 से बढ़कर 35 तथा 32 मिमी0 से अधिक हो जाय

(1) यदि रेल हेड का ऊपरी सतह भी घिसा हुआ हो तो चक्के का फ्लैन्ज, फिश प्लेट तथा डिस्टेन्स ब्लाक चेक ब्लाक से टकराने लगता है।

(2) चक्के के ट्रेड के साथ–साथ फ्लैन्ज में भी घिसाव होता रहता है। अतः फ्लैन्ज के डीप होने की अवस्था में उसका थिन हो जाना भी स्वाभाविक है। जिससे फ्लैन्ज बल का मान भी बढ़ जाता है।

शार्प फ्लैन्ज

फ्लैन्ज के टिप का अर्धव्यास 5 मिमी से कम

प्रभाव–

(1) पाजिटिव एंगुलरिटी बढ़ जाती है।

(2) घर्षण बल का मान बढ़ जाता है।

(3) फेसिंग दिशा में चक्का दो रास्तों पर जा सकता है अथवा घिसे या थोड़ा सा टूटे हुए टंग रेल के प्वाइंट पर चढ़कर अवपथित हो सकता है।

हालो टायर/फाल्स फ्लैन्ज

बाहरी सिरा मध्य की अपेक्षा 5 मिमी0 से ज्यादा नीचे आ जाय

प्रभाव–

(1) फाल्स फ्लैन्ज ट्रेलिंग दिशा में चलते समय प्वाइन्ट को चीर कर उसमें (Gap) अन्तर बना सकता है जिसके फलस्वरूप फेसिंग दिशा में आ रही किसी दूसरी गाड़ी का चक्का दो रास्तों पर जा सकता है।

(2) क्रासिंग पोर्सन पर चक्का विंग रेल के सम्पर्क में चल कर नोज पर गिर सकता है।

(3) अत्याधिक हंटिंग (Hunting) होती है।

थिन फ्लैन्ज

बीजी में 28.5 मिमी. तथा एमजी में 25.5 मिमी. से घटकर 16 मिमी. से कम रह जाय

प्रभाव–

(1) रेल पथ तथा चक्कों के मध्य अन्तर बढ़ जाने के कारण लर्चिंग बढ़ जाती है। जिससे फ्लैन्ज बल का मान भी बढ़ जाती है।

(2) एक्सल की कोणीयता (**Angularity**) बढ़ जाती है।

रूट रेडियस में घिसाव

बीजी में 16 मिमी. तथा एमजी में 15 मिमी. से घटकर 13 मिमी. रह जाय

प्रभाव–

(1) चक्के तथा रेल हेड के मध्य सम्पर्क क्षेत्र बढ़ जाने के कारण घर्षण बल का मान भी बढ़ जाता है। क्योंकि इस दशा में फ्लैन्ज घिस जाने के कारण उसमें 1:2.5 का प्रारम्भिक ढाल काफी कम हो जाता है।

(2) धूरे की कोणीयता के समान मान के लिए भी पाजिटिव इसेन्ट्रिसिटी बढ़ जाती है।

फ्लैट टायर

एमजी में 51मिमी, बीजी सवारी यानों में 50 तथा माल यानों में 60 मिमी. चपटा हो जाय।

प्रभाव—धीमी गति 20–25 किमी0/घंटा पर हैमरिंग का प्रभाव (Hammering effect) बढ़ जाता है। जिसके कारण रेल में उत्पन्न होने वाले प्रतिबल का मान भी लगभग 2.5 गुना तक हो जाता है।

ह्वील गेज में अन्तर

ह्वील गेज बीजी तथा एमजी के लिए क्रमशः 1600 मिमी. तथा 930 मिमी. होता हैं। माल यानों तथा सवारी यानों के लिए इसमें 02 मिमी. ढोला तथा 01 मिमी. टाइट अनुमेय है। ह्वील गेज अधिक ढोला अथवा टाइट नहीं होना चाहिए।

- **प्रभाव**–चक्के में घुमावदार गति (**W0bbling**) होने लगती है जो यान की स्थिरता को प्रभावित करती है।

चक्के के व्यास में अन्तर

- चक्के के व्यास में निम्न अन्तर अनुमेय है
- एक ही यान में –एमजी में 10 तथा बीजी में 13 मिमी.
- एक ही ट्राली में – 5 मिमी. तथा
- एक ही एक्सल पर– केवल 0.5 मिमी.

प्रभाव–

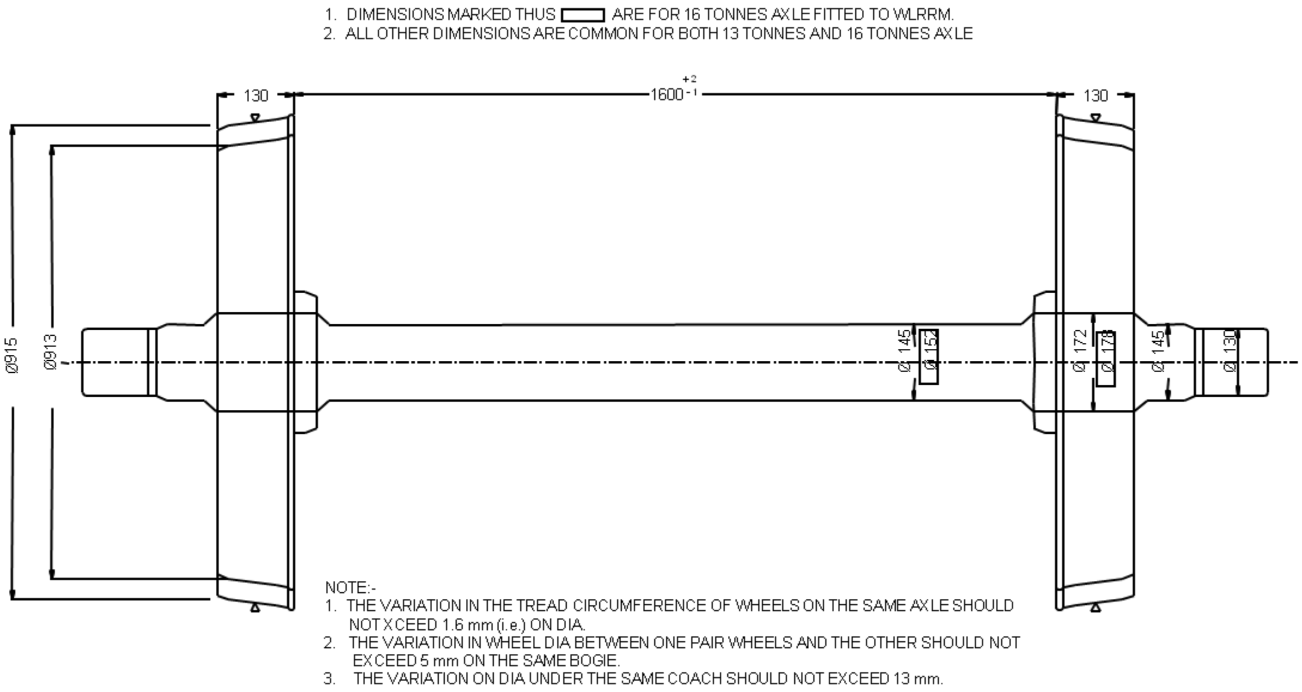
(1) एक ही एक्सल पर चक्के के व्यास में अन्तर के कारण उनके द्वारा समान चक्करों में चली गयी दूरी भी अलग–अलग होती है जिससे पाजिटिव एंगुलरिटी लगातार बनी रहती है।

(2) एक ही यान के चक्कों के व्यास में अत्याधिक अन्तर बफर हाइट को प्रभावित कर सकता है।

(3) यान के अन्य कारकों के साथ मिलकर फर्श के ढाल को भी प्रभावित करता है।

WHEEL & AXLE

Wheel, Tread and Axle



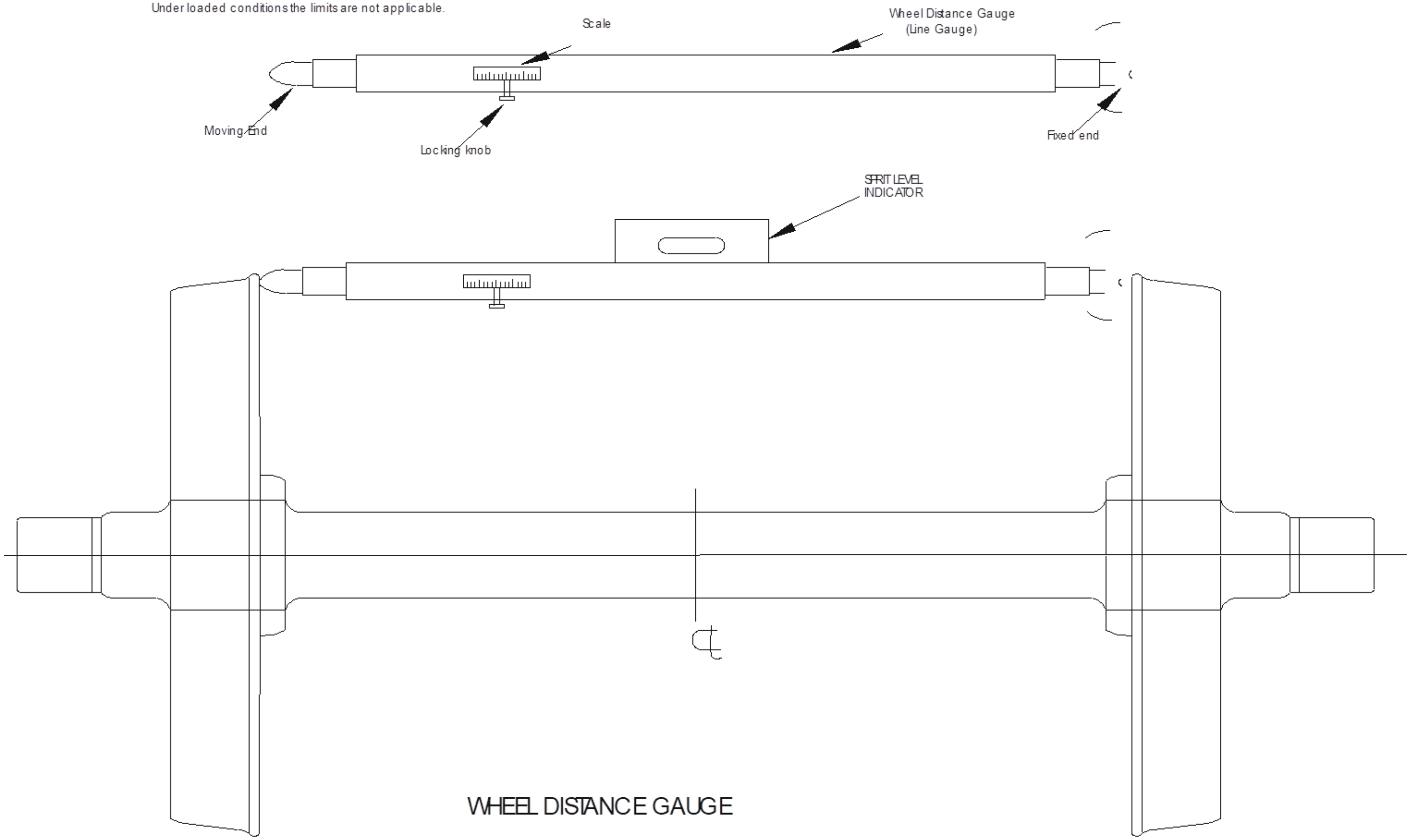
- Nomenclature
  - Axle
    - Journal
    - Collar
    - Wheel seat
  - Disc
    - Tread
    - Hub
    - Tyre profile

Wheel Gauge

Newly assembled wheel set should be checked for the distance between inner face of wheel i.e. 1600 + 2/-1 mm using Wheel Distance Gauge.

The wheels to be gauged on a level track after taking off from coaching vehicle.

Under loaded conditions the limits are not applicable.

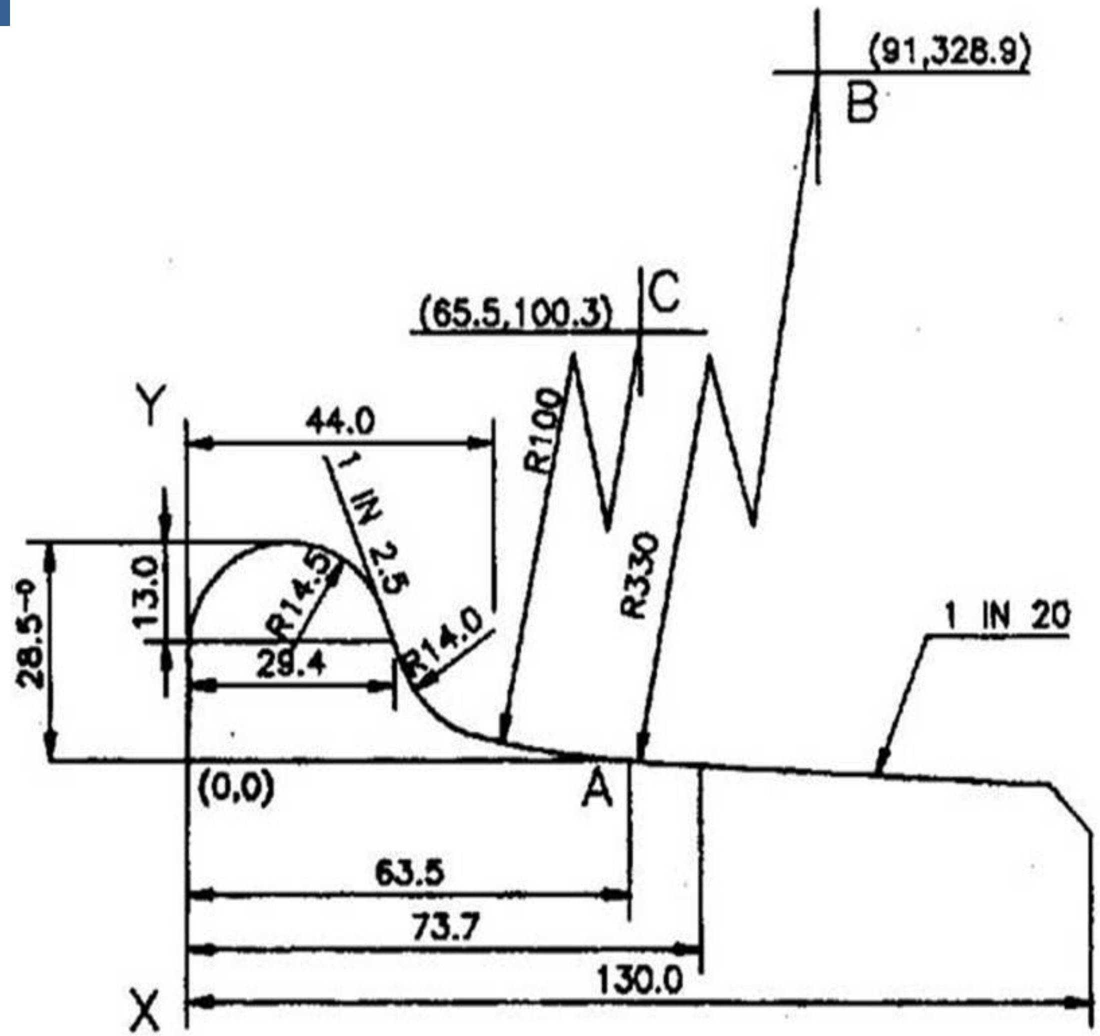


WHEEL DISTANCE GAUGE

FIGURE 10.6

Wheel Tyre Profile

- Standard wheel profile
- Worn wheel profile (Conforming profile)
- No Intermediate profile now.



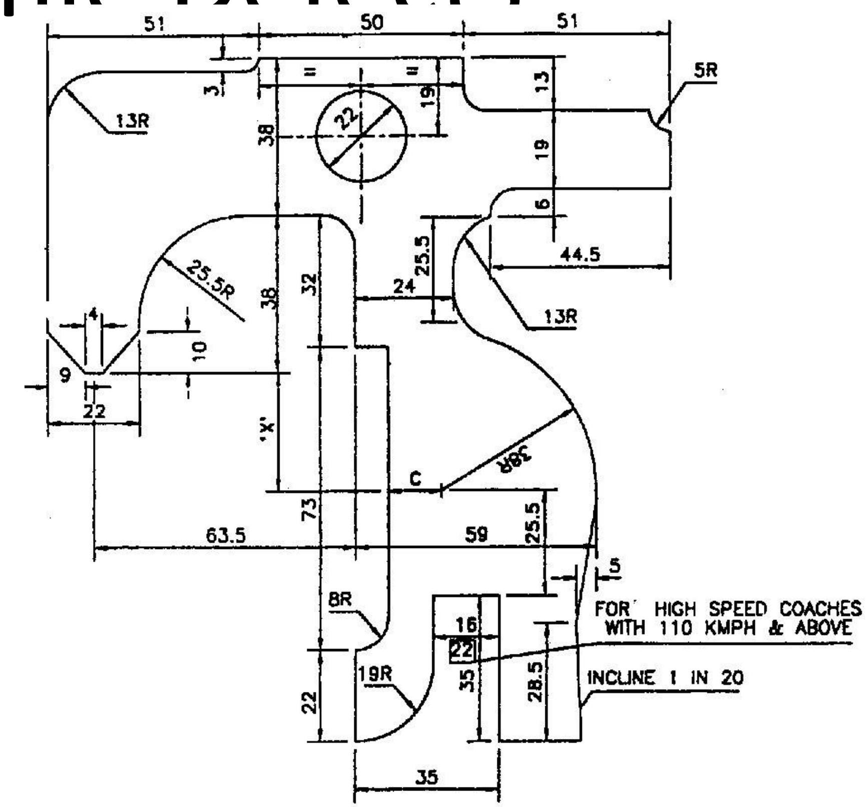
Difference in Wheel Diameter

	On the same axle	On the same trolley	On the same wagon
For Wagon	0.5	13	25
For Coach	0.5	5	13

- Prescribed in
  - Rule No. 2.8.14.2 IRCA Part III and
  - Rule No. 2.9.4 IRCA Part IV
- These limits do not form a part of train examination.
- The rejection of wheels worn beyond service limits will continue to be determined by the normal wear limits specified in IRCA Rules (Rly. Bd. letter No. 86/M(N)960/8 Dated 22.8.86).

Wheel Profile Defects

- Flat tyre
- Hollow tyre
- Sharp flange
- False flange
- Deep flange
- Thin flange
- Root radius



All coaches (Including EMU & DMU) 50 mm

NOTE:–

1. CONDEMNING MARK 'C' TO BE STAMPED ON BOTH SIDE OF GAUGE.
2. CONDEMNING MARKS FOR TYPE OF STOCK ON LINE ONLY NEEDS TO BE STAMPED.
3. DISTANCE 'X' AT WHICH CONDEMNING MARK 'C' FOR VARIOUS TYPE OF WHEELS TO BE STAMPED ARE AS BELOW:–

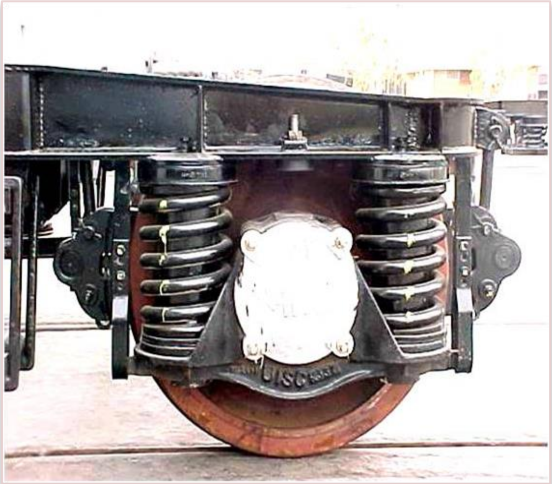
i) SOLID WHEEL OF ICF & BEML MAIN LINE COACHES	6.5 mm.
ii) SOLID WHEEL OF IRS MAIN LINE COACHES	5 mm.
iii) TYRED WHEEL OF IRS, ICF & BEML MAIN LINE COACHES	26 mm.
iv) TYRED WHEEL OF ac & dc EMU MOTOR COACHES.	38.5 mm.
v) TYRED WHEEL OF ac & dc EMU TRAILER COACHES.	28.5 mm.

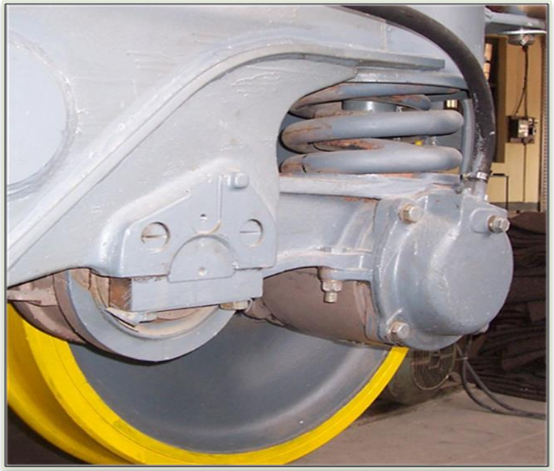
Axle Guide Arrangement

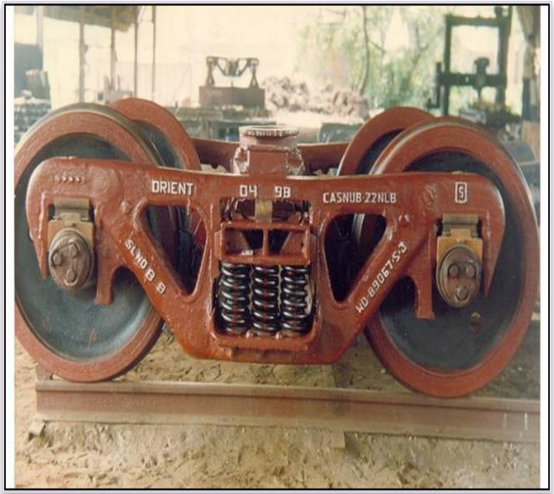
ICF

FIAT

CASNUB







Function of Axle Guides

- Guides the axle w.r.t. bogie frame laterally as well as longitudinally.
- Transmits tractive & braking force between bogie frame & axle box.
- In ICF, acts as a single acting hydraulic vertical shock absorber for primary spring.
- In FIAT bogie, provides control flexibility between frame and axle.

Axle Box Bearing

- CASNUB bogie
  – CTRB
- ICF bogie
  – Spherical type roller bearing with self-align feature.
    - Automatically adjust to the deviation in the centre line of the axle during run.
- FIAT bogie
  – CTRB

Wheels

MSTC/GKP

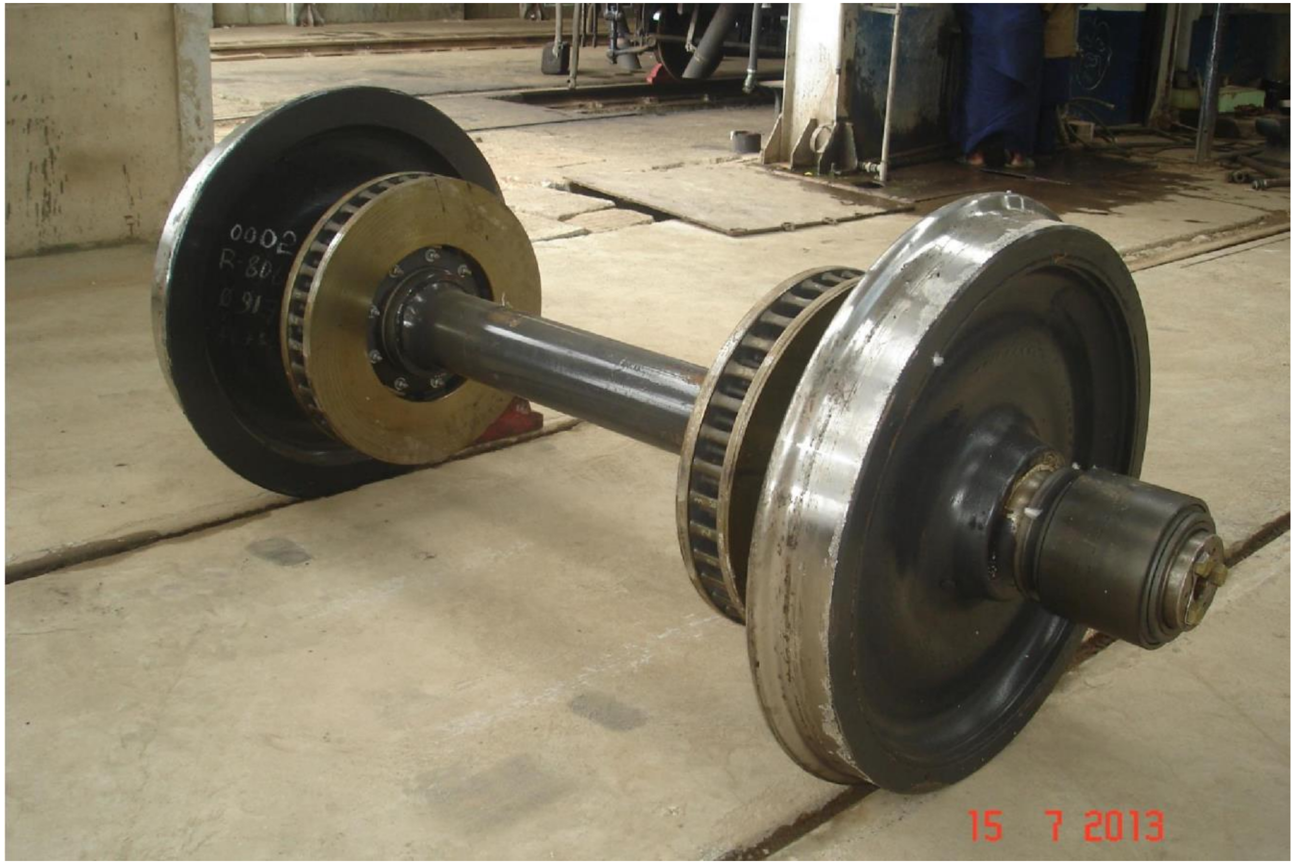
Railway Wheels

- Railway wheel is assembly of two wheels fixed to the axle by interference fit and they rotate along with the axle, without any independent relative movement as in the case of other automobile wheels.
- These wheels are provided with flange towards the inner side, which guide the wheels to travel on the rails and does not allow it to fall down from the rails.

Railway Wheels

ICF Coach Wheel

Railway Wheels



LHB Coach Wheel

Material of Wheel

- Steel made by Electric or Basic Oxygen process
- Steel shall be of killed quality for forged steel
- The max hydrogen content shall not exceed 3 ppm
- The max nitrogen content shall not exceed 0.007%

Railway Whee

BOXN Wheel

Material of Wheel

The chemical composition of the steel for Cast Wheel	
C	0.47% to 0.57% for type A used for carriage stock 0.57% to 0.67% for type B used for wagon stock
Mn	0.60 to 0.80%
P	0.03% max
S	0.03% max
Cr	0.15% max
Ni	0.25% max
Mo	0.06% max
Combined % for Cr, Ni & Mo must be 0.40% max	

The procedure to calculate chemical composition will be in accordance to IS:228

Mechanical Properties of Cast Wheel

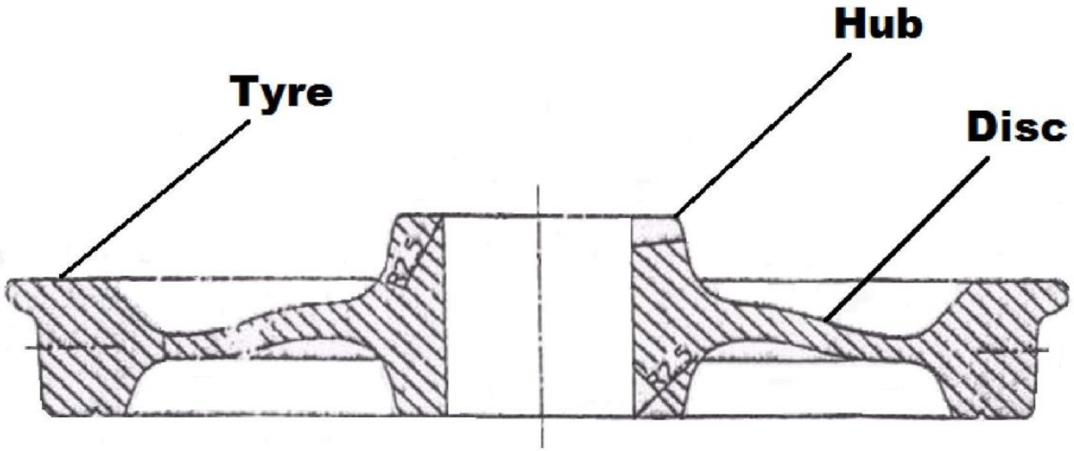
Sl. No.	Particulars	Type A	Type B
1	Tensile Strength at 15 mm below tread face	900 N/m2 min.	930 N/m2 min.
2	Tensile strength at middle of the web	800 N/m2 min.	800 N/m2 min.
3	Minum yield strength at 15 mm below tread face	50% of UTS	50% of UTS
4	Minimum yield strength at middle of the web	50% of UTS	50% of UTS
5	Minimum elongation at 15 mm below tread face	5.0%	4.5%
6	Minimum elongation at middle of the web	7.0%	7.0%
7	Hardness range at 15 mm below tread face	255-320 BHN	271-341 BHN
8	Minimum impact strength at 15 mm below tread face	10 J/cm2 at 20 deg C	--

Railway Wheels

The wheel is better understood by dividing it into the following parts

- Hub
- Disc
- Tyre

Wheel



hub

- Hub is the centre portion of the wheel, where the wheel is fixed to the axle by means of interference fit.
- Thickness of the wheel is maximum at the hub portion.
- UT details is marked on the Hub

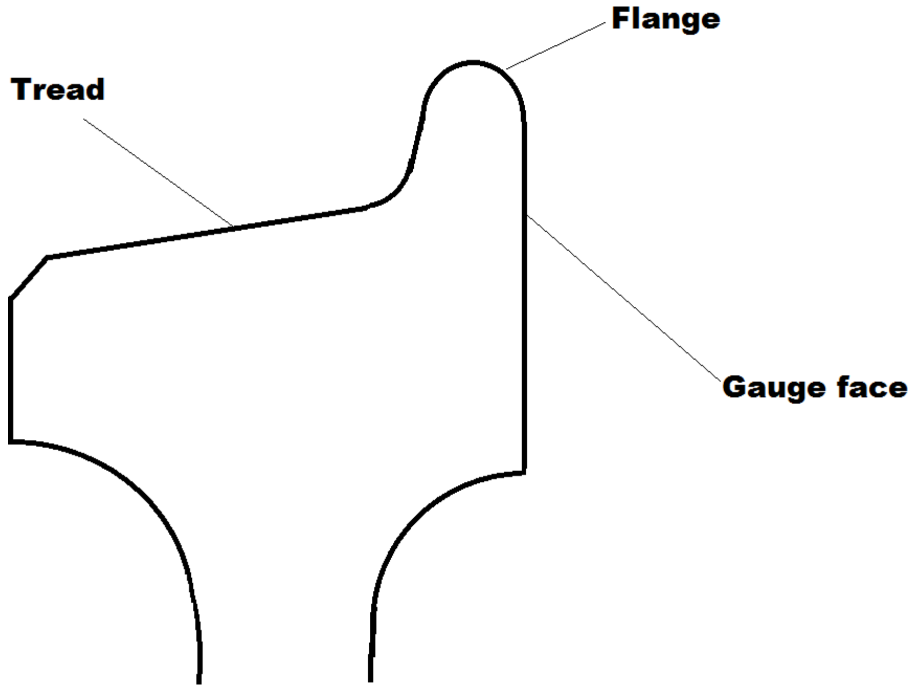
Disc

- Disc is the portion of the wheel between the hub and the tyre.
- This portion is the thinnest portion of the wheel as it does not come in contact with rail nor it is coming in contact with the axle.

Tyre

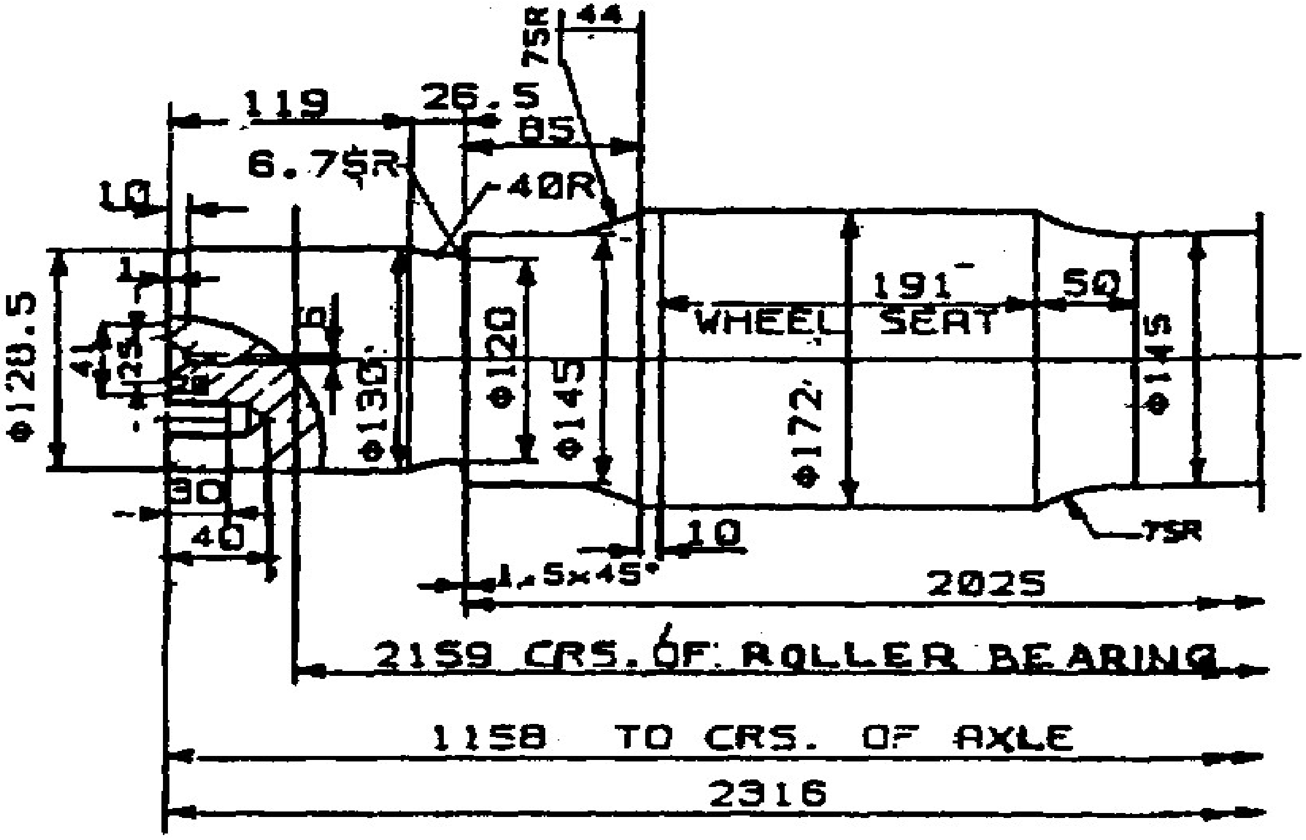
- Tyre is the portion in contact with the rail, which wears out in service.
- The profile of the tyre is significant for safe running of the trains.
- Taper is given on the tread to have higher diameter near the flange and lower diameter at the outer edge, to facilitate curve negotiation.

Tyre



Axles

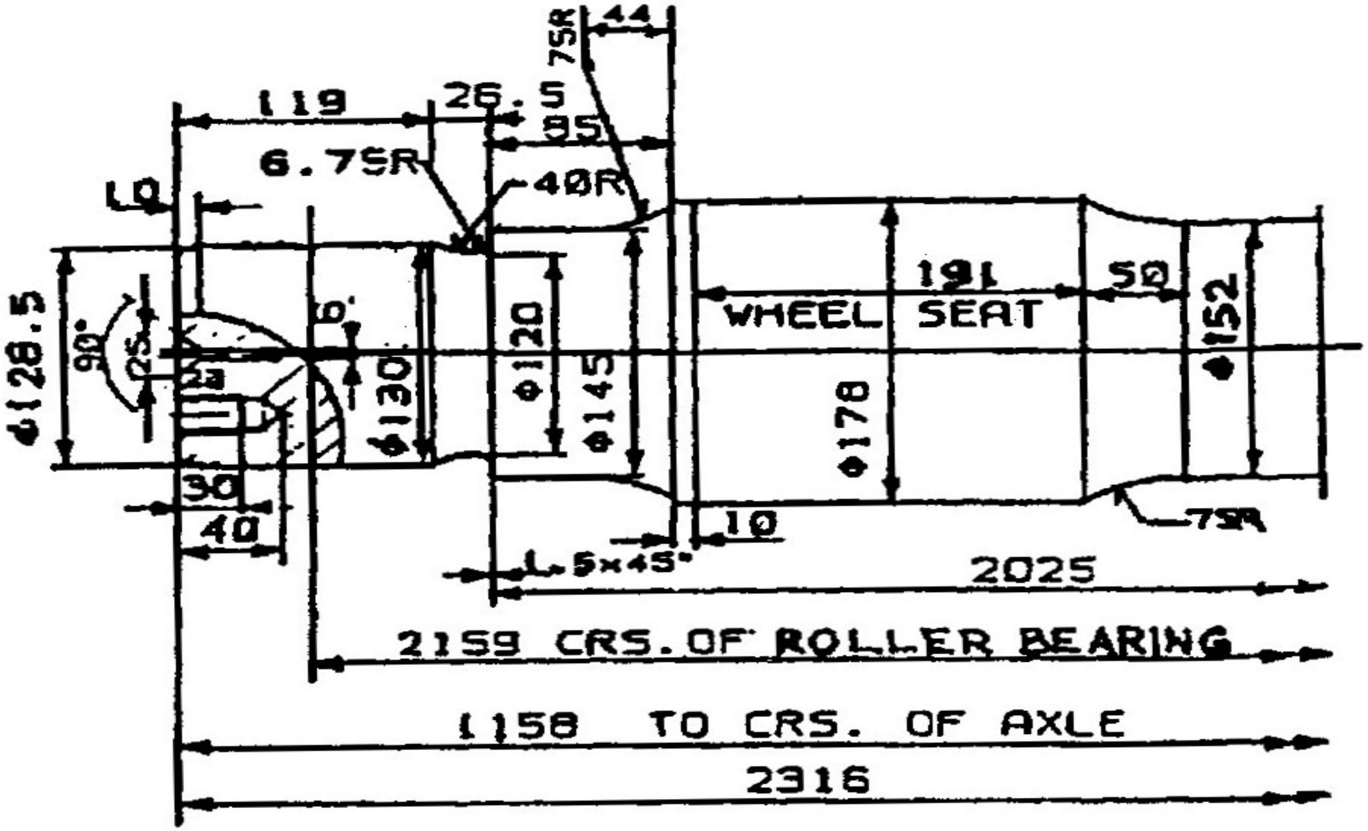
13 t Axle for ICF coach



ICF DRG. NO. T-0-2-622

Axles

16.25 t Axle for ICF coach



ICF DRG. NO. $WTAC_3$-0-2-301

Press fit of wheel on axles

- Wheel disc is pressed to axle with interference fit (the bore of the wheel should be 0.304 mm to 0.355 mm less than the outer dia of the wheel seat on the Axle)
- Wheel Gauge should be in between 1599 and 1602 mm
- Axial off centre should be within 1.0 mm (wagon) & 0.8 mm (coach)
- Radial off centre should be within 0.5 mm (wagon) & 0.25 mm (coach)
- The Journals should be protected with bituminous black to IS:9862
- All Axles fitted by workshop during POH or despatched to depot should be Ultrasonically tested

Press fit of wheel on axles

Hydraulic press is used for assembly of the wheel with a force of 400 to 500 Kgs per mm dia of wheel seat (approximate force used for different wheels are given below)

Description	Tonnage
13 tonne axle	68.8 to 103.2 t
16.25 tonne axle	71.2 to 106.8 t
BOXN & BLC	85 to 127 t

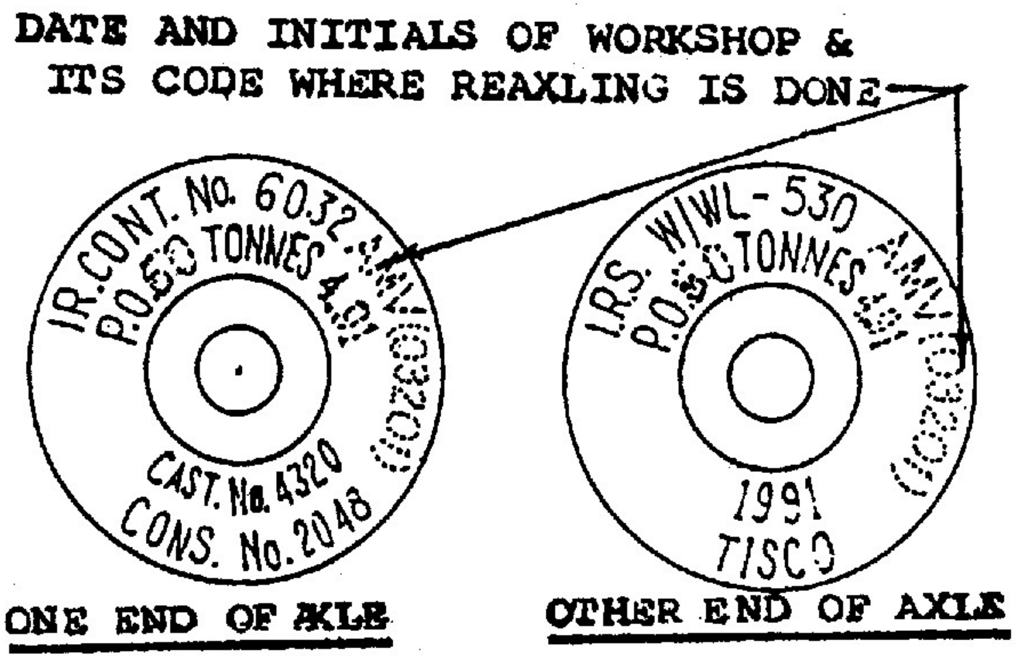
Stamping of particulars

Whenever axles are renewed the workshop shall punch in 5 mm letters the following particulars on the journal face

- Place of pressing
- Date of pressing
- Pressure of pressing

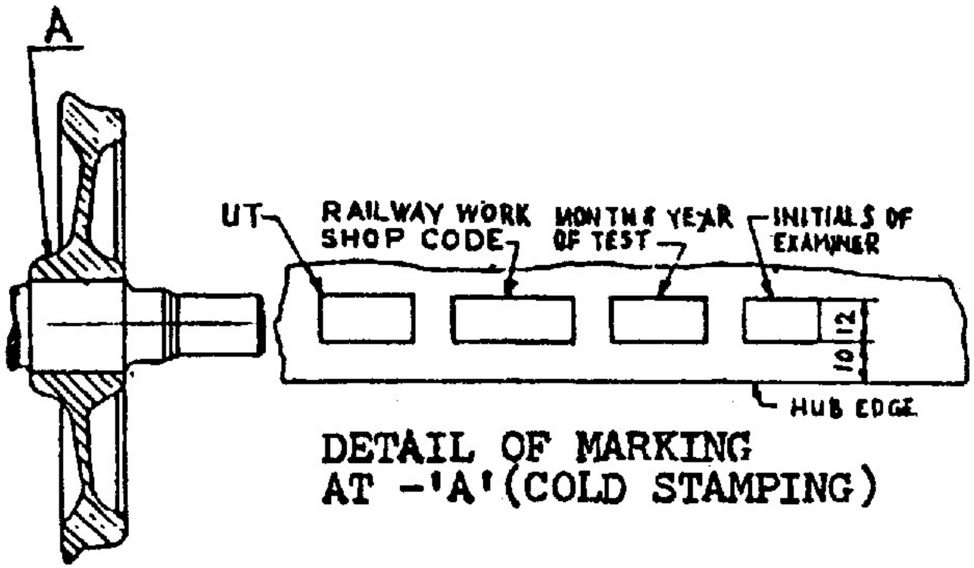
Whenever UT is done the details shall be stamped cold on the inner hub fillet with 6 mm punch not more than 1.5 mm depth

Stamping of particulars



NOTE:
ALL STAMPING TO BE DONE WITHIN 63 DIA.
ON BOTH JOURNAL FACES.

Stamping of particulars

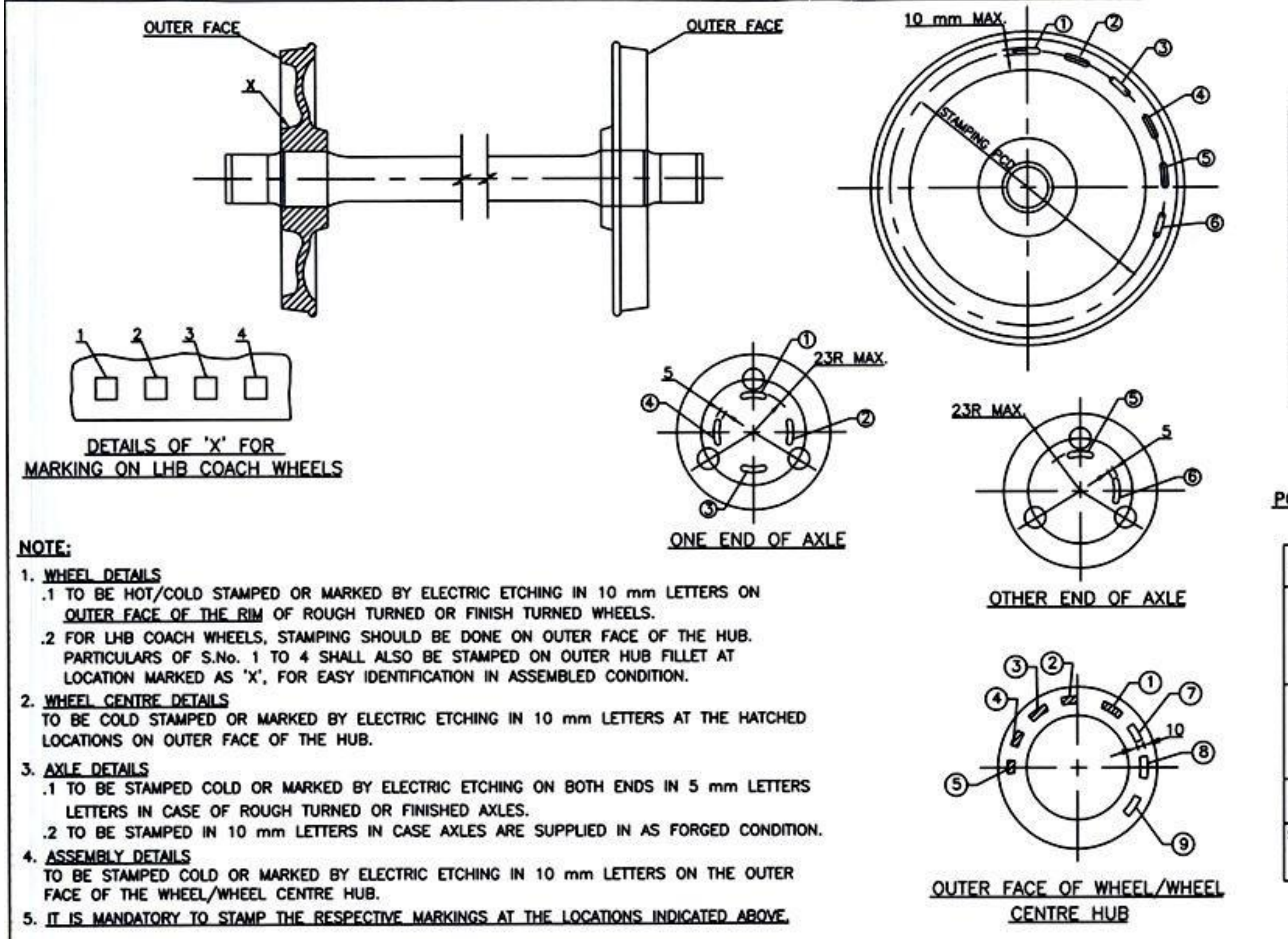


DETAIL OF MARKING
AT -'A'(COLD STAMPING)

NOTE:-

1. 'UT' INDICATES ULTRASONIC TESTING OF AXLES.
2. THE MARKING SHALL BE STAMPED COLD ON THE INNER HUB FILLET AS SHOWN AT 'A' AFTER THE SURFACE IS GROUND PROPERLY.
3. THE EXAMINING WORKSHOPS SHALL MAINTAIN ALL THE PARTICULARS OF AXLES TESTED VIZ. I.R. PART NO., CONTRACT NUMBER, CAST AND CONSECUTIVE NUMBERS, MANUFACTURER'S INITIALS AND YEAR OF MANUFACTURE IN REGISTER PROPERLY MAINTAINED BY THEM.
4. REF. WDO DRG. NO. WD-81089/S-1

Stamping of particulars



NOTE:

1. WHEEL DETAILS
   .1 TO BE HOT/COLD STAMPED OR MARKED BY ELECTRIC ETCHING IN 10 mm LETTERS ON OUTER FACE OF THE RIM OF ROUGH TURNED OR FINISH TURNED WHEELS.
   .2 FOR LHB COACH WHEELS, STAMPING SHOULD BE DONE ON OUTER FACE OF THE HUB. PARTICULARS OF S.No. 1 TO 4 SHALL ALSO BE STAMPED ON OUTER HUB FILLET AT LOCATION MARKED AS 'X', FOR EASY IDENTIFICATION IN ASSEMBLED CONDITION.
2. WHEEL CENTRE DETAILS
   TO BE COLD STAMPED OR MARKED BY ELECTRIC ETCHING IN 10 mm LETTERS AT THE HATCHED LOCATIONS ON OUTER FACE OF THE HUB.
3. AXLE DETAILS
   .1 TO BE STAMPED COLD OR MARKED BY ELECTRIC ETCHING ON BOTH ENDS IN 5 mm LETTERS LETTERS IN CASE OF ROUGH TURNED OR FINISHED AXLES.
   .2 TO BE STAMPED IN 10 mm LETTERS IN CASE AXLES ARE SUPPLIED IN AS FORGED CONDITION.
4. ASSEMBLY DETAILS
   TO BE STAMPED COLD OR MARKED BY ELECTRIC ETCHING IN 10 mm LETTERS ON THE OUTER FACE OF THE WHEEL/WHEEL CENTRE HUB.
5. IT IS MANDATORY TO STAMP THE RESPECTIVE MARKINGS AT THE LOCATIONS INDICATED ABOVE.

STAMPING PARTICULARS

WHEEL/WHEEL CENTRE AND AXLE DETAILS	1	MANUFACTURER'S CODE
	2	YEAR OF MANUFACTURE
	3	CONSECUTIVE No.
	4	BATCH No.
	5	INSPECTOR'S APPROVAL STAMP
	6	'UT' FOR ULTRASONIC TESTING
ASSEMBLY DETAILS	7	MANUFACTURER'S/WORKSHOP'S CODE
	8	MONTH AND YEAR OF ASSEMBLY
	9	PRESSING ON PRESSURE IN TONNES

PCD OF STAMPING OF DIFFERENT WHEELS

TYPE OF WHEEL	PCD OF STAMPING ON RIM
COACHING WTAC3-0-2-301 T-0-2-622 W/WL-1660 MG/T-0-1-004	788 mm 788 mm 788 mm 610 mm
WAGON W/WL-4764 W/WL-4771 WD-89025/S-5 WD-89025/S-9	870 mm 780 mm 830 mm 960 mm
CONTAINER FLAT CONTR.-9404-S/13	755 mm
SOLID WHEEL FOR EMU Sk-K4004	842 mm (FOR MC) 832 mm (FOR TC)

ALT.	ITEM	AUTHY.	DESCRIPTION	DATE
7	--	SS/21/09	DETAILS OF 'X' FOR ADDITIONAL MARKING ON LHB COACH WHEELS ADDED AND NOTE 1.2 MODIFIED.	12/09
6	--	SS/19/09	RADIUS AT END VIEWS OF THE AXLE CHANGED FROM 18R TO 23R.	10/09
5	--	SS/01/06	DRAWING REVISED	1/06
4	--	SS/13/03	DRAWING REVISED	3/03
3	--	SS/3/02	DRAWING REVISED	2/02
2	--	CD/17/99	DRAWING REVISED	8/99
1	--	CD/6/97	DRAWING REVISED	9/97

SUPERSEDED BY:
SUPERSEDES:

SCALE	P	
	C	G.V.RAMAN
	D	PANTA SANJAY
	T	--
	J.S.	--
B.G.	R.D.S.O. [c]	

BRANDING DETAILS ON WHEEL & AXLE

SKETCH-92114

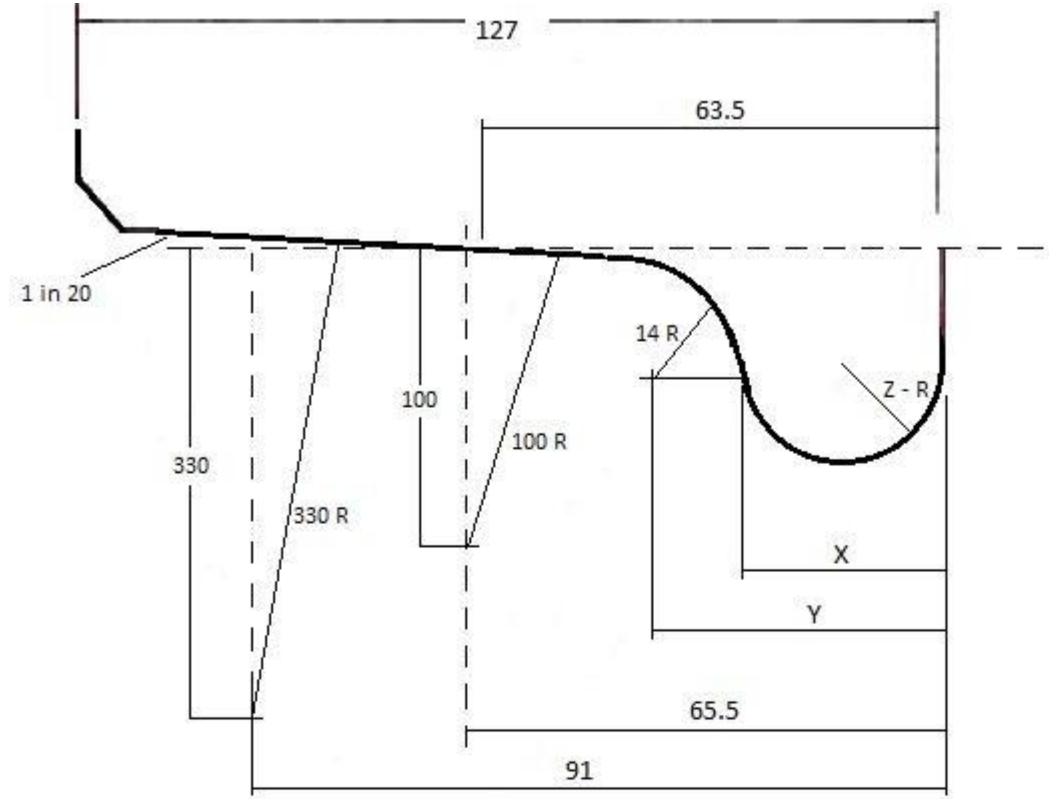
Worn Wheel Profile

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

Worn Wheel Profile

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

Worn Wheel Profile



Step Sizes of Worn Wheel Profile

Further to reduce the metal removal during tyre turning, intermediate worn wheel profile based on the flange thickness is introduced.

Flange Thickness (X)	Y	Z
28 mm	42.23 mm	13.5 mm
27 mm	41.29 mm	13.0 mm
26 mm	40.34 mm	12.5 mm
25 mm	38.41 mm	11.5 mm
24 mm	37.44 mm	11.0 mm
23 mm	36.47 mm	10.5 mm
22 mm	35.49 mm	10.0 mm
21 mm	34.5 mm	9.5 mm
20 mm	33.5 mm	9.0 mm

Wheel Defects

- Manufacturing Defects
- Improper Assembly Practices
- Normal Wear and Tear during service

Manufacturing Defects

- Casting Defects
- Improper Heat treatment
- Machining Imperfections

Improper Assembly Practices

- Stipulated dimensional tolerances for Wheel seat and bore not adhered to resulting in use of higher or lower than the prescribed force during pressing leading to improper wheel set assembly.
- Ovality on Journals - 0.02 mm (max)
- Taper on Journal - 0.01mm (max)
- Difference in dia of wheels on the same axle should not exceed 0.5mm

Wheel defects

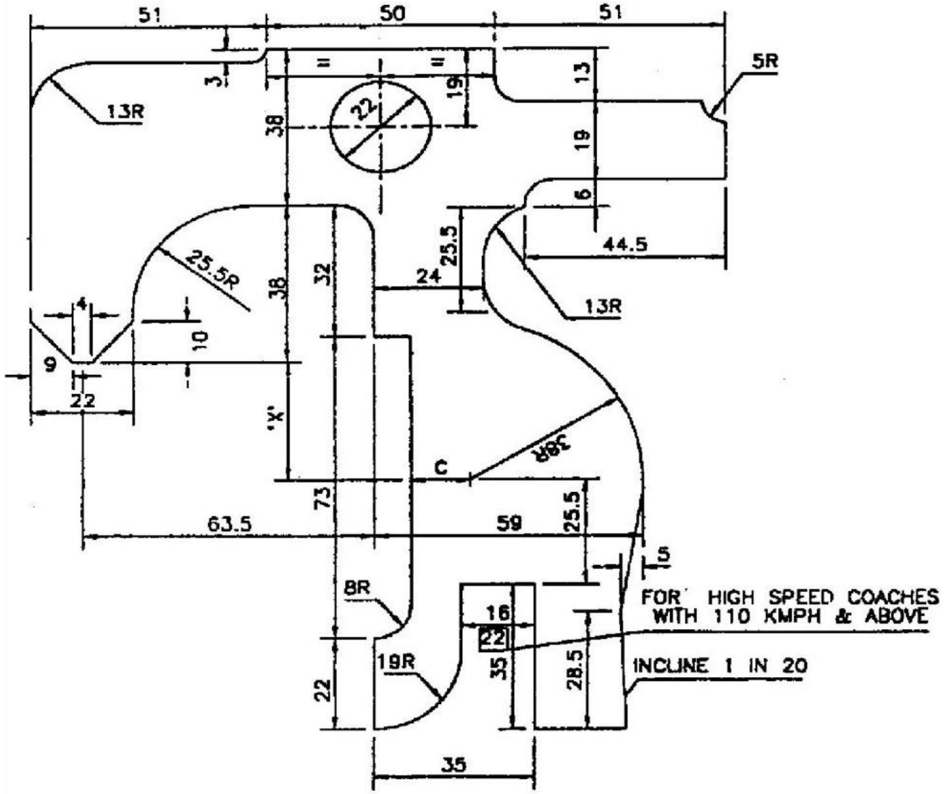
Measurable wheel defects arising due to normal wear & tear during service

- Thin flange
- Deep flange
- Sharp flange
- Less radius at root of flange
- Hollow tyre
- Thin tyre
- Flat tyre

Std & cond limits

Defect	Std	Cond
Thin flange	28.5	22 (Coaches) 16 (Wagons)
Deep flange	28.5	35
Sharp flange (radius)	14.5	5
Less radius at root of flange (radius)	14 (wwp)	13
Hollow tyre		5
Thin tyre		Based on wheel dia
Flat tyre		50 (Coaches) 60 (wagons)

Tyre Defect Gauge



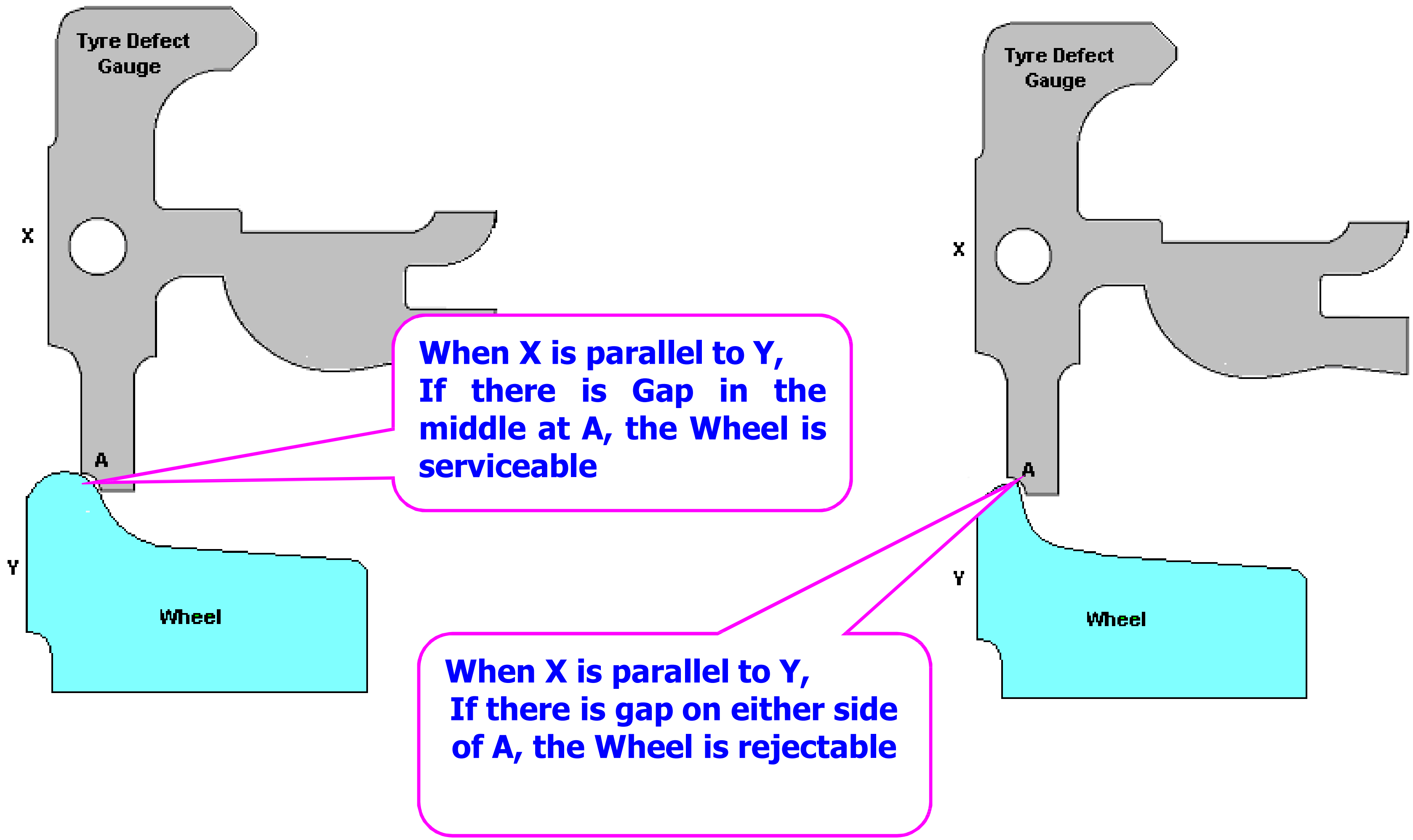
All coaches (Including EMU & DMU) 50 mm

NOTE:-

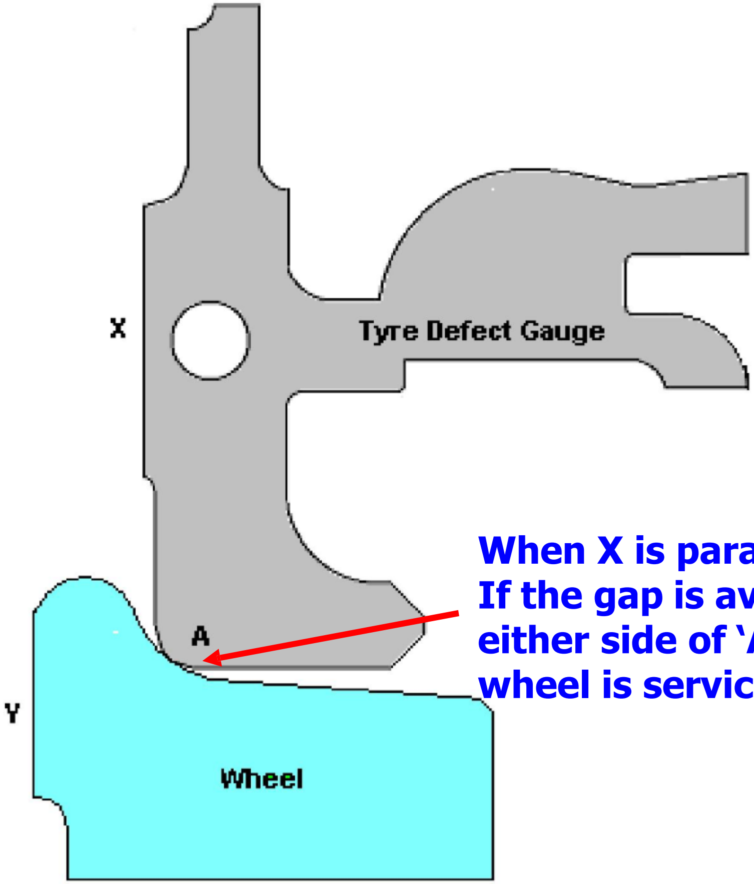
1. CONDEMNING MARK 'C' TO BE STAMPED ON BOTH SIDE OF GAUGE.
2. CONDEMNING MARKS FOR TYPE OF STOCK ON LINE ONLY NEEDS TO BE STAMPED.
3. DISTANCE 'X' AT WHICH CONDEMNING MARK 'C' FOR VARIOUS TYPE OF WHEELS TO BE STAMPED ARE AS BELOW:-

i) SOLID WHEEL OF ICF & BEML MAIN LINE COACHES	6.5 mm.
ii) SOLID WHEEL OF IRS MAIN LINE COACHES	5 mm.
iii) TYRED WHEEL OF IRS, ICF & BEML MAIN LINE COACHES	26 mm.
iv) TYRED WHEEL OF ac & dc EMU MOTOR COACHES.	38.5 mm.
v) TYRED WHEEL OF ac & dc EMU TRAILER COACHES.	28.5 mm.

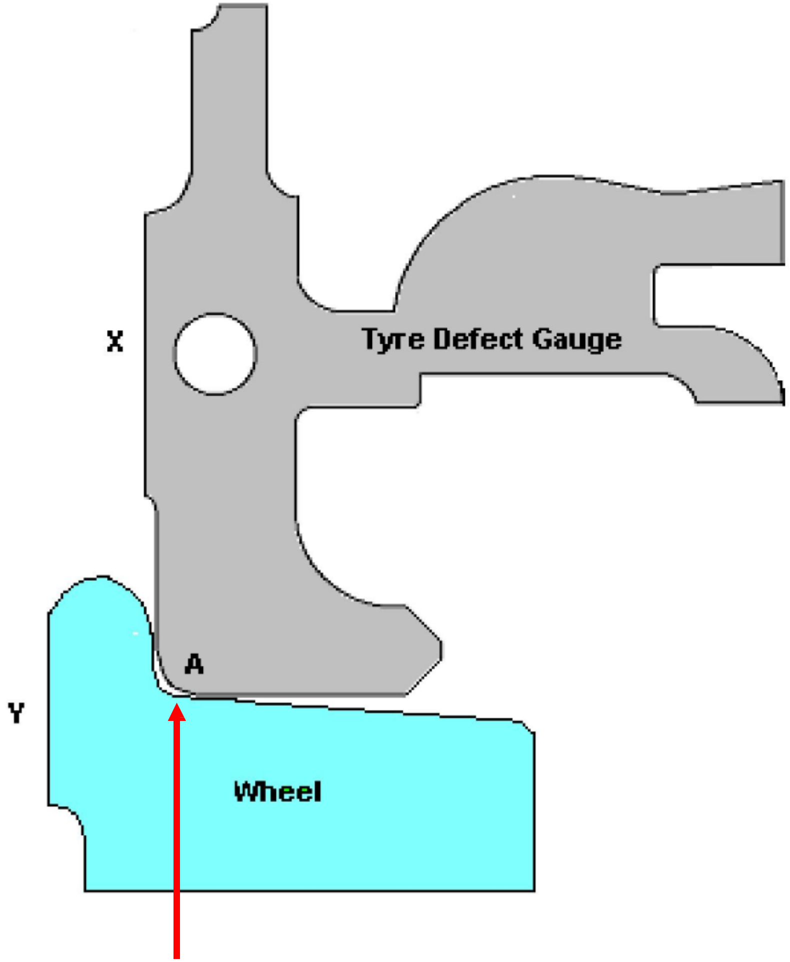
Checking for sharp flange



Checking the root of flange

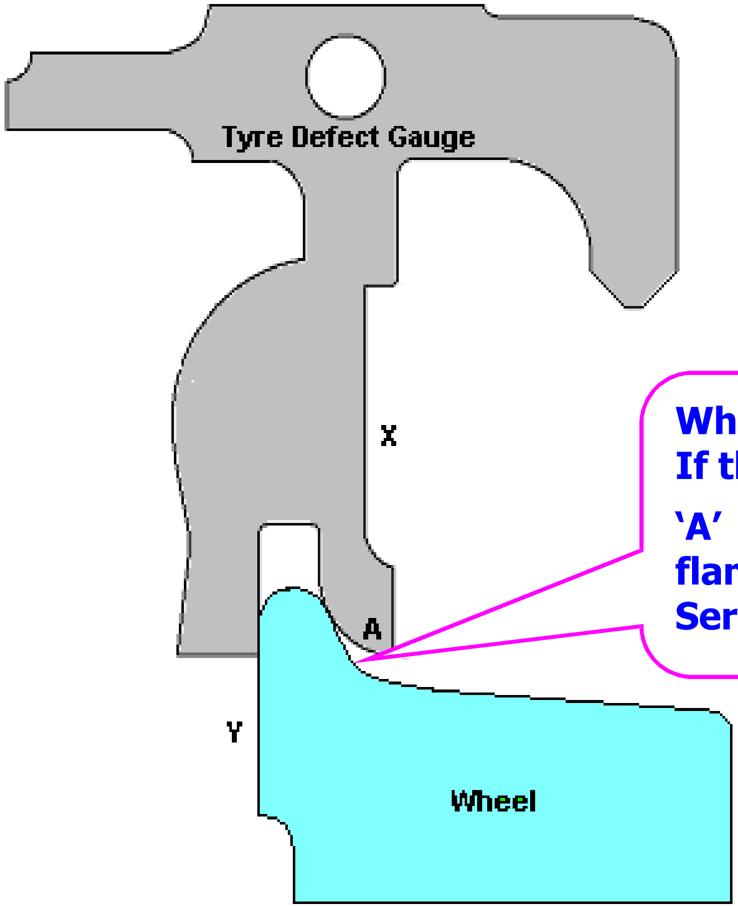


When X is parallel to Y, If the gap is available at either side of 'A', the wheel is serviceable.

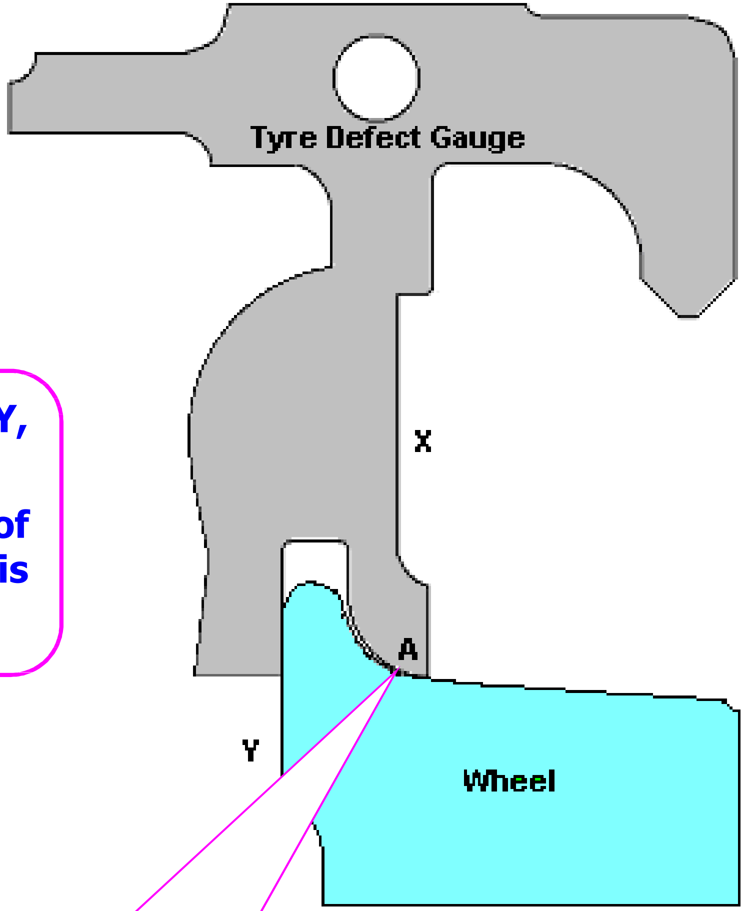


When X is parallel to Y , If there is a gap between gauge and the Root of Flange at A , the Wheel is Rejectable

Checking Thin flange

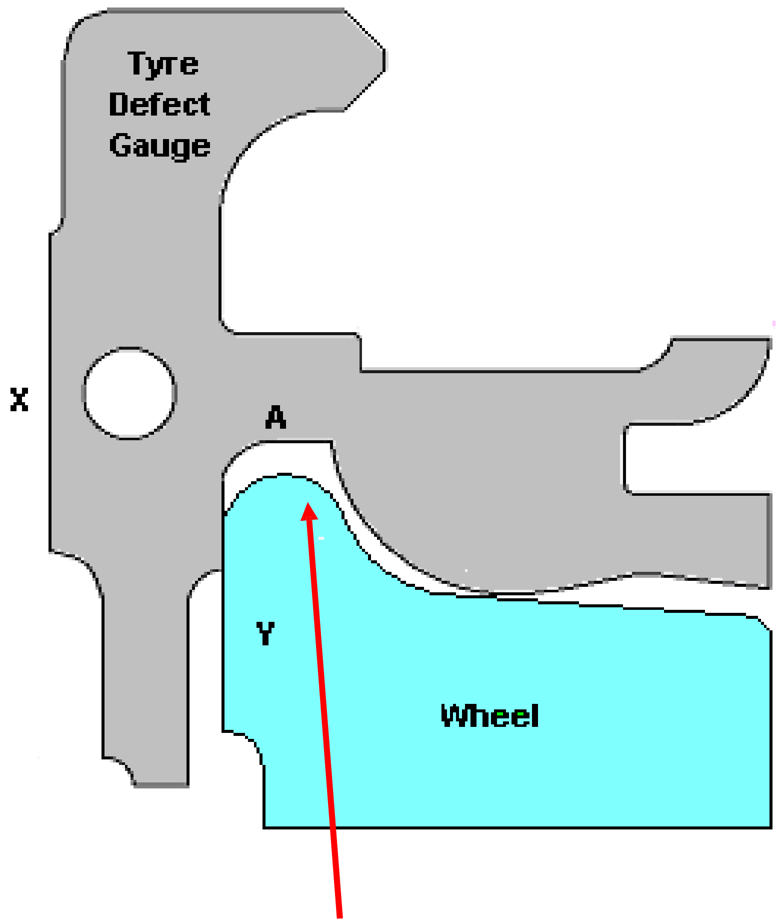


When X is parallel to Y, If there is gap between 'A' and the root of flange, the wheel is Serviceable

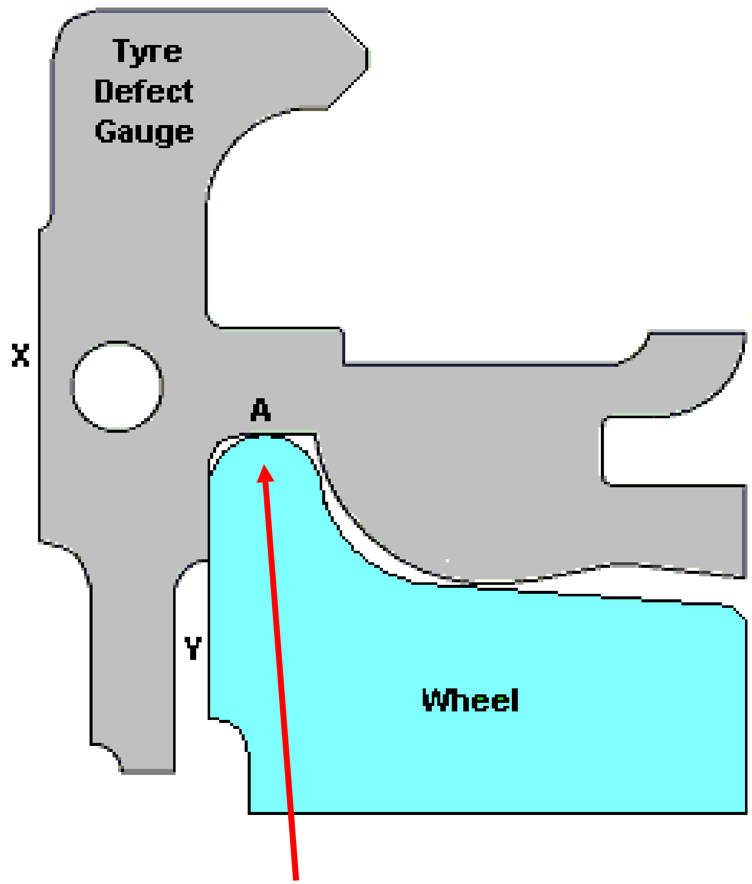


When X is Parallel to Y, If there is no gap between 'A' and the root of flange, the wheel is rejectable

Checking Deep Flange

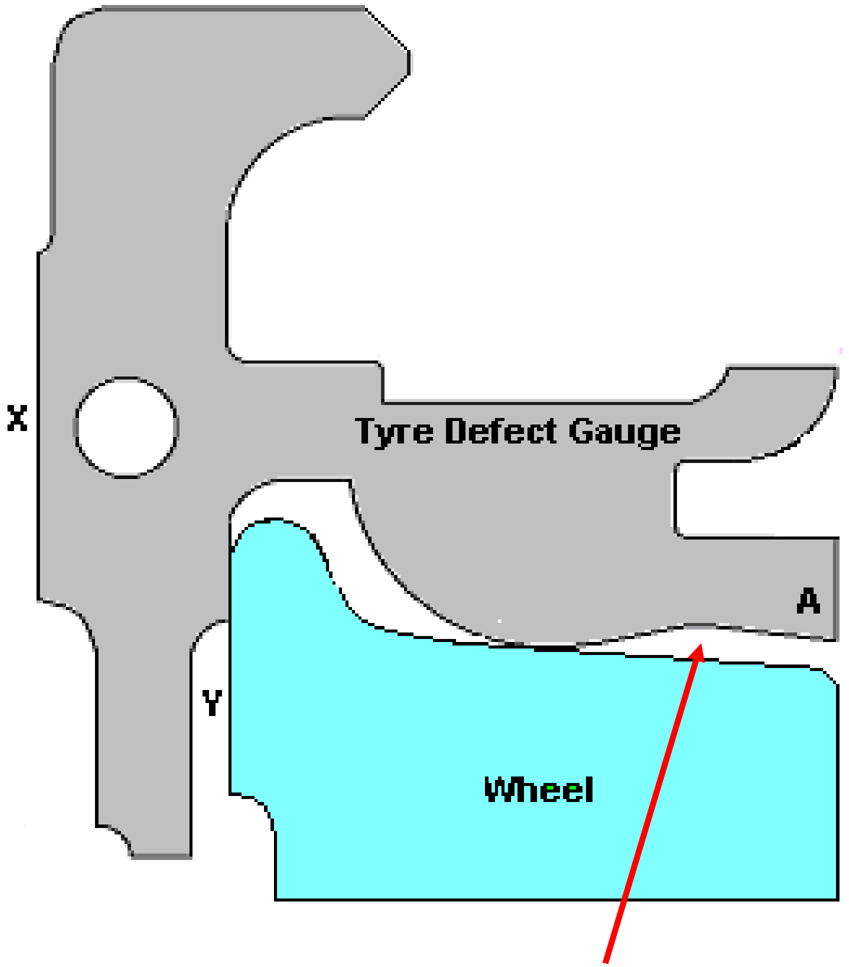


When X is parallel to Y,
If there is a gap between 'A' and tip of the flange, the wheel is serviceable.

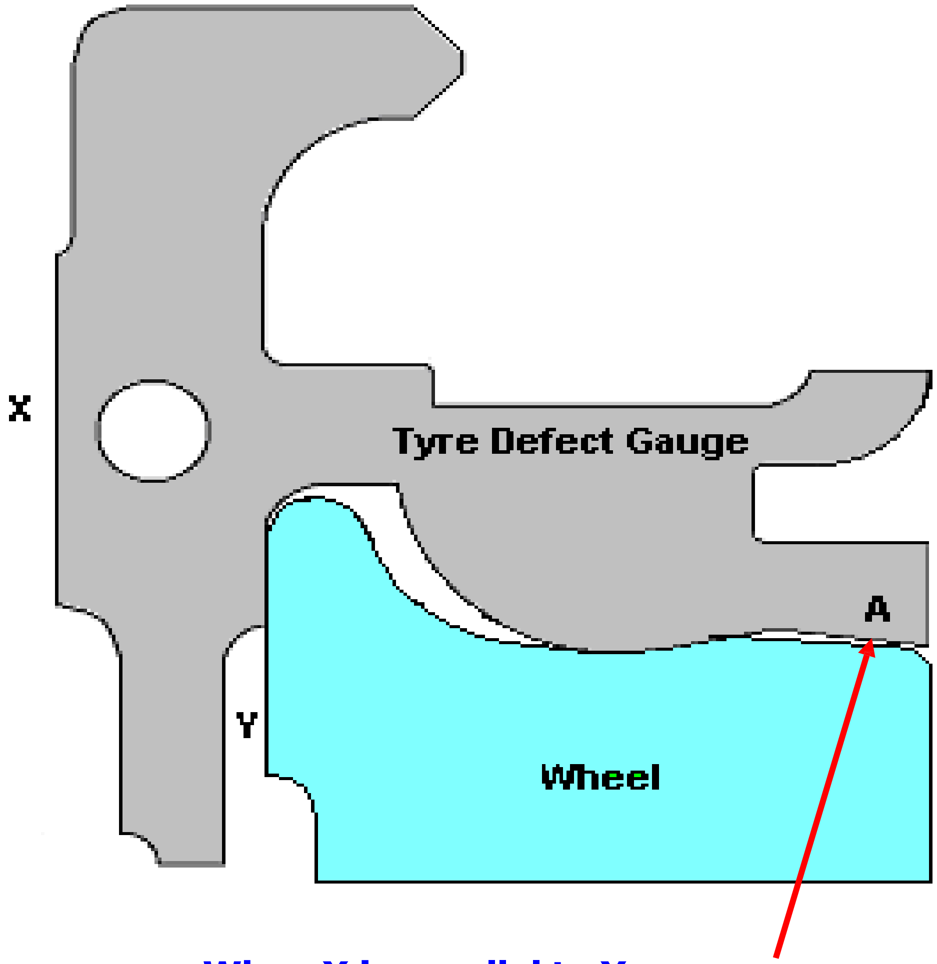


When X is parallel to Y,
If there is no gap between 'A' and tip of the flange, the wheel is rejectable

Checking Hollow tyre

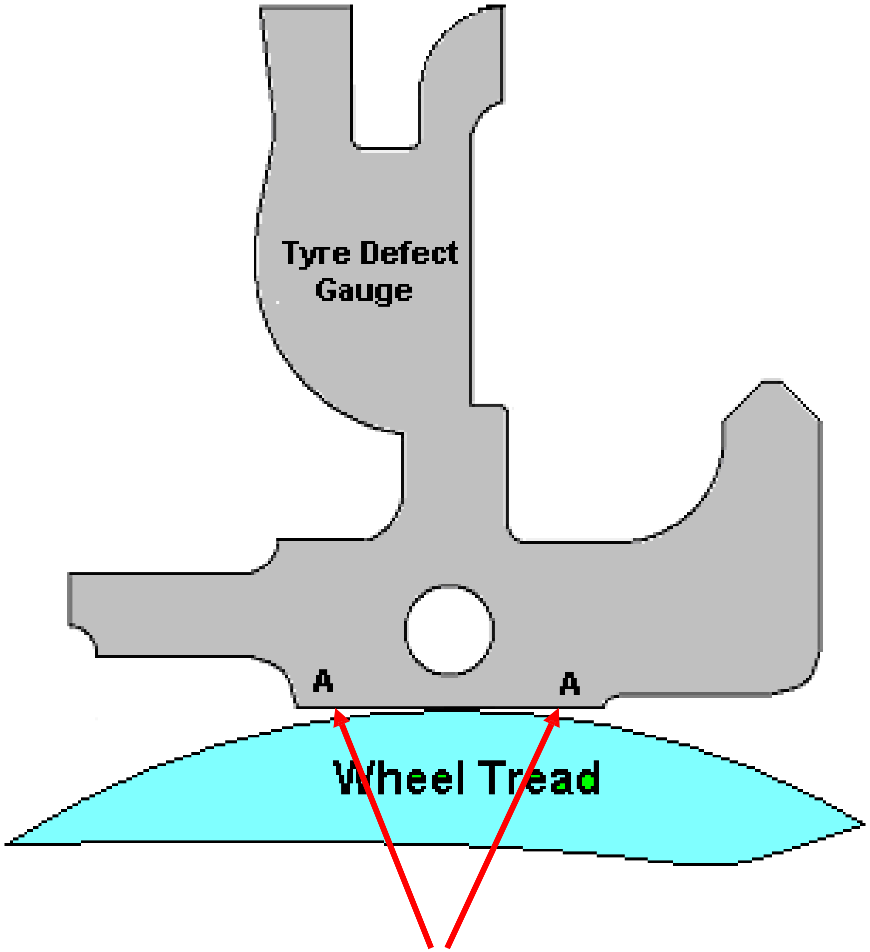


When X is parallel to Y,
If there is gap between the wheel tread and gauge at "A",the wheel is serviceable

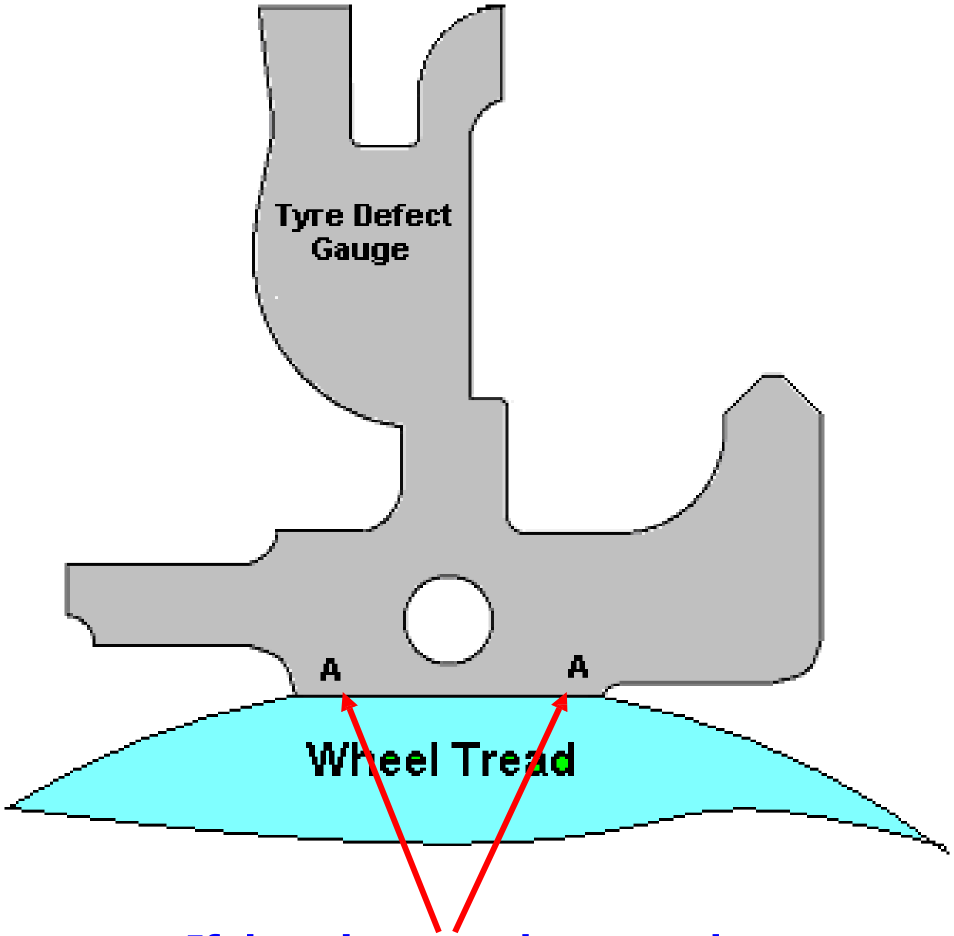


When X is parallel to Y,
If the gauge touches the wheel tread at "A",The wheel is rejectable.

Checking Flat tyre

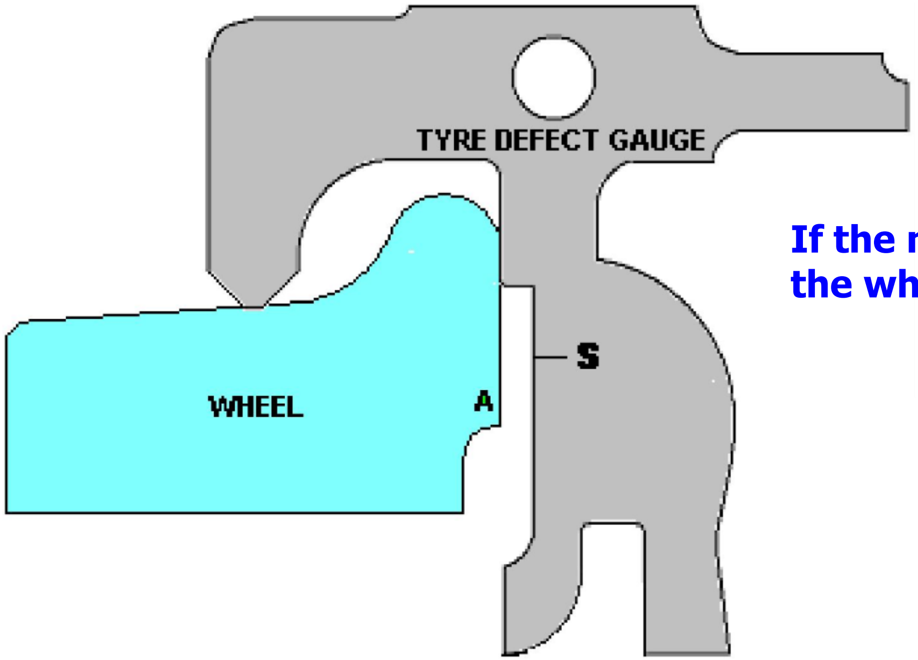


If there is gap between the gauge and the wheel tread at "A", the wheel is serviceable.

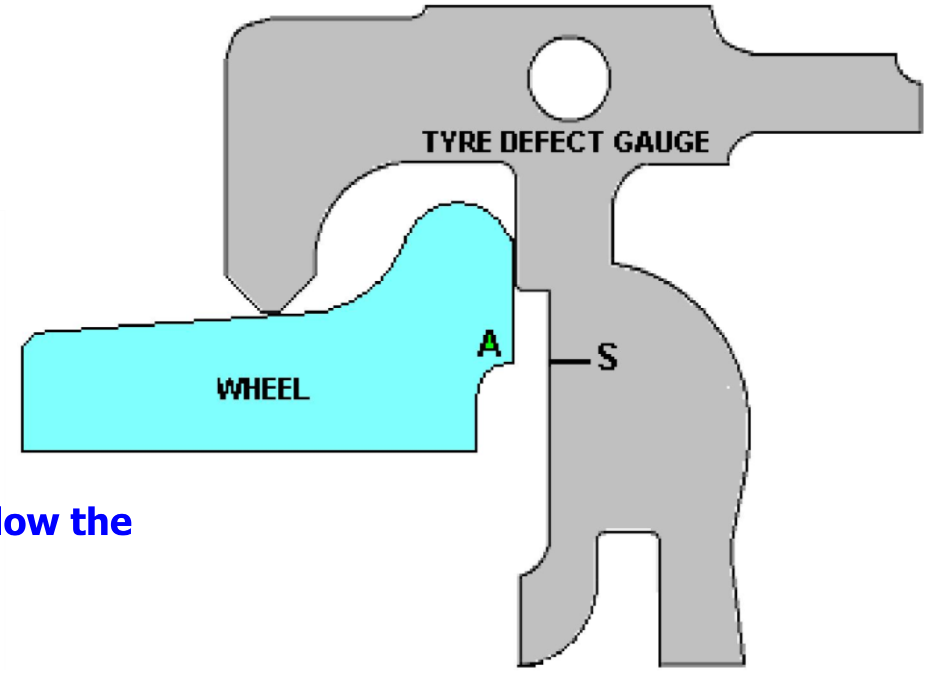


If there is no gap between the gauge and the wheel tread at "A", the wheel is rejectable.

Checking Thin tyre



If the mark S in the gauge is above the location A , the wheel is serviceable.



If the mark S in the gauge is in line or below the location A , the wheel is rejectable.

Wheel defect as per CMI K 003

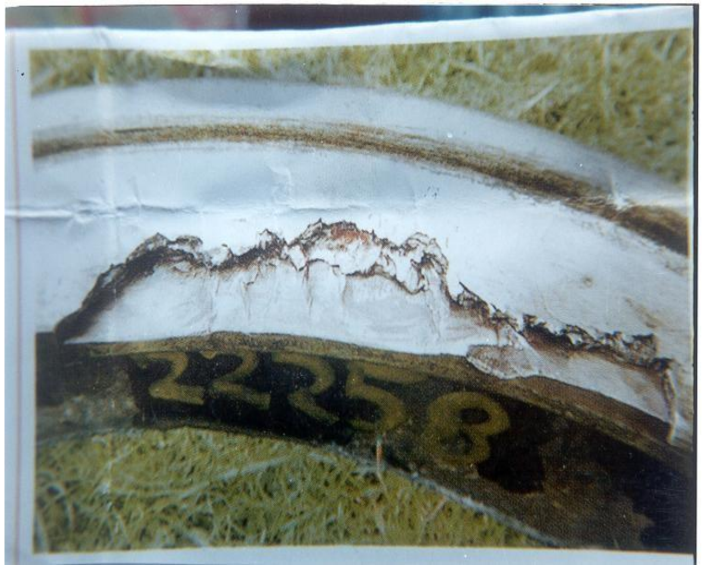
- Shelled tread
- Shattered rim
- Spread rim
- Thermal crack
- Heat checks
- Disc crack
- Loose axle

Shelled Tread

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

Shattered Rim

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



Spread Rim

If the rim widens out for a short distance on the front face, an internal defect may be present. Spreading of the rim is usually accompanied by a flattening of the tread, which may or may not have cracks or shelling on the tread. Such wheels must be withdrawn from service.

Rim Flow

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

Thermal Crack

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

Thermal Crack

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

Heat Checks

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

Disc Crack

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

Loose Axle

- While assembling wheel with axle proper interference should be maintained between wheel and axle. Due to improper selection of interference the wheel may shift outwards or it may come out completely. Loose axle is a rejectable defect.
- Axles involved in Accidents should be magnaflux tested in addition to Ultrasonic test.
- Axle having notch should be withdrawn from service

- All wheel sets withdrawn from service for any of the conditions mentioned above must be sent to the associated workshops for detailed investigations and further disposal.
- The date and station code of the maintenance depot where the wheels are changed should be stencilled on the end panels. An entry should also be made in the maintenance card of the coach.
- No repairs, except wheel profiling of wheel sets is permitted to be done in the maintenance depot.

Wheel Gauge

Description	Std	Max	Min
Coach MG	930	932	929
ICF coach BG	1600	1602	1599
LHB coach	1600	1601	1599
Wagons	1600	1602	1599

Wheel Diameter

Description	Std	Cond
Coach MG		
ICF coach BG	915	825
LHB coach	915	845
BOXN	1000	906
UIC	1000	860
BLC	840	780

Wheel Changing

Wheels to be paired within the diameters variation as below while changing the wheels

Type	On the same bogie	On the same coach
Coach MG	5	10
Coach BG	5	13
Wagons	13	25

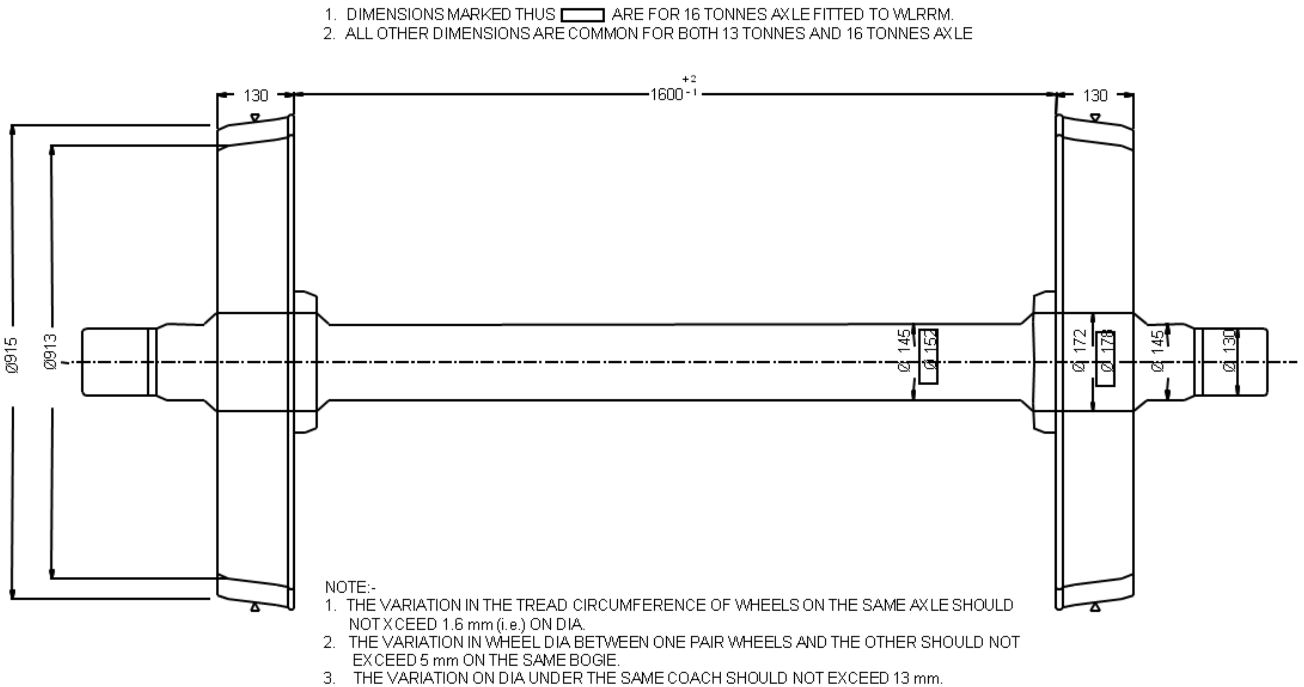
While tyre turning, it should be ensured that variation on the same axle is within 0.5 mm

For in service wheels the variation on the same axle shall be guided by the tyre defect gauge

Thank You

WHEEL & AXLE

Wheel, Tread and Axle



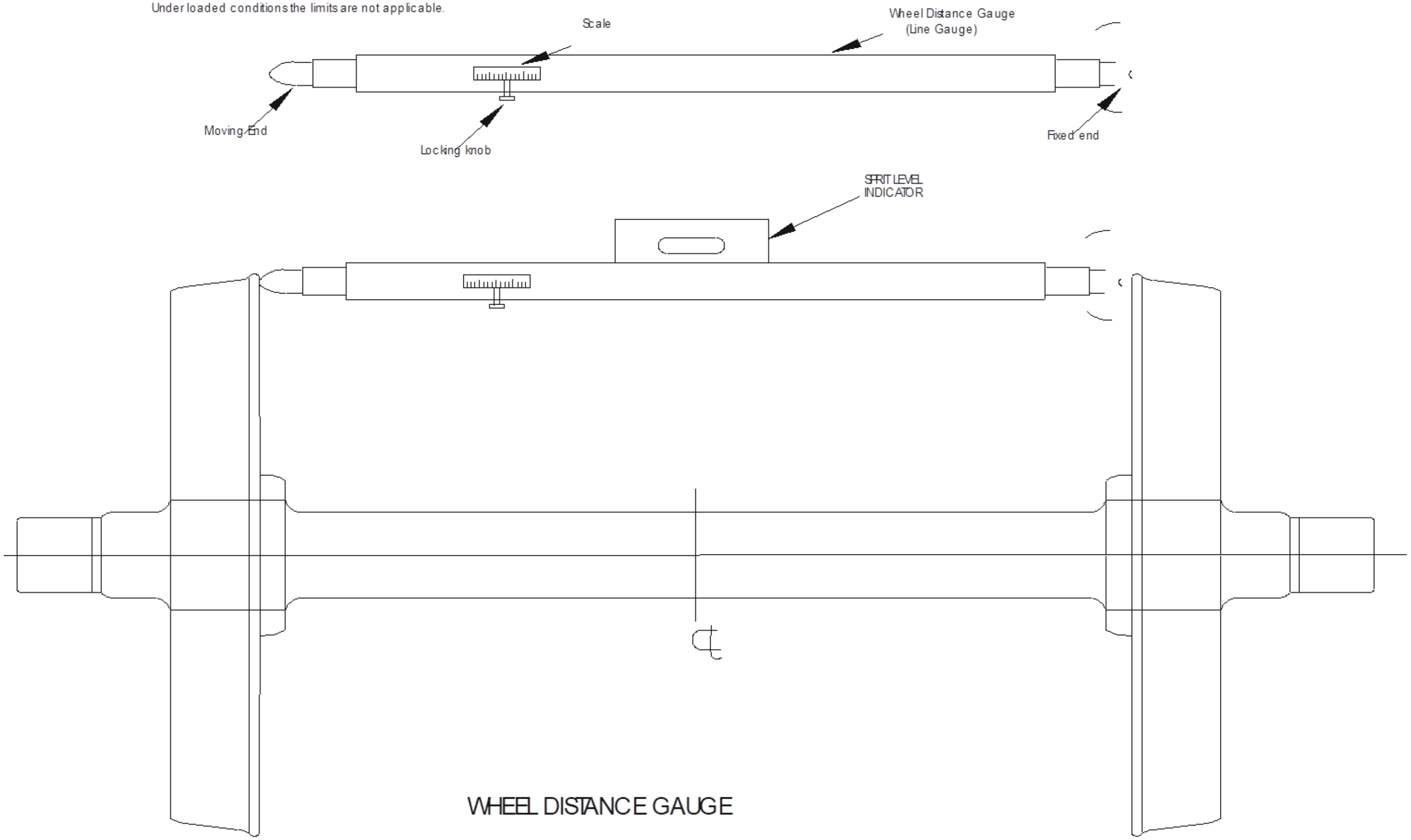
- Nomenclature
  - Axle
    - Journal
    - Collar
    - Wheel seat
  - Disc
    - Tread
    - Hub
    - Tyre profile

Wheel Gauge

Newly assembled wheel set should be checked for the distance between inner face of wheel i.e. 1600 + 2/-1 mm using Wheel Distance Gauge.

The wheels to be gauged on a level track after taking off from coaching vehicle.

Under loaded conditions the limits are not applicable.

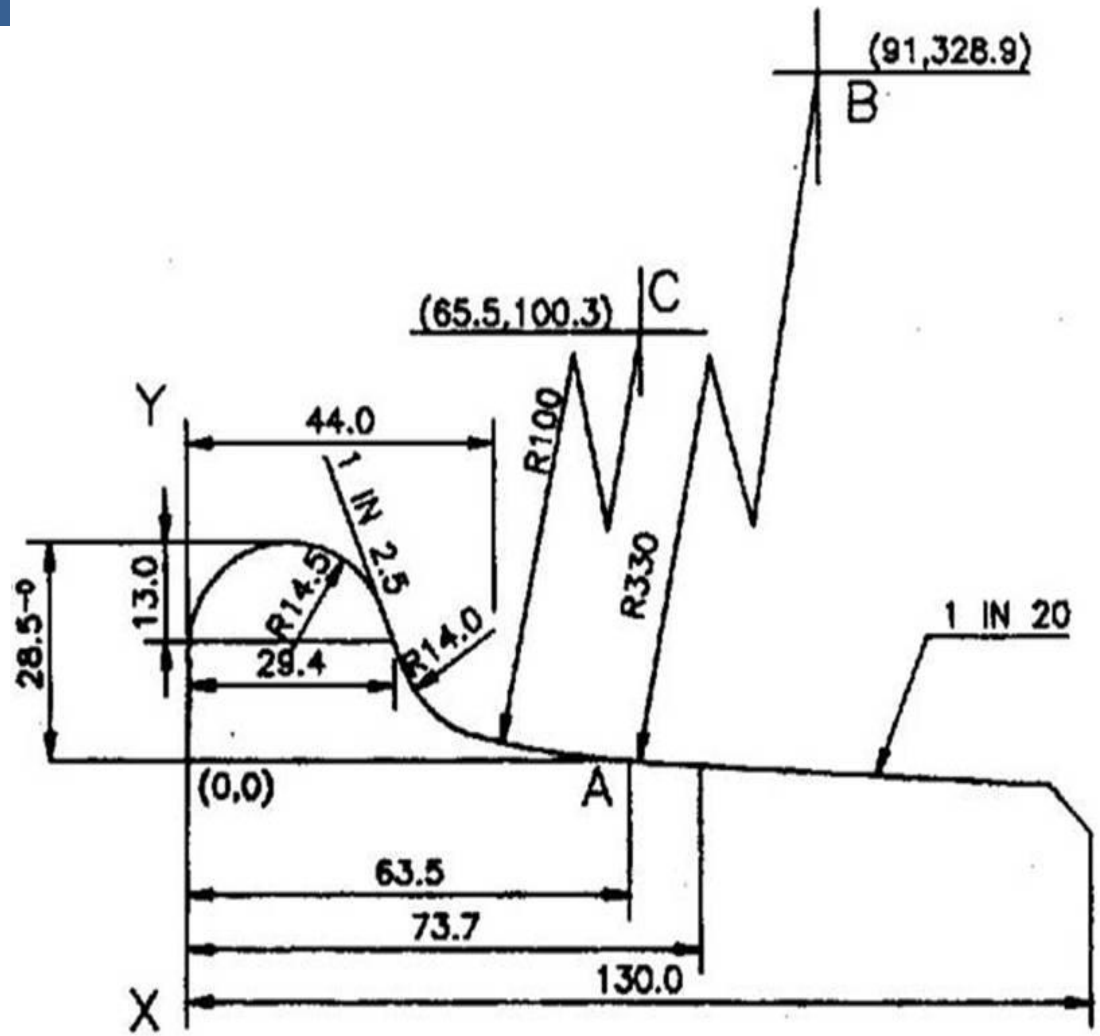


WHEEL DISTANCE GAUGE

FIGURE 10.6

Wheel Tyre Profile

- Standard wheel profile
- Worn wheel profile (Conforming profile)
- No Intermediate profile now.



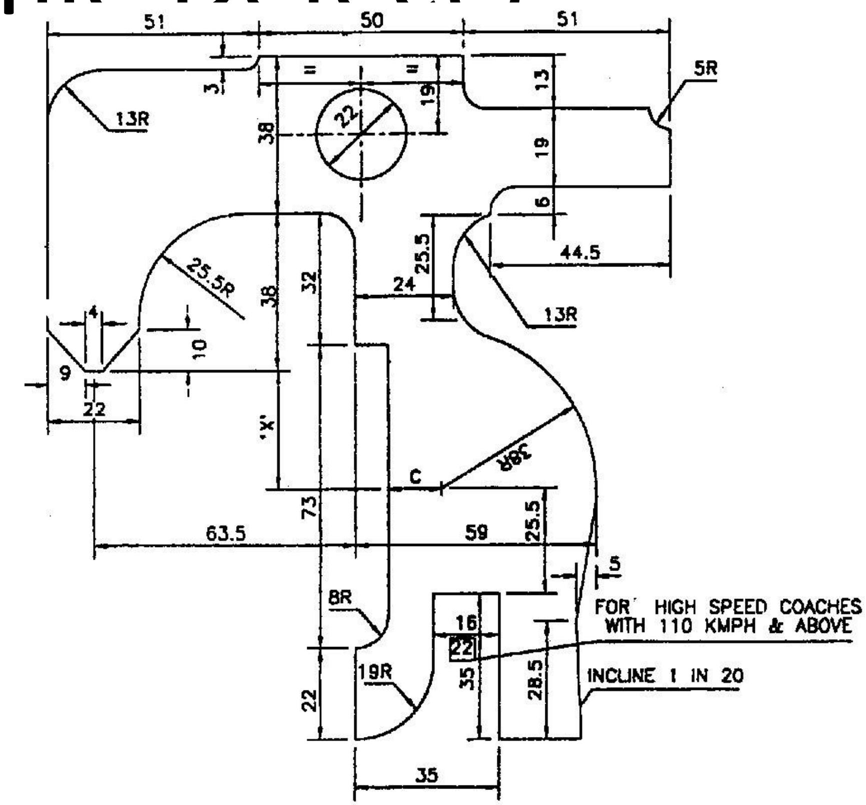
Difference in Wheel Diameter

	On the same axle	On the same trolley	On the same wagon
For Wagon	0.5	13	25
For Coach	0.5	5	13

- Prescribed in
  - Rule No. 2.8.14.2 IRCA Part III and
  - Rule No. 2.9.4 IRCA Part IV
- These limits do not form a part of train examination.
- The rejection of wheels worn beyond service limits will continue to be determined by the normal wear limits specified in IRCA Rules (Rly. Bd. letter No. 86/M(N)960/8 Dated 22.8.86).

Wheel Profile Defects

- Flat tyre
- Hollow tyre
- Sharp flange
- False flange
- Deep flange
- Thin flange
- Root radius



All coaches (Including EMU & DMU) 50 mm

NOTE:–

1. CONDEMNING MARK 'C' TO BE STAMPED ON BOTH SIDE OF GAUGE.
2. CONDEMNING MARKS FOR TYPE OF STOCK ON LINE ONLY NEEDS TO BE STAMPED.
3. DISTANCE 'X' AT WHICH CONDEMNING MARK 'C' FOR VARIOUS TYPE OF WHEELS TO BE STAMPED ARE AS BELOW:–

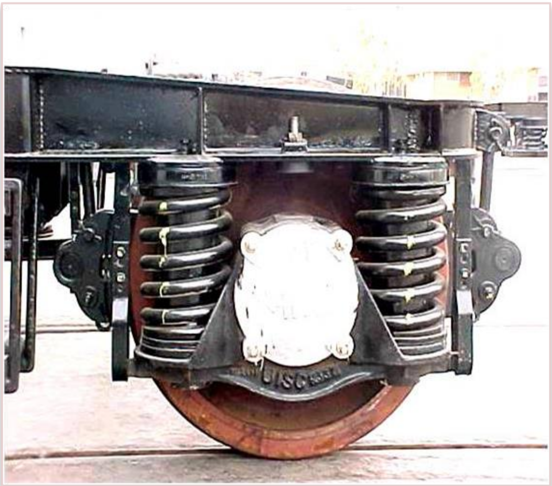
i) SOLID WHEEL OF ICF & BEML MAIN LINE COACHES	6.5 mm.
ii) SOLID WHEEL OF IRS MAIN LINE COACHES	5 mm.
iii) TYRED WHEEL OF IRS, ICF & BEML MAIN LINE COACHES	26 mm.
iv) TYRED WHEEL OF ac & dc EMU MOTOR COACHES.	38.5 mm.
v) TYRED WHEEL OF ac & dc EMU TRAILER COACHES.	28.5 mm.

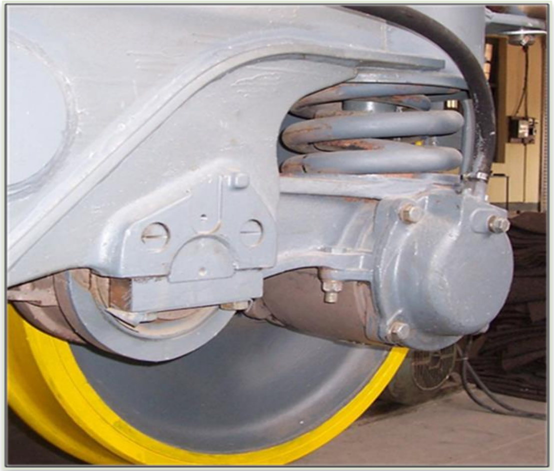
Axle Guide Arrangement

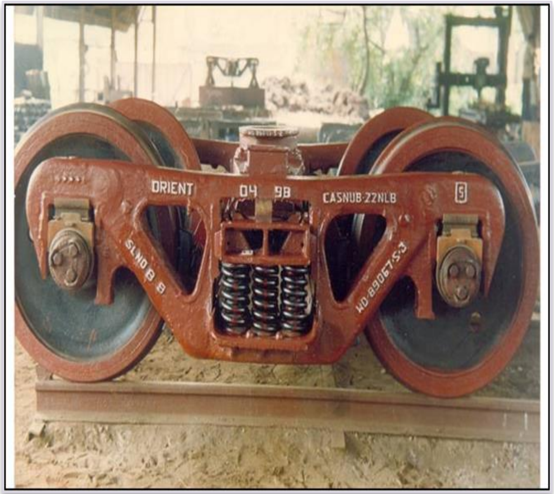
ICF

FIAT

CASNUB







Function of Axle Guides

- Guides the axle w.r.t. bogie frame laterally as well as longitudinally.
- Transmits tractive & braking force between bogie frame & axle box.
- In ICF, acts as a single acting hydraulic vertical shock absorber for primary spring.
- In FIAT bogie, provides control flexibility between frame and axle.

Axle Box Bearing

- CASNUB bogie
  - CTRB
- ICF bogie
  - Spherical type roller bearing with self-align feature.
    - Automatically adjust to the deviation in the centre line of the axle during run.
- FIAT bogie
  - CTRB

चक्के से सम्बन्धित दोष और परिचालन में यान की स्थिरता पर उसका प्रभाव

डीप फ्लैन्ज

बीजी में 28.5 तथा एमजी में 25.5 से बढ़कर 35 तथा 32 मिमी0 से अधिक हो जाय

(1) यदि रेल हेड का ऊपरी सतह भी घिसा हुआ हो तो चक्के का फ्लैन्ज, फिश प्लेट तथा डिस्टेन्स ब्लाक चेक ब्लाक से टकराने लगता है।

(2) चक्के के ट्रेड के साथ–साथ फ्लैन्ज में भी घिसाव होता रहता है। अतः फ्लैन्ज के डीप होने की अवस्था में उसका थिन हो जाना भी स्वाभाविक है। जिससे फ्लैन्ज बल का मान भी बढ़ जाता है।

शार्प फ्लैन्ज

फ्लैन्ज के टिप का अर्धव्यास 5 मिमी से कम

प्रभाव–

(1) पाजिटिव एंगुलरिटी बढ़ जाती है।

(2) घर्षण बल का मान बढ़ जाता है।

(3) फेसिंग दिशा में चक्का दो रास्तों पर जा सकता है अथवा घिसे या थोड़ा सा टूटे हुए टंग रेल के प्वाइंट पर चढ़कर अवपथित हो सकता है।

हालो टायर/फाल्स फ्लैन्ज

बाहरी सिरा मध्य की अपेक्षा 5 मिमी0 से ज्यादा नीचे आ जाय

प्रभाव–

(1) फाल्स फ्लैन्ज ट्रेलिंग दिशा में चलते समय प्वाइन्ट को चीर कर उसमें (Gap) अन्तर बना सकता है जिसके फलस्वरूप फेसिंग दिशा में आ रही किसी दूसरी गाड़ी का चक्का दो रास्तों पर जा सकता है।

(2) क्रासिंग पोर्सन पर चक्का विंग रेल के सम्पर्क में चल कर नोज पर गिर सकता है।

(3) अत्याधिक हंटिंग (Hunting) होती है।

थिन फ्लैन्ज

बीजी में 28.5 मिमी. तथा एमजी में 25.5 मिमी. से घटकर 16 मिमी. से कम रह जाय

प्रभाव—

(1) रेल पथ तथा चक्कों के मध्य अन्तर बढ़ जाने के कारण लर्चिंग बढ़ जाती है। जिससे फ्लैन्ज बल का मान भी बढ़ जाती है।

(2) एक्सल की कोणीयता (Angularity) बढ़ जाती है।

रूट रेडियस में घिसाव

बीजी में 16 मिमी. तथा एमजी में 15 मिमी. से घटकर 13 मिमी. रह जाय

प्रभाव–

(1) चक्के तथा रेल हेड के मध्य सम्पर्क क्षेत्र बढ़ जाने के कारण घर्षण बल का मान भी बढ़ जाता है। क्योंकि इस दशा में फ्लैन्ज घिस जाने के कारण उसमें 1:2.5 का प्रारम्भिक ढाल काफी कम हो जाता है।

(2) धूरे की कोणीयता के समान मान के लिए भी पाजिटिव इसेन्ट्रिसिटी बढ़ जाती है।

फ्लैट टायर

एमजी में 51मिमी, बीजी सवारी यानों में 50 तथा माल यानों में 60 मिमी. चपटा हो जाय।

प्रभाव—धीमी गति 20—25 किमी0/घंटा पर हैमरिंग का प्रभाव (Hammering effect) बढ़ जाता है। जिसके कारण रेल में उत्पन्न होने वाले प्रतिबल का मान भी लगभग 2.5 गुना तक हो जाता है।

ह्वील गेज में अन्तर

ह्वील गेज बीजी तथा एमजी के लिए क्रमशः 1600 मिमी. तथा 930 मिमी. होता हैं। माल यानों तथा सवारी यानों के लिए इसमें 02 मिमी. ढोला तथा 01 मिमी. टाइट अनुमेय है। ह्वील गेज अधिक ढोला अथवा टाइट नहीं होना चाहिए।

- **प्रभाव**–चक्के में घुमावदार गति (W0bbling) होने लगती है जो यान की स्थिरता को प्रभावित करती है।

चक्के के व्यास में अन्तर

- चक्के के व्यास में निम्न अन्तर अनुमेय है
- एक ही यान में –एमजी में 10 तथा बीजी में 13 मिमी.
- एक ही ट्राली में – 5 मिमी. तथा
- एक ही एक्सल पर– केवल 0.5 मिमी.

प्रभाव–

(1) एक ही एक्सल पर चक्के के व्यास में अन्तर के कारण उनके द्वारा समान चक्करों में चली गयी दूरी भी अलग–अलग होती है जिससे पाजिटिव एंगुलरिटी लगातार बनी रहती है।

(2) एक ही यान के चक्कों के व्यास में अत्याधिक अन्तर बफर हाइट को प्रभावित कर सकता है।

(3) यान के अन्य कारकों के साथ मिलकर फर्श के ढाल को भी प्रभावित करता है।

Wheels

MSTC/GKP

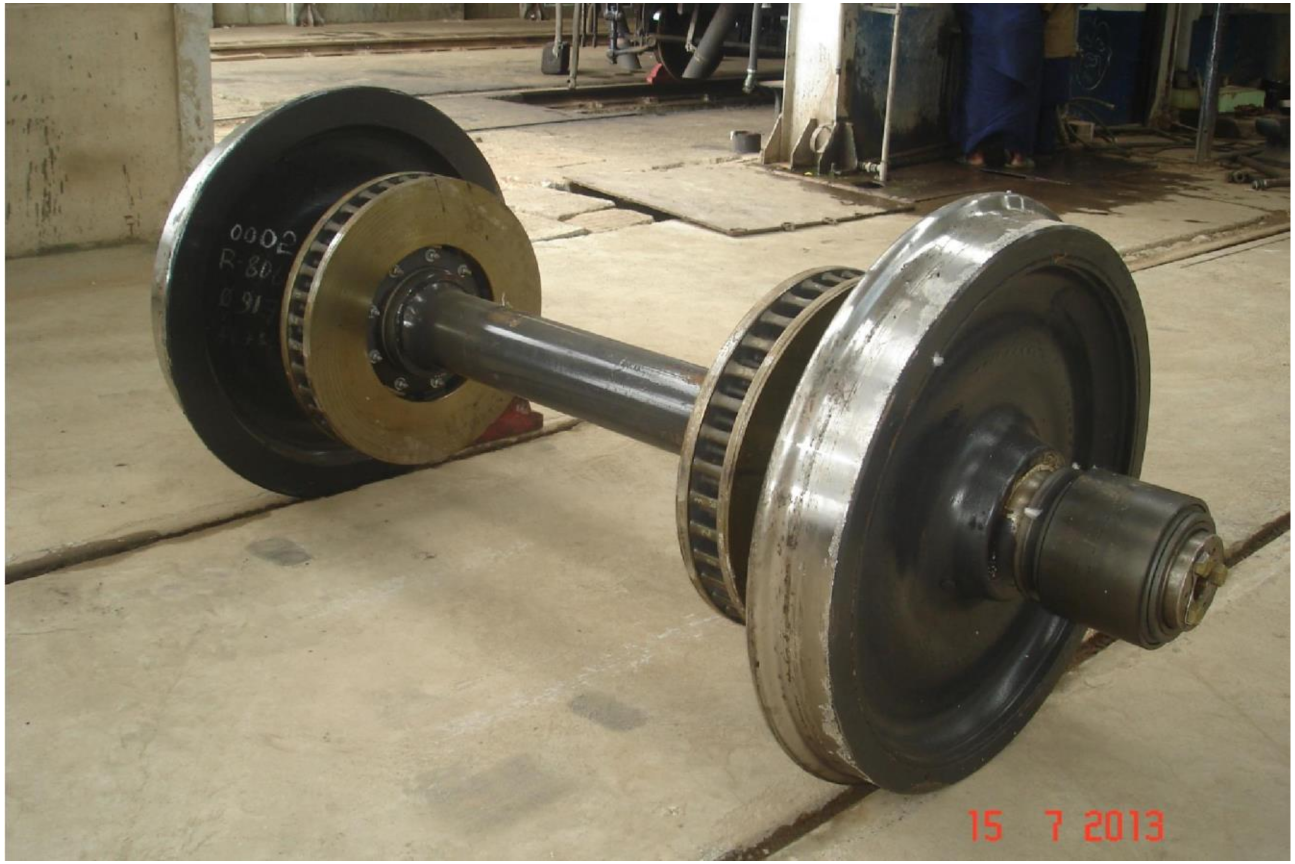
Railway Wheels

- Railway wheel is assembly of two wheels fixed to the axle by interference fit and they rotate along with the axle, without any independent relative movement as in the case of other automobile wheels.
- These wheels are provided with flange towards the inner side, which guide the wheels to travel on the rails and does not allow it to fall down from the rails.

Railway Wheels

ICF Coach Wheel

Railway Wheels



LHB Coach Wheel

Material of Wheel

- Steel made by Electric or Basic Oxygen process
- Steel shall be of killed quality for forged steel
- The max hydrogen content shall not exceed 3 ppm
- The max nitrogen content shall not exceed 0.007%

Railway Whee

BOXN Wheel

Material of Wheel

The chemical composition of the steel for Cast Wheel	
C	0.47% to 0.57% for type A used for carriage stock 0.57% to 0.67% for type B used for wagon stock
Mn	0.60 to 0.80%
P	0.03% max
S	0.03% max
Cr	0.15% max
Ni	0.25% max
Mo	0.06% max
Combined % for Cr, Ni & Mo must be 0.40% max	

The procedure to calculate chemical composition will be in accordance to IS:228

Mechanical Properties of Cast Wheel

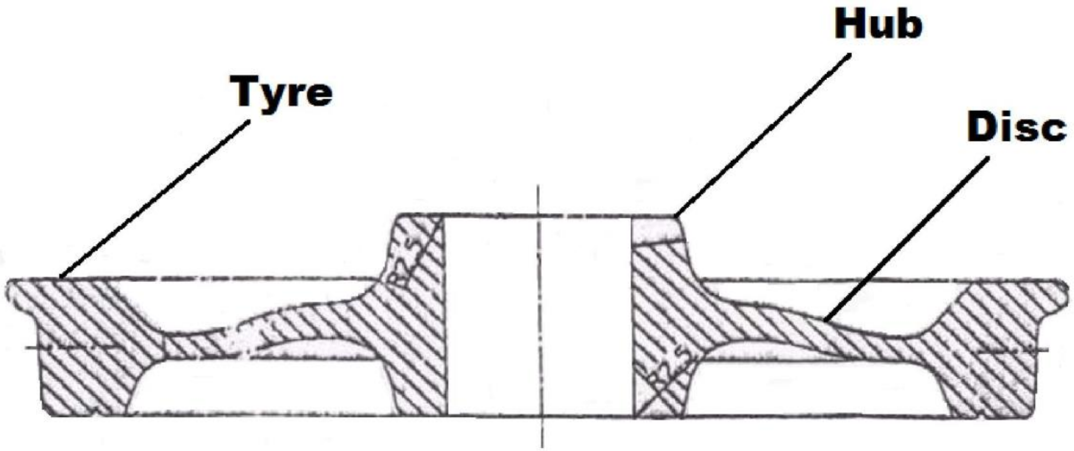
Sl. No.	Particulars	Type A	Type B
1	Tensile Strength at 15 mm below tread face	900 N/m2 min.	930 N/m2 min.
2	Tensile strength at middle of the web	800 N/m2 min.	800 N/m2 min.
3	Minum yield strength at 15 mm below tread face	50% of UTS	50% of UTS
4	Minimum yield strength at middle of the web	50% of UTS	50% of UTS
5	Minimum elongation at 15 mm below tread face	5.0%	4.5%
6	Minimum elongation at middle of the web	7.0%	7.0%
7	Hardness range at 15 mm below tread face	255-320 BHN	271-341 BHN
8	Minimum impact strength at 15 mm below tread face	10 J/cm2 at 20 deg C	--

Railway Wheels

The wheel is better understood by dividing it into the following parts

- Hub
- Disc
- Tyre

Wheel



hub

- Hub is the centre portion of the wheel, where the wheel is fixed to the axle by means of interference fit.
- Thickness of the wheel is maximum at the hub portion.
- UT details is marked on the Hub

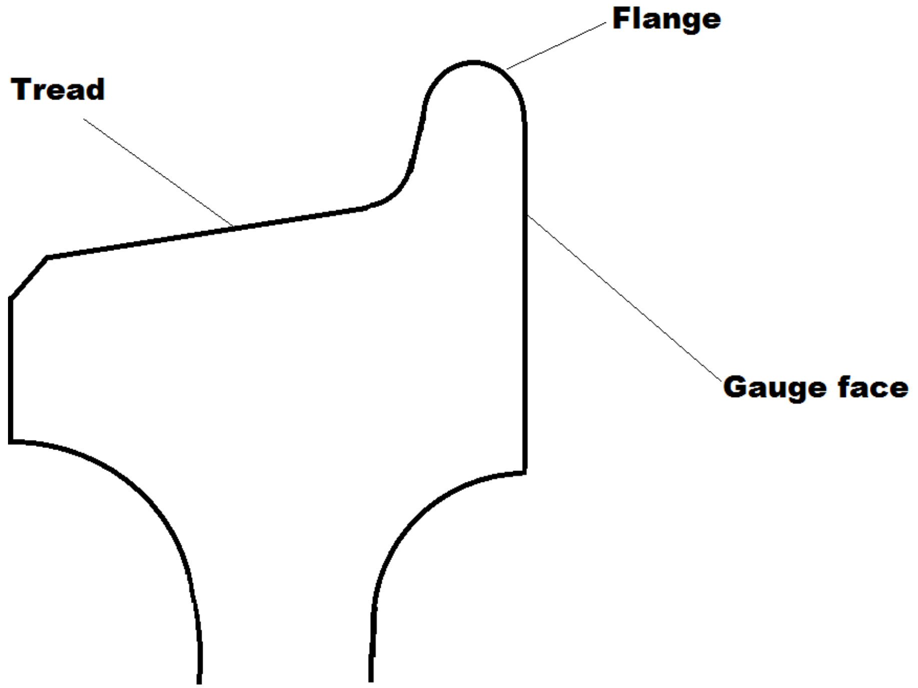
Disc

- Disc is the portion of the wheel between the hub and the tyre.
- This portion is the thinnest portion of the wheel as it does not come in contact with rail nor it is coming in contact with the axle.

Tyre

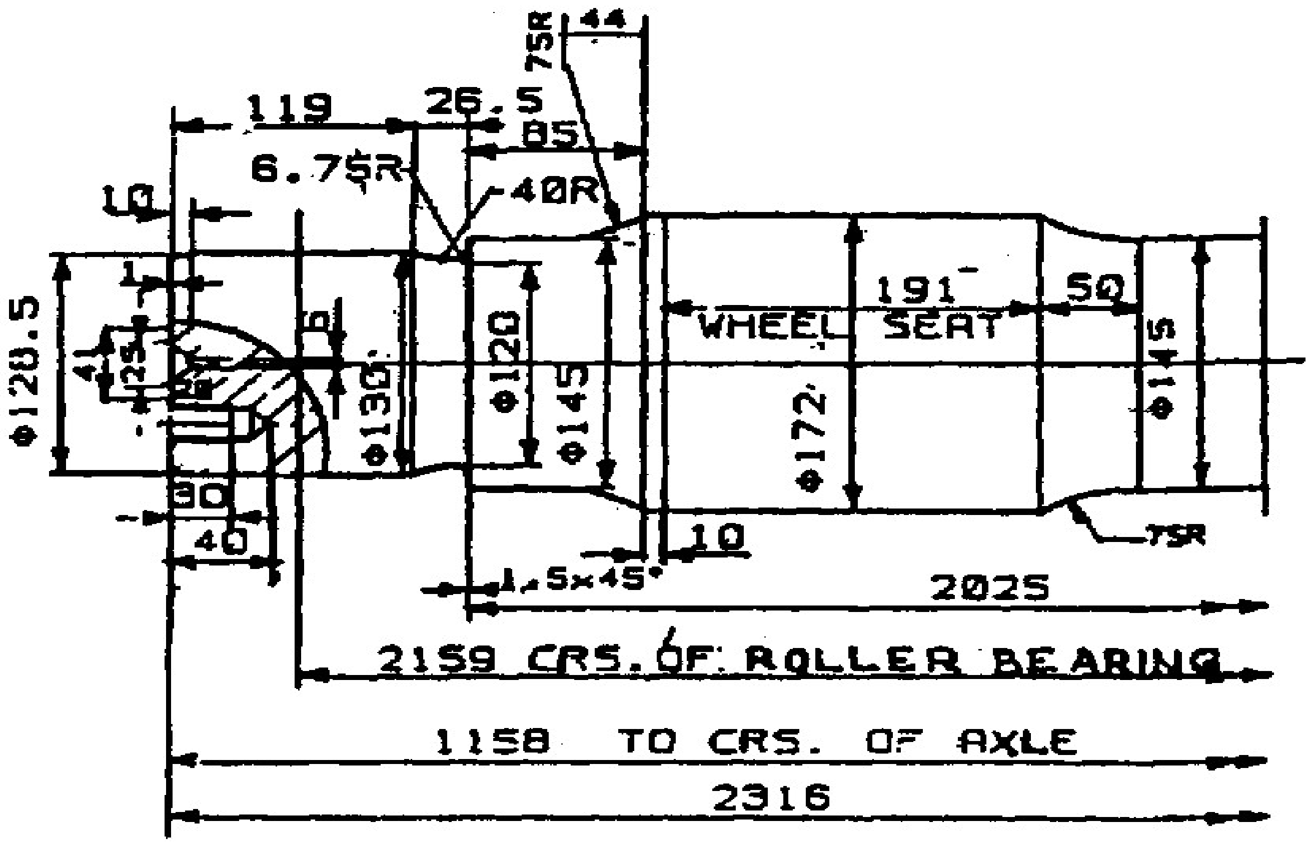
- Tyre is the portion in contact with the rail, which wears out in service.
- The profile of the tyre is significant for safe running of the trains.
- Taper is given on the tread to have higher diameter near the flange and lower diameter at the outer edge, to facilitate curve negotiation.

Tyre



Axles

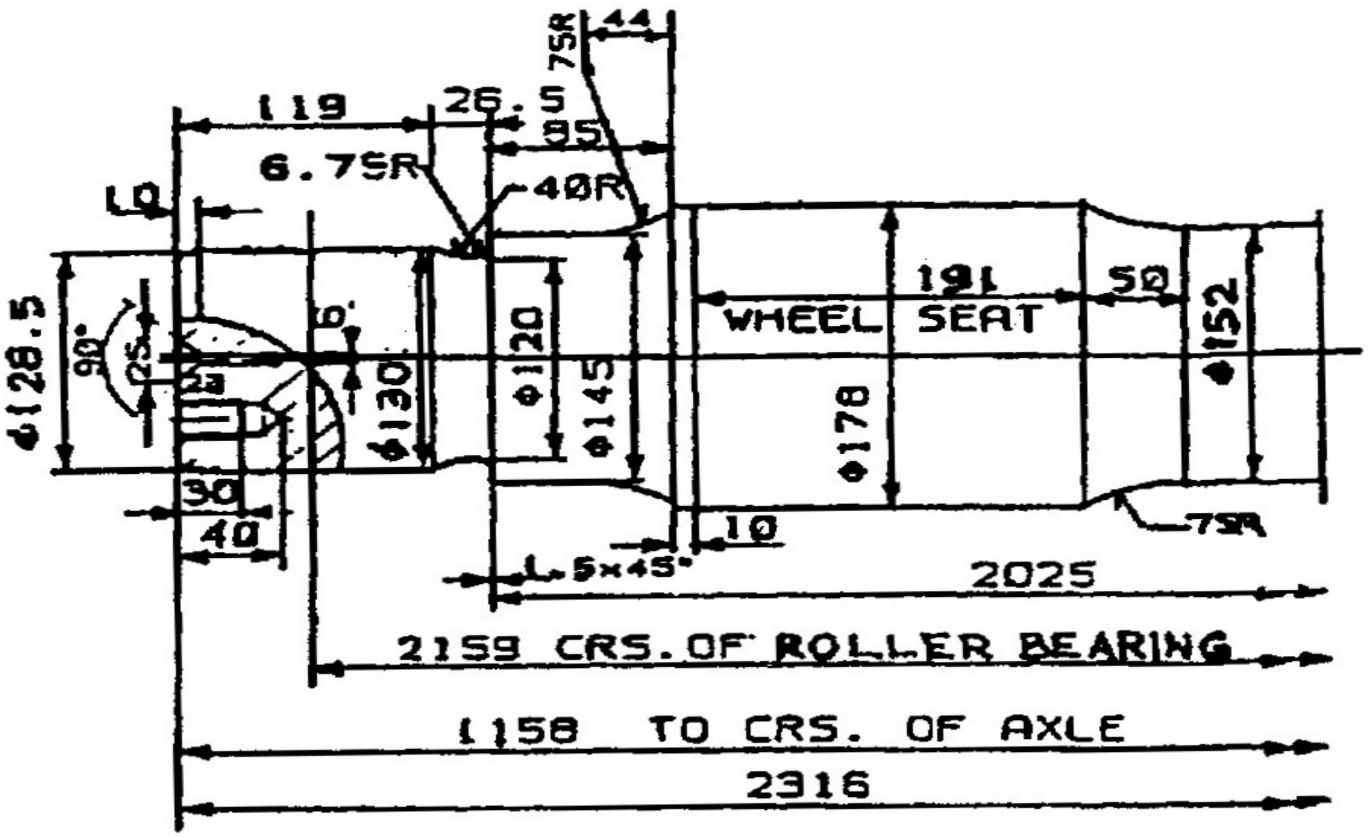
13 t Axle for ICF coach



ICF DRG. NO. T-0-2-622

Axles

16.25 t Axle for ICF coach



ICF DRG. NO. WTAC3-0-2-301

Press fit of wheel on axles

- Wheel disc is pressed to axle with interference fit (the bore of the wheel should be 0.304 mm to 0.355 mm less than the outer dia of the wheel seat on the Axle)
- Wheel Gauge should be in between 1599 and 1602 mm
- Axial off centre should be within 1.0 mm (wagon) & 0.8 mm (coach)
- Radial off centre should be within 0.5 mm (wagon) & 0.25 mm (coach)
- The Journals should be protected with bituminous black to IS:9862
- All Axles fitted by workshop during POH or despatched to depot should be Ultrasonically tested

Press fit of wheel on axles

Hydraulic press is used for assembly of the wheel with a force of 400 to 500 Kgs per mm dia of wheel seat (approximate force used for different wheels are given below)

Description	**Tonnage**
13 tonne axle	68.8 to 103.2 t
16.25 tonne axle	71.2 to 106.8 t
BOXN & BLC	85 to 127 t

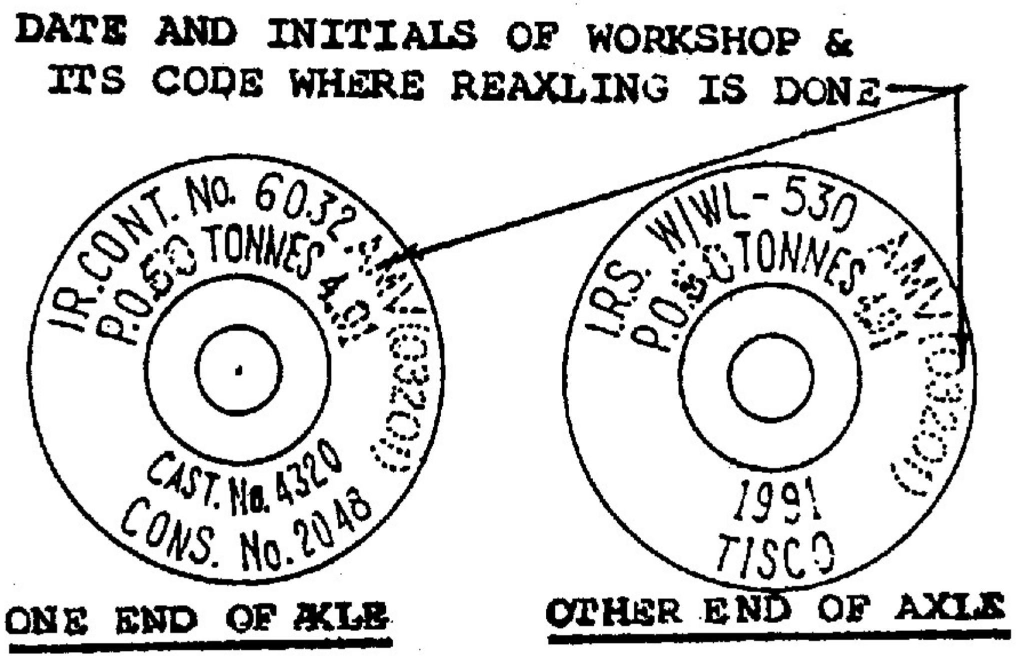
Stamping of particulars

Whenever axles are renewed the workshop shall punch in 5 mm letters the following particulars on the journal face

- Place of pressing
- Date of pressing
- Pressure of pressing

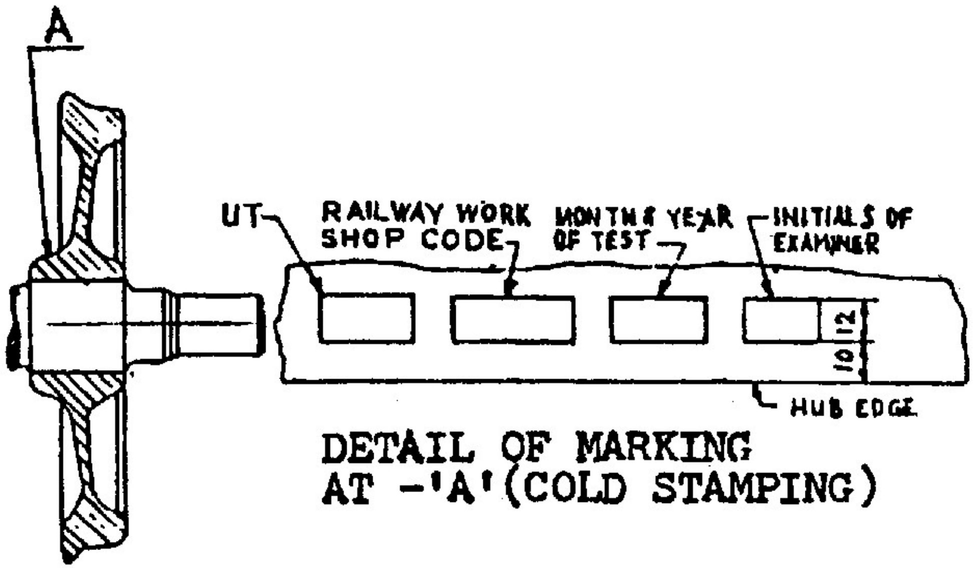
Whenever UT is done the details shall be stamped cold on the inner hub fillet with 6 mm punch not more than 1.5 mm depth

Stamping of particulars



NOTE:
ALL STAMPING TO BE DONE WITHIN 63 DIA.
ON BOTH JOURNAL FACES.

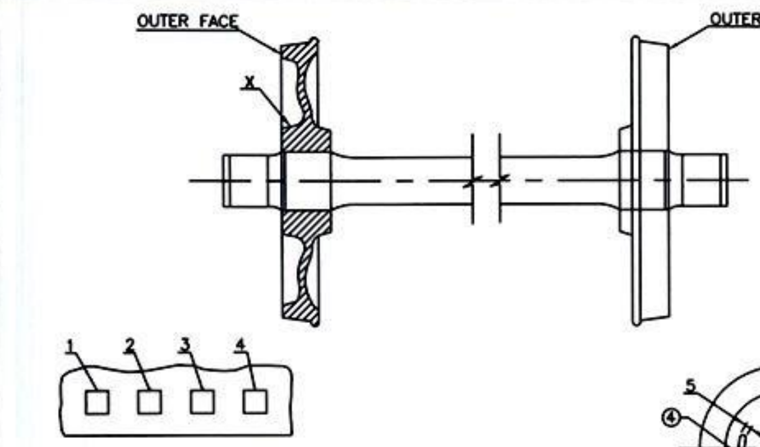
Stamping of particulars



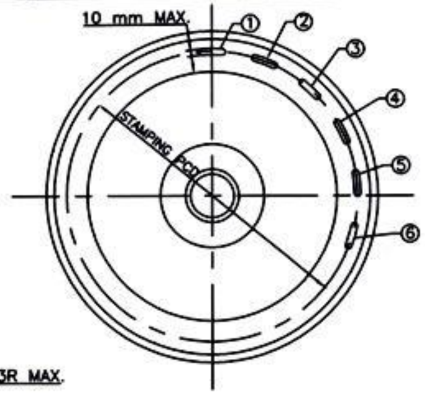
NOTE:-

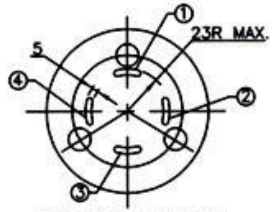
1. 'UT' INDICATES ULTRASONIC TESTING OF AXLES.
2. THE MARKING SHALL BE STAMPED COLD ON THE INNER HUB FILLET AS SHOWN AT 'A' AFTER THE SURFACE IS GROUND PROPERLY.
3. THE EXAMINING WORKSHOPS SHALL MAINTAIN ALL THE PARTICULARS OF AXLES TESTED VIZ. I.R. PART NO., CONTRACT NUMBER, CAST AND CONSECUTIVE NUMBERS, MANUFACTURER'S INITIALS AND YEAR OF MANUFACTURE IN REGISTER PROPERLY MAINTAINED BY THEM.
4. REF. WDO DRG. NO. WD-81089/S-1

Stamping of particulars

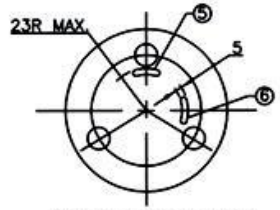


DETAILS OF 'X' FOR MARKING ON LHB COACH WHEELS

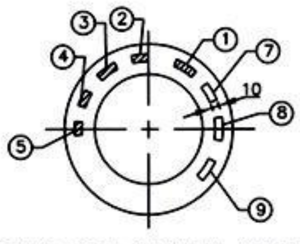




ONE END OF AXLE



OTHER END OF AXLE



OUTER FACE OF WHEEL/WHEEL CENTRE HUB

STAMPING PARTICULARS

WHEEL/WHEEL CENTRE AND AXLE DETAILS	1	MANUFACTURER'S CODE
	2	YEAR OF MANUFACTURE
	3	CONSECUTIVE No.
	4	BATCH No.
	5	INSPECTOR'S APPROVAL STAMP
	6	'UT' FOR ULTRASONIC TESTING
ASSEMBLY DETAILS	7	MANUFACTURER'S/WORKSHOP'S CODE
	8	MONTH AND YEAR OF ASSEMBLY
	9	PRESSING ON PRESSURE IN TONNES

PCD OF STAMPING OF DIFFERENT WHEELS

TYPE OF WHEEL	PCD OF STAMPING ON RIM
COACHING WTAC3-0-2-301 T-0-2-622 W/WL-1660 MG/T-0-1-004	 788 mm 788 mm 788 mm 610 mm
WAGON W/WL-4764 W/WL-4771 WD-89025/S-5 WD-89025/S-9	 870 mm 780 mm 830 mm 960 mm
CONTAINER FLAT CONTR.-9404-S/13	755 mm
SOLID WHEEL FOR EMU Sk-K4004	842 mm (FOR MC) 832 mm (FOR TC)

NOTE:

1. WHEEL DETAILS
   .1 TO BE HOT/COLD STAMPED OR MARKED BY ELECTRIC ETCHING IN 10 mm LETTERS ON OUTER FACE OF THE RIM OF ROUGH TURNED OR FINISH TURNED WHEELS.
   .2 FOR LHB COACH WHEELS, STAMPING SHOULD BE DONE ON OUTER FACE OF THE HUB. PARTICULARS OF S.No. 1 TO 4 SHALL ALSO BE STAMPED ON OUTER HUB FILLET AT LOCATION MARKED AS 'X', FOR EASY IDENTIFICATION IN ASSEMBLED CONDITION.
2. WHEEL CENTRE DETAILS
   TO BE COLD STAMPED OR MARKED BY ELECTRIC ETCHING IN 10 mm LETTERS AT THE HATCHED LOCATIONS ON OUTER FACE OF THE HUB.
3. AXLE DETAILS
   .1 TO BE STAMPED COLD OR MARKED BY ELECTRIC ETCHING ON BOTH ENDS IN 5 mm LETTERS LETTERS IN CASE OF ROUGH TURNED OR FINISHED AXLES.
   .2 TO BE STAMPED IN 10 mm LETTERS IN CASE AXLES ARE SUPPLIED IN AS FORGED CONDITION.
4. ASSEMBLY DETAILS
   TO BE STAMPED COLD OR MARKED BY ELECTRIC ETCHING IN 10 mm LETTERS ON THE OUTER FACE OF THE WHEEL/WHEEL CENTRE HUB.
5. IT IS MANDATORY TO STAMP THE RESPECTIVE MARKINGS AT THE LOCATIONS INDICATED ABOVE.

ALT.	ITEM	AUTHY.	DESCRIPTION	DATE
7	--	SS/21/09	DETAILS OF 'X' FOR ADDITIONAL MARKING ON LHB COACH WHEELS ADDED AND NOTE 1.2 MODIFIED.	12/09
6	--	SS/19/09	RADIUS AT END VIEWS OF THE AXLE CHANGED FROM 18R TO 23R.	10/09
5	--	SS/01/06	DRAWING REVISED	1/06
4	--	SS/13/03	DRAWING REVISED	3/03
3	--	SS/3/02	DRAWING REVISED	2/02
2	--	CD/17/99	DRAWING REVISED	8/99
1	--	CD/6/97	DRAWING REVISED	9/97

SUPERSEDED BY:			
SUPERSEDES:			
SCALE	P		BRANDING DETAILS ON WHEEL & AXLE
Z	C	G.V.RAMAN	
	D	PANT& SANJAY	
	T	--	
	J.S.	--	
B.G.	R.D.S.O. [c]		SKETCH-92114

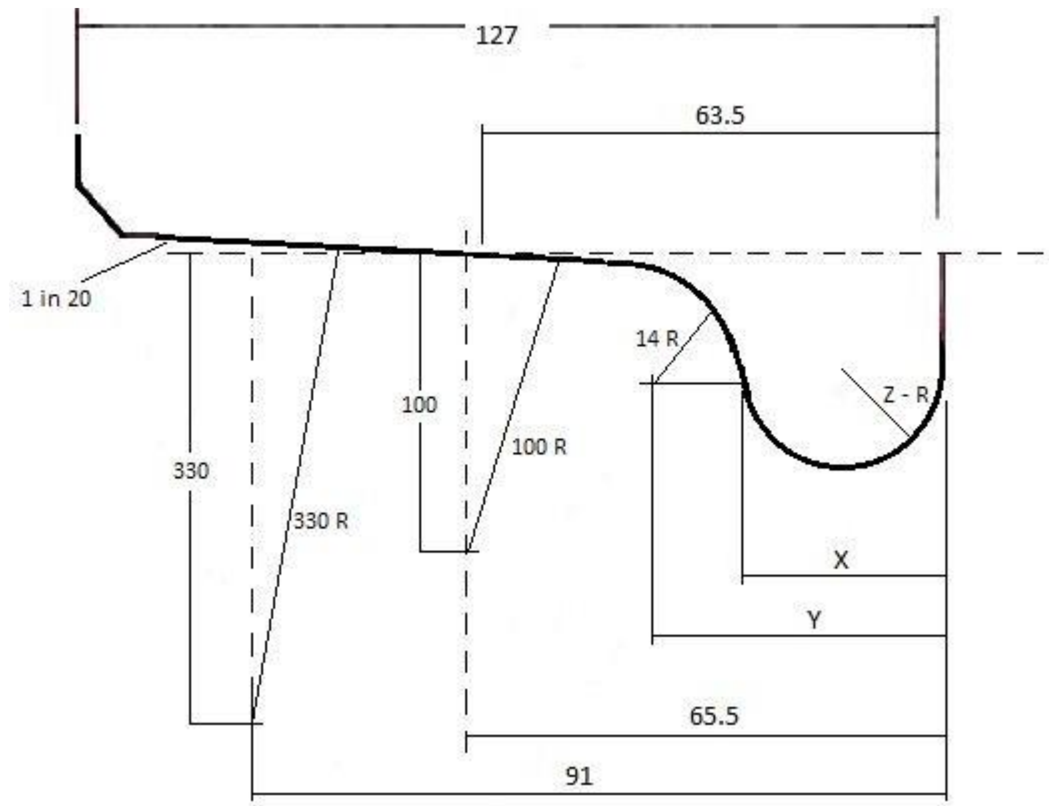
Worn Wheel Profile

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

Worn Wheel Profile

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

Worn Wheel Profile



Step Sizes of Worn Wheel Profile

Further to reduce the metal removal during tyre turning, intermediate worn wheel profile based on the flange thickness is introduced.

Flange Thickness (X)	Y	Z
28 mm	42.23 mm	13.5 mm
27 mm	41.29 mm	13.0 mm
26 mm	40.34 mm	12.5 mm
25 mm	38.41 mm	11.5 mm
24 mm	37.44 mm	11.0 mm
23 mm	36.47 mm	10.5 mm
22 mm	35.49 mm	10.0 mm
21 mm	34.5 mm	9.5 mm
20 mm	33.5 mm	9.0 mm

Wheel Defects

- Manufacturing Defects
- Improper Assembly Practices
- Normal Wear and Tear during service

Manufacturing Defects

- Casting Defects
- Improper Heat treatment
- Machining Imperfections

Improper Assembly Practices

- Stipulated dimensional tolerances for Wheel seat and bore not adhered to resulting in use of higher or lower than the prescribed force during pressing leading to improper wheel set assembly.
- Ovality on Journals - 0.02 mm (max)
- Taper on Journal - 0.01mm (max)
- Difference in dia of wheels on the same axle should not exceed 0.5mm

Wheel defects

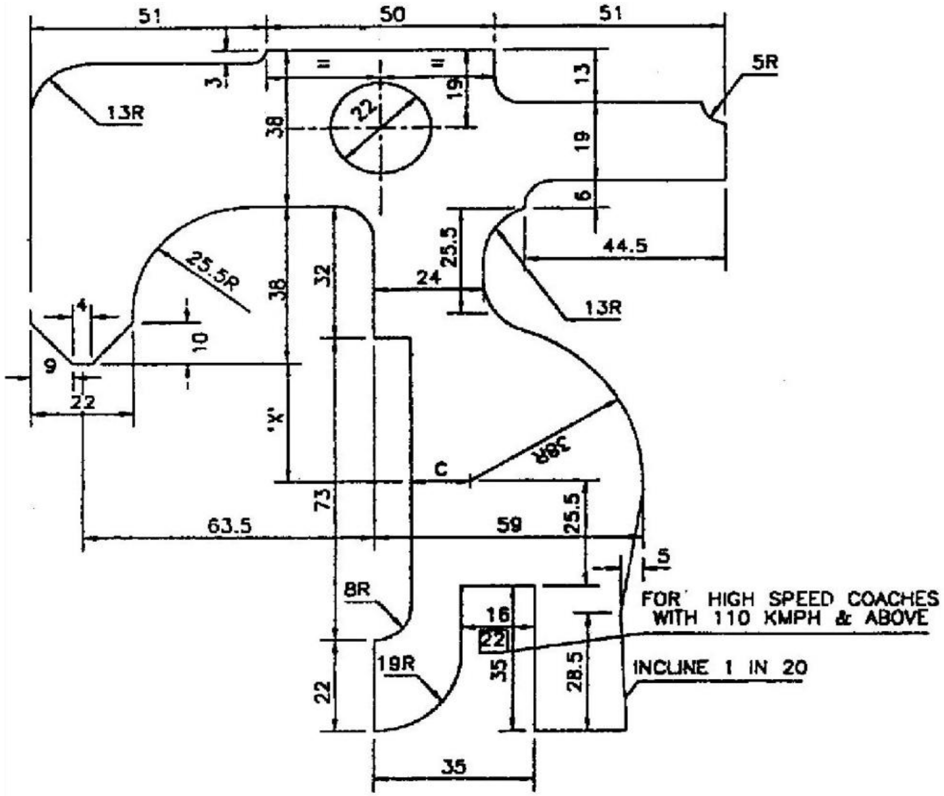
Measurable wheel defects arising due to normal wear & tear during service

- Thin flange
- Deep flange
- Sharp flange
- Less radius at root of flange
- Hollow tyre
- Thin tyre
- Flat tyre

Std & cond limits

Defect	Std	Cond
Thin flange	28.5	22 (Coaches) 16 (Wagons)
Deep flange	28.5	35
Sharp flange (radius)	14.5	5
Less radius at root of flange (radius)	14 (wwp)	13
Hollow tyre		5
Thin tyre		Based on wheel dia
Flat tyre		50 (Coaches) 60 (wagons)

Tyre Defect Gauge



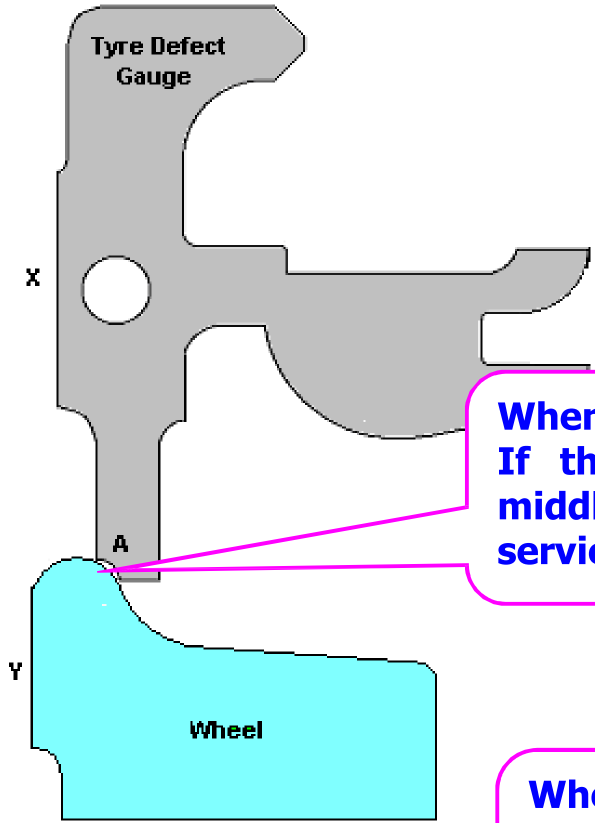
All coaches (Including EMU & DMU) 50 mm

NOTE:-

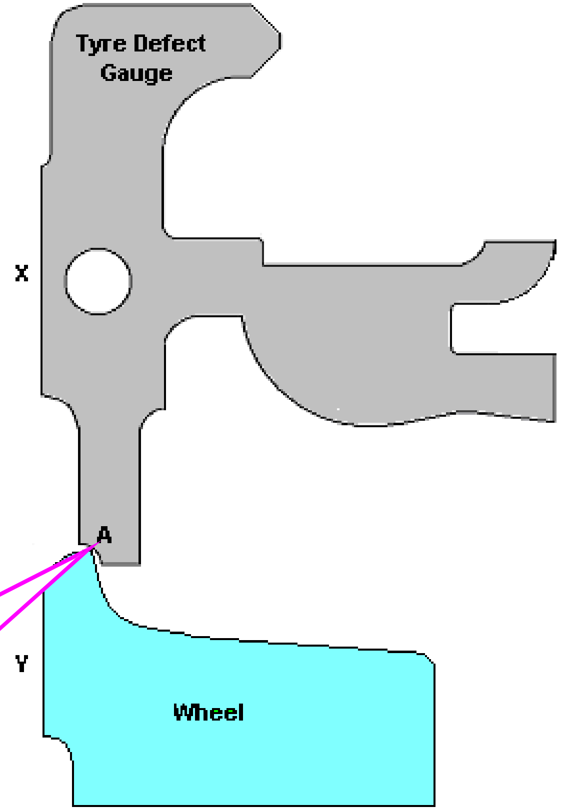
1. CONDEMNING MARK 'C' TO BE STAMPED ON BOTH SIDE OF GAUGE.
2. CONDEMNING MARKS FOR TYPE OF STOCK ON LINE ONLY NEEDS TO BE STAMPED.
3. DISTANCE 'X' AT WHICH CONDEMNING MARK 'C' FOR VARIOUS TYPE OF WHEELS TO BE STAMPED ARE AS BELOW:-

i) SOLID WHEEL OF ICF & BEML MAIN LINE COACHES	6.5 mm.
ii) SOLID WHEEL OF IRS MAIN LINE COACHES	5 mm.
iii) TYRED WHEEL OF IRS, ICF & BEML MAIN LINE COACHES	26 mm.
iv) TYRED WHEEL OF ac & dc EMU MOTOR COACHES.	38.5 mm.
v) TYRED WHEEL OF ac & dc EMU TRAILER COACHES.	28.5 mm.

Checking for sharp flange

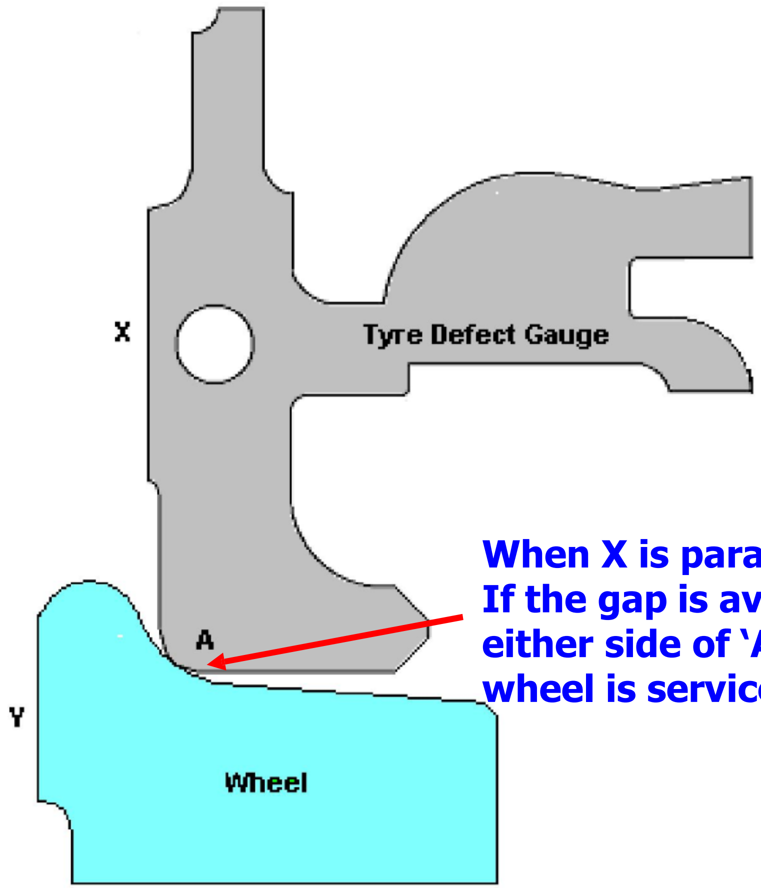


When X is parallel to Y,
If there is Gap in the middle at A, the Wheel is serviceable

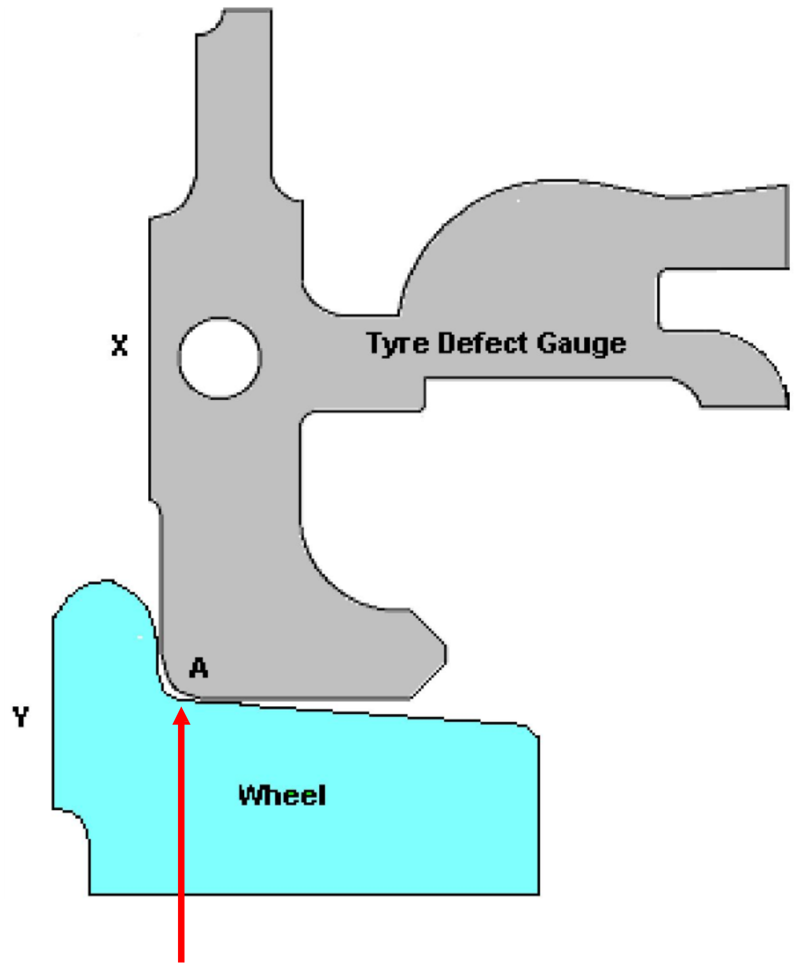


When X is parallel to Y,
If there is gap on either side of A, the Wheel is rejectable

Checking the root of flange

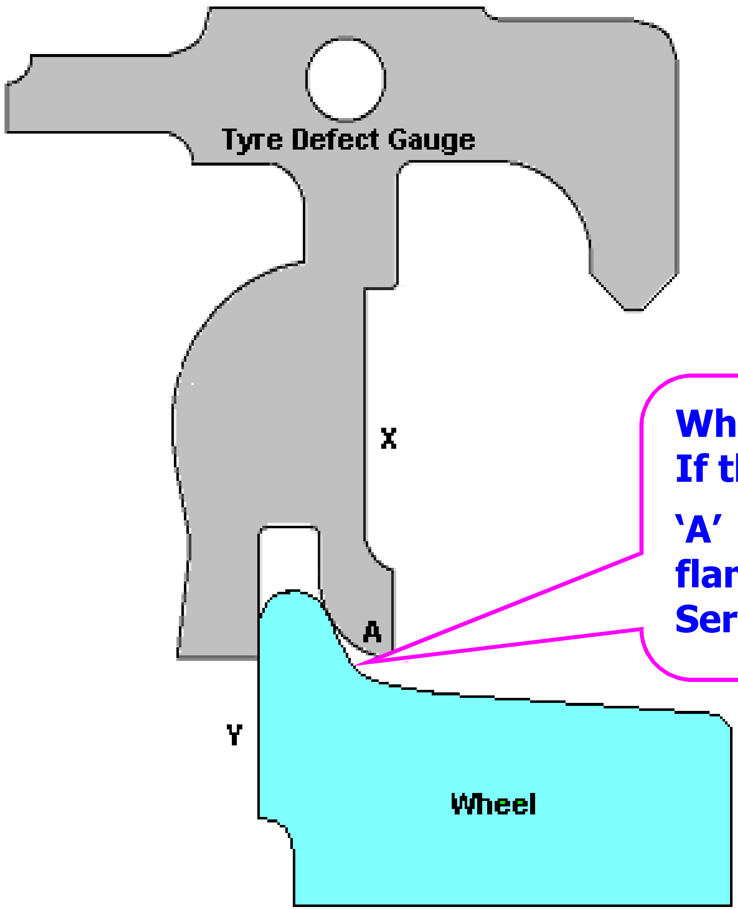


When X is parallel to Y, If the gap is available at either side of 'A', the wheel is serviceable.

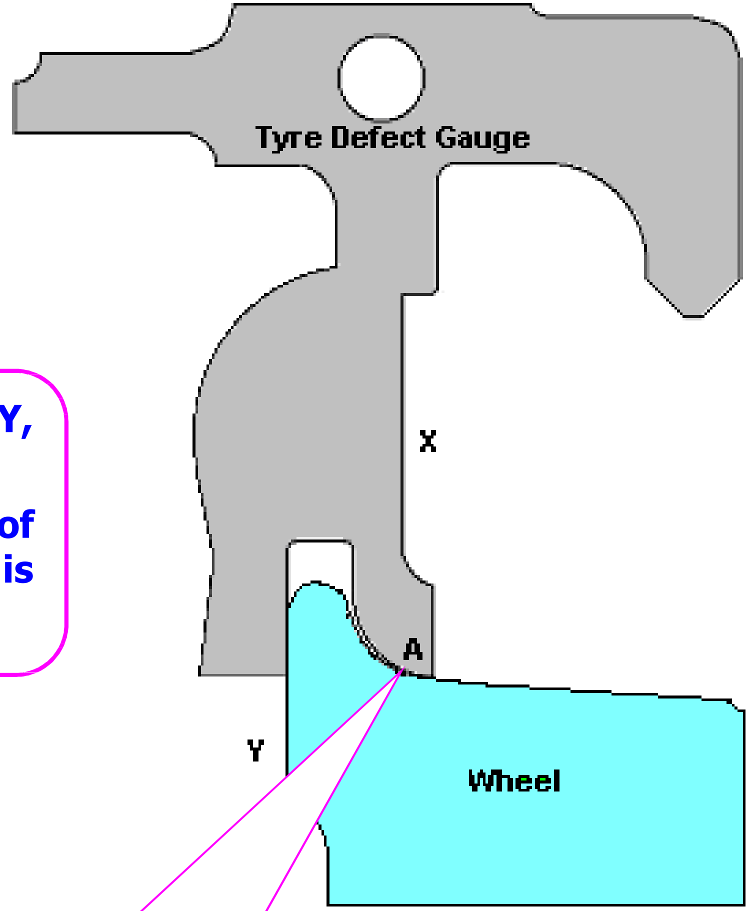


When X is parallel to Y , If there is a gap between gauge and the Root of Flange at A , the Wheel is Rejectable

Checking Thin flange

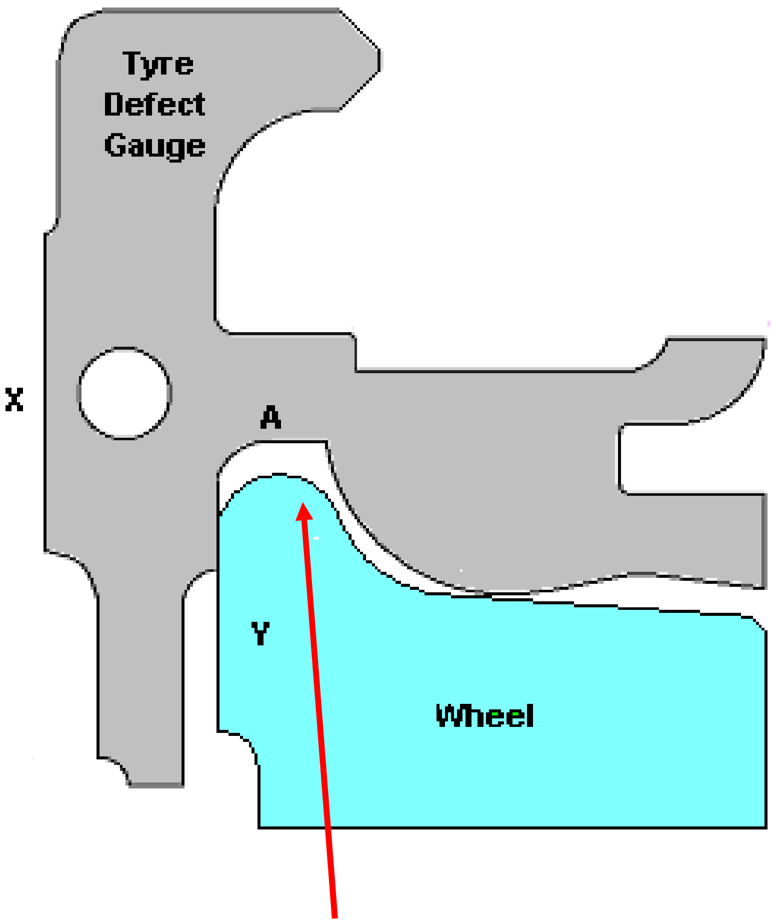


When X is parallel to Y, If there is gap between 'A' and the root of flange, the wheel is Serviceable

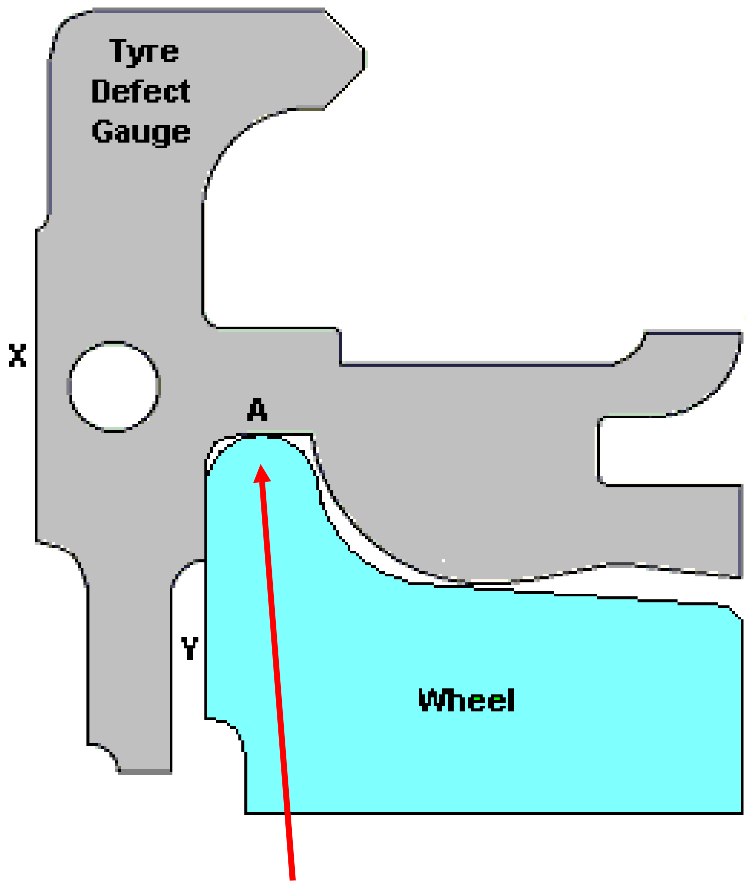


When X is Parallel to Y, If there is no gap between 'A' and the root of flange, the wheel is rejectable

Checking Deep Flange

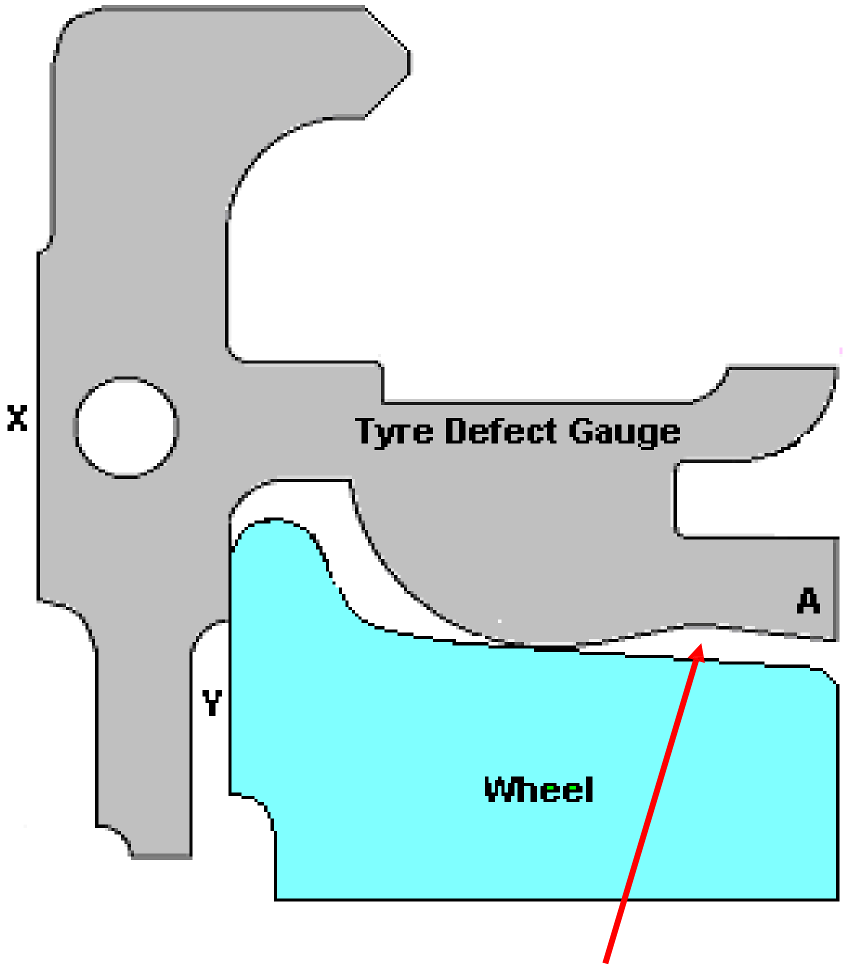


**When X is parallel to Y,
If there is a gap between 'A'
and tip of the flange, the wheel is
serviceable.**

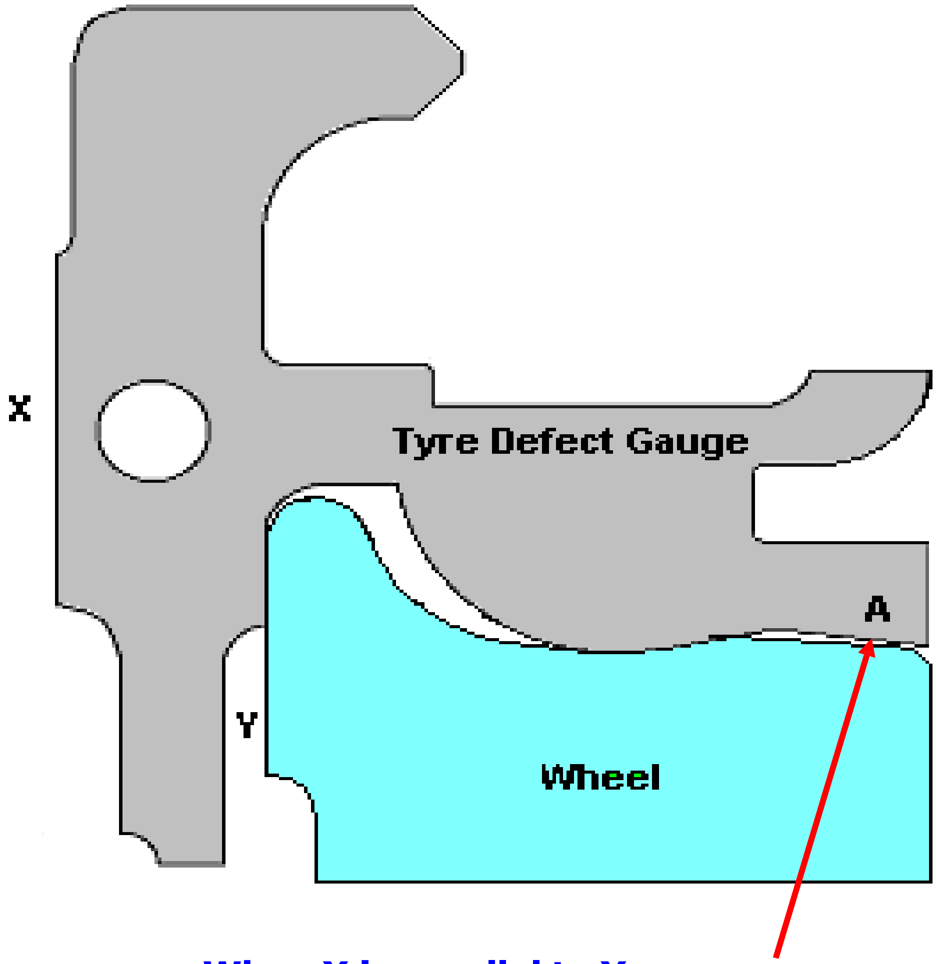


**When X is parallel to Y,
If there is no gap between 'A'
and tip of the flange, the wheel is
rejectable**

Checking Hollow tyre

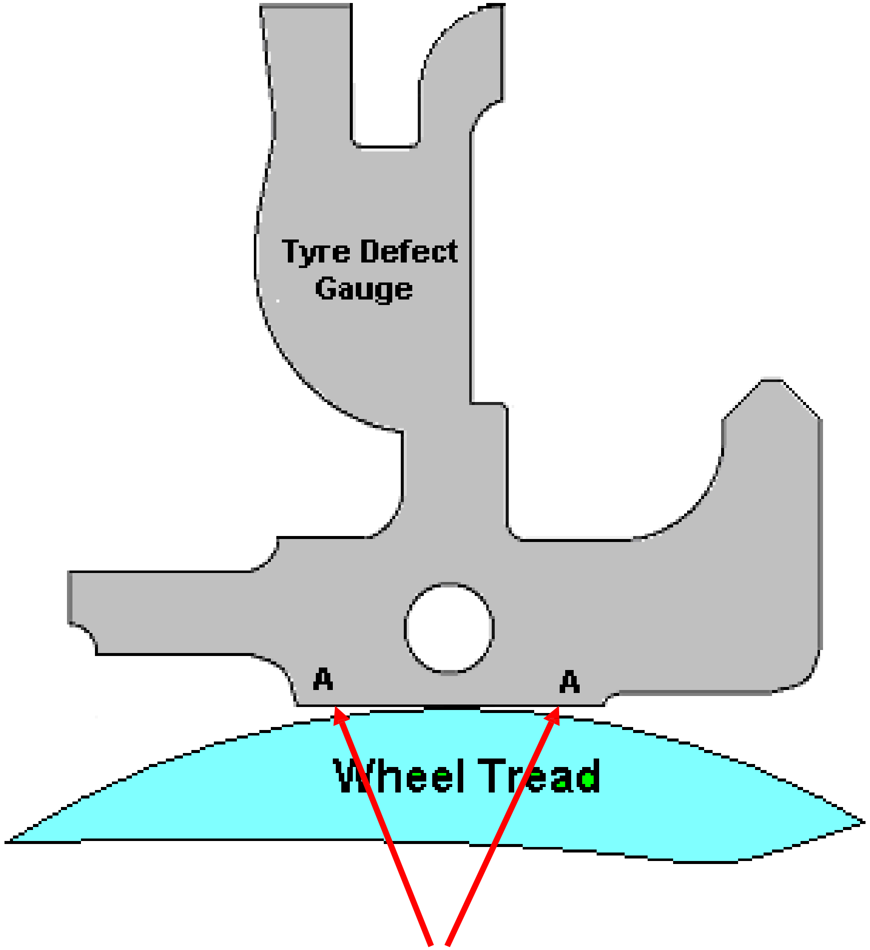


When X is parallel to Y,
If there is gap between the wheel tread and gauge at "A",the wheel is serviceable

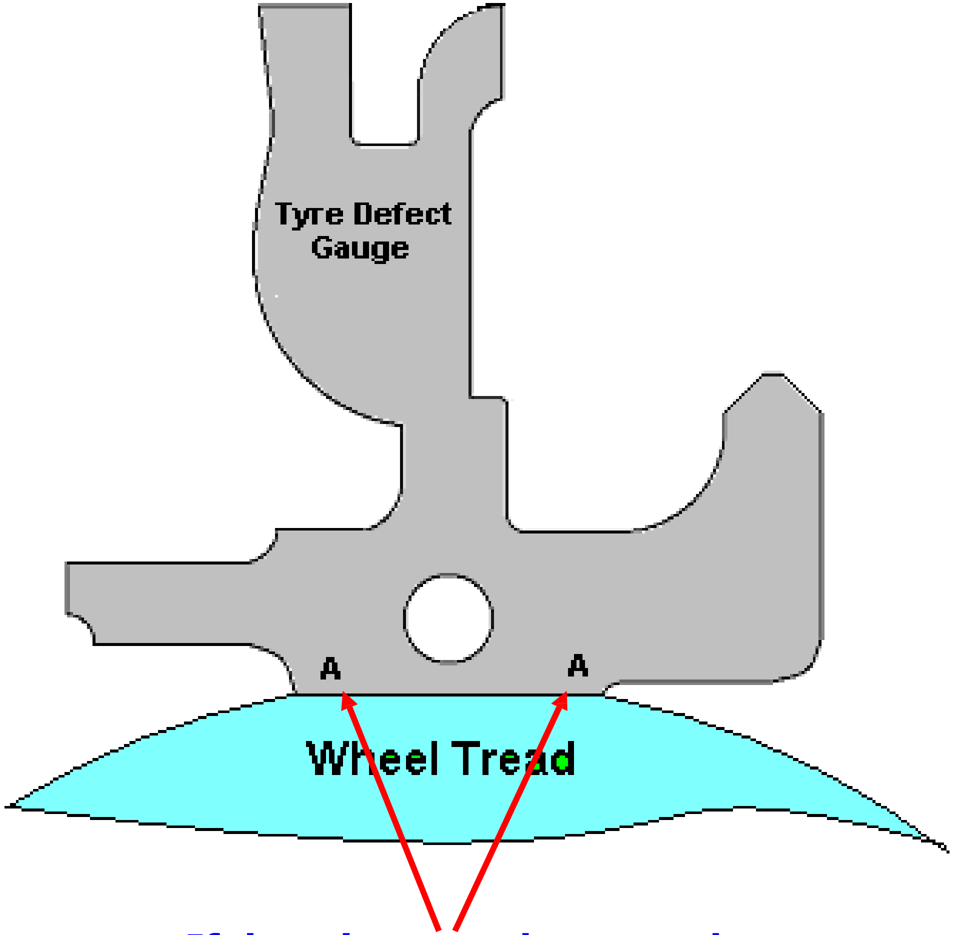


When X is parallel to Y,
If the gauge touches the wheel tread at "A",The wheel is rejectable.

Checking Flat tyre

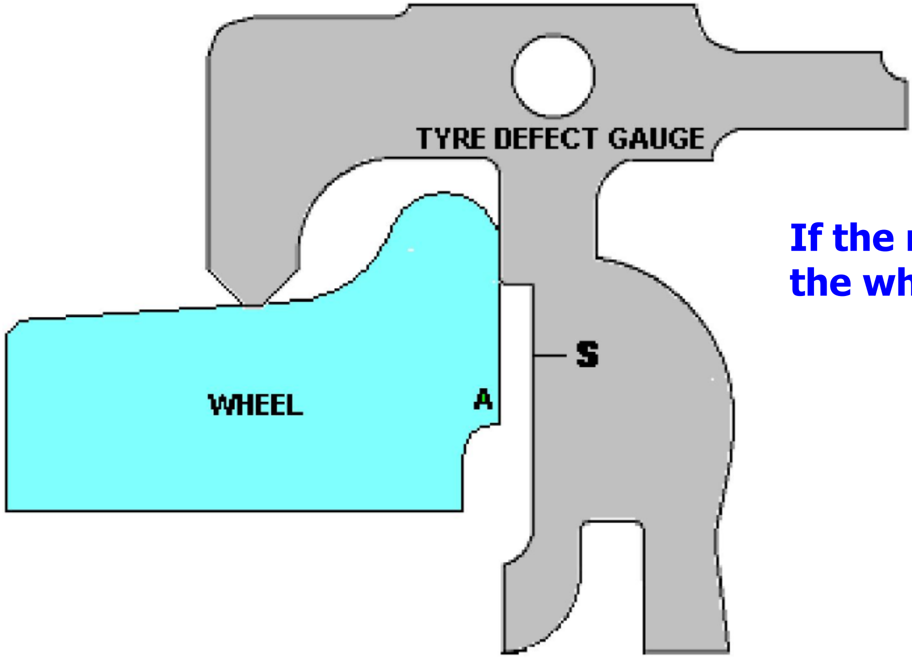


If there is gap between the gauge and the wheel tread at "A", the wheel is serviceable.

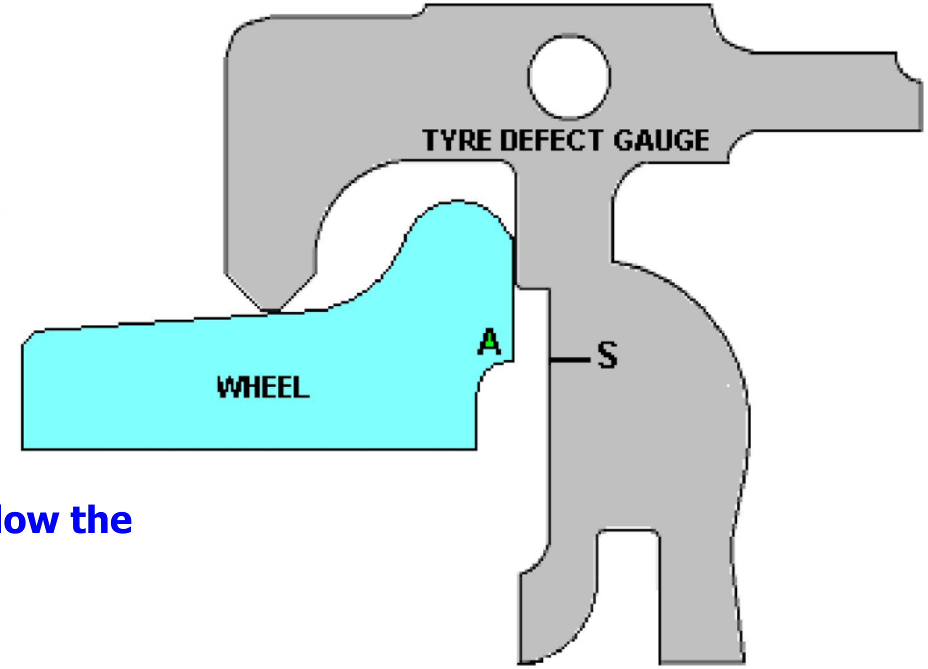


If there is no gap between the gauge and the wheel tread at "A", the wheel is rejectable.

Checking Thin tyre



If the mark S in the gauge is above the location A , the wheel is serviceable.



If the mark S in the gauge is in line or below the location A , the wheel is rejectable.

Wheel defect as per CMI K 003

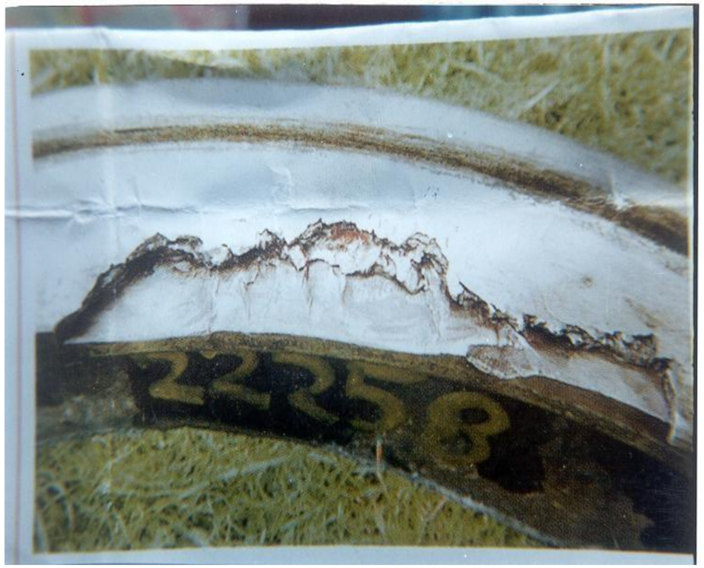
- Shelled tread
- Shattered rim
- Spread rim
- Thermal crack
- Heat checks
- Disc crack
- Loose axle

Shelled Tread

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

Shattered Rim

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



Spread Rim

If the rim widens out for a short distance on the front face, an internal defect may be present. Spreading of the rim is usually accompanied by a flattening of the tread, which may or may not have cracks or shelling on the tread. Such wheels must be withdrawn from service.

Rim Flow

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

Thermal Crack

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

Thermal Crack

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

Heat Checks

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

Disc Crack

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

Loose Axle

- While assembling wheel with axle proper interference should be maintained between wheel and axle. Due to improper selection of interference the wheel may shift outwards or it may come out completely. Loose axle is a rejectable defect.
- Axles involved in Accidents should be magnaflux tested in addition to Ultrasonic test.
- Axle having notch should be withdrawn from service

- All wheel sets withdrawn from service for any of the conditions mentioned above must be sent to the associated workshops for detailed investigations and further disposal.
- The date and station code of the maintenance depot where the wheels are changed should be stencilled on the end panels. An entry should also be made in the maintenance card of the coach.
- No repairs, except wheel profiling of wheel sets is permitted to be done in the maintenance depot.

Wheel Gauge

Description	Std	Max	Min
Coach MG	930	932	929
ICF coach BG	1600	1602	1599
LHB coach	1600	1601	1599
Wagons	1600	1602	1599

Wheel Diameter

Description	Std	Cond
Coach MG		
ICF coach BG	915	825
LHB coach	915	845
BOXN	1000	906
UIC	1000	860
BLC	840	780

Wheel Changing

Wheels to be paired within the diameters variation as below while changing the wheels

Type	On the same bogie	On the same coach
Coach MG	5	10
Coach BG	5	13
Wagons	13	25

While tyre turning, it should be ensured that variation on the same axle is within 0.5 mm

For in service wheels the variation on the same axle shall be guided by the tyre defect gauge

Thank You

ICF BOGIE

Vestibule type AC Pantry car

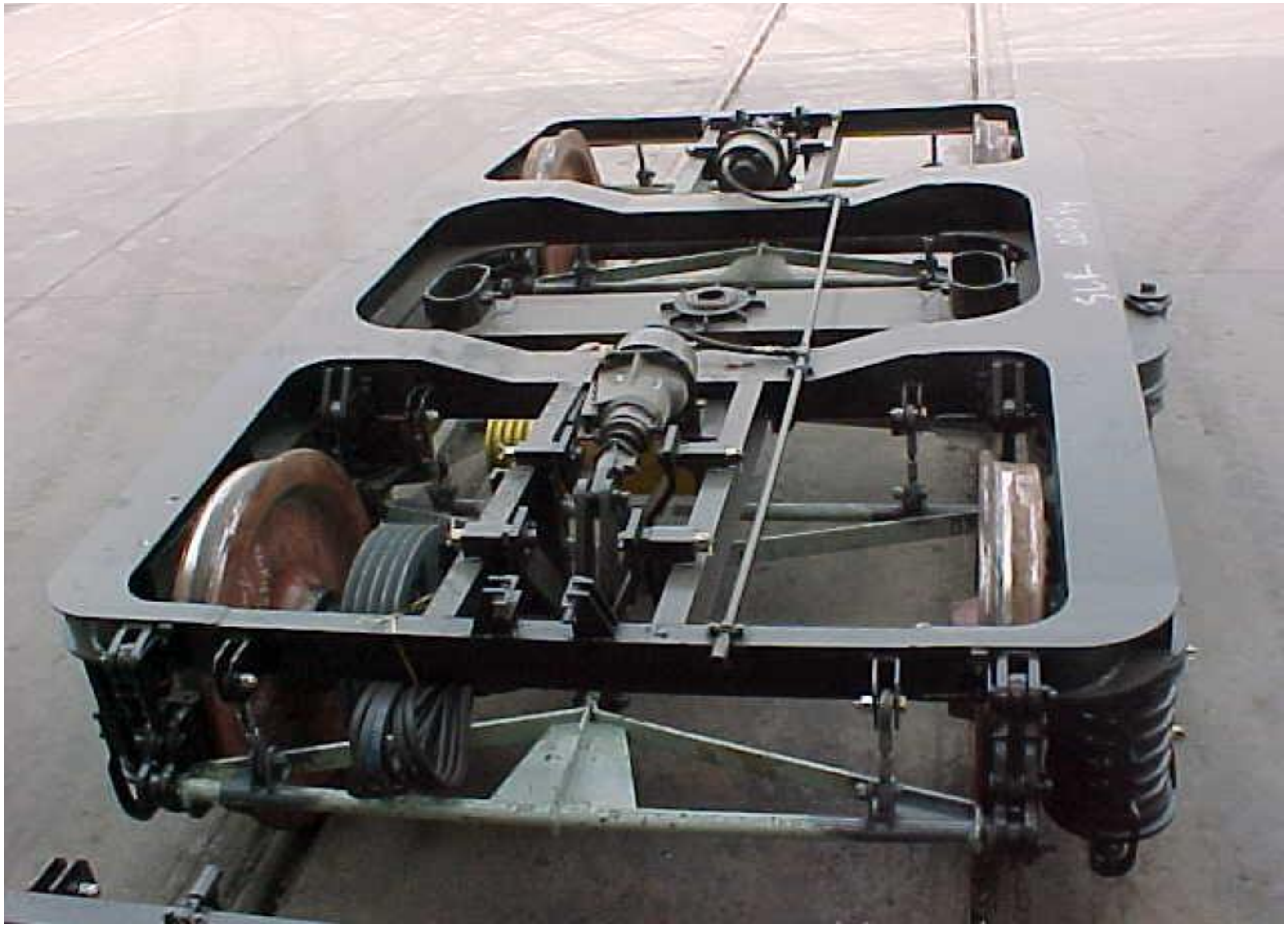
Construction of coaching stock

- Shell or the skeleton part
- Furnishing or the provisions of amenities
- Bogie (Trolley), the running gear

Running of passenger Coaches with safety

Speed and Comfort mainly depends on the bogie on which the coach is placed.

Bogie



BOGIE (TROLLEY)

What ?

Why?

Bogie - What?

- **It is an independent unit used under a long vehicle.**

- **It is usually mounted on two pairs of wheels.**

  (In exceptional cases, such as special purpose stocks or high capacity vehicles of well Wagons or crocodile trucks, inspection carriages etc the bogie may be mounted on three or more pairs of Wheels)

Bogie - What?

- **Normally two bogies are used under a Vehicle.**
- **Each bogie carries half the load of the vehicle body and it's loading.**
- **Each bogie is provided with a pivot on its central transom or bolster for engagement with its male counterpart provided underneath the vehicle under frame.**

Bogie - What?

- The bogie trucks can swivel about these pivots with case and without restraining the vehicle body while negotiating a curved truck.

Bogie - Why?

- Limitation of maximum rigid wheel base of a vehicle
- Limitation of maximum axle load prescribed for track
- Full utilisation of track loading density

Requirement of Bogie

- **Sturdy construction to withstand vertical, longitudinal and lateral shocks**
- **Satisfactory damping devices**
- **Suitable suspension gear**

Requirement of Bogie

- Sturdy running gears to give trouble free service
- Easy negotiability on curved track without restraining body structure

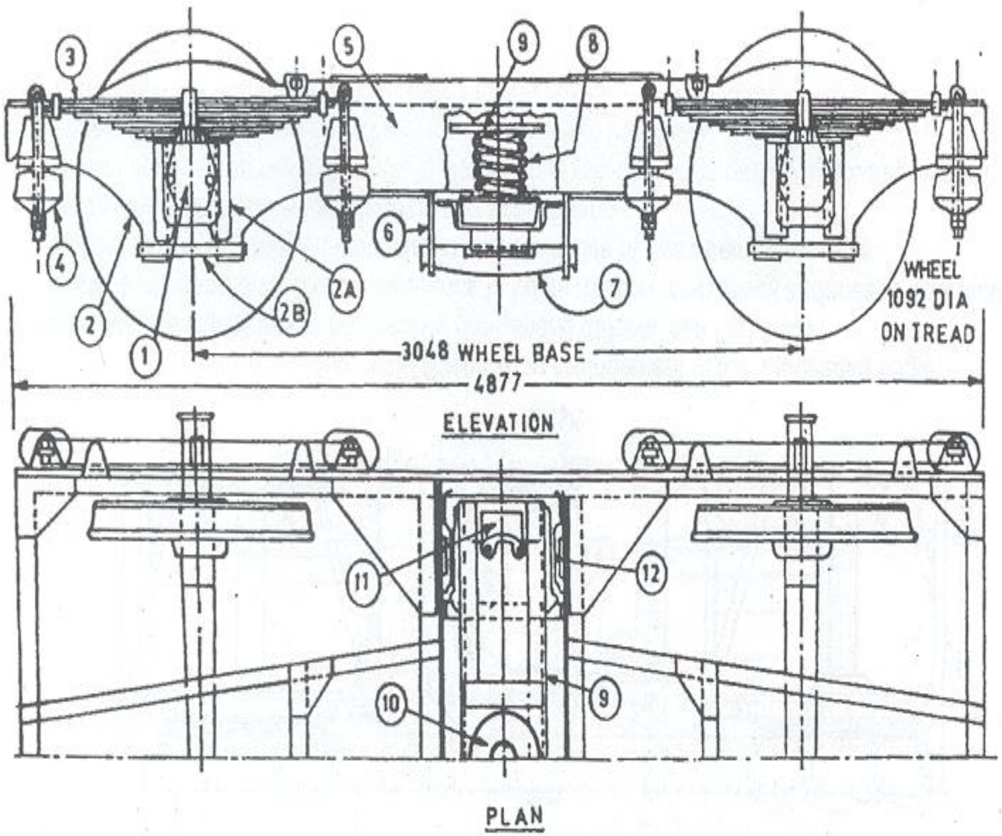
Main Units of a Bogie

1. Bogie Frame
2. Wheel and Axle
3. Bearing Arrangement
4. Bogie Frame – Axle Joint
5. Bolster
6. Primary Suspension
7. Secondary Suspension
8. Bogie – Body Joint
9. Brake System

Version of Coaching Bogie

- IRS Bogie
- SCHLIEREN Bogie (ICF Laminated Bogie)
- MAN-HAL Bogie (BEML Bogie)
- ICF All Coiled Bogie
- IR-20 Bogie
- Fiat Bogie (Similar to IR-20 Bogie)

IRS Bogie



1. Plain bearing axle box.
2. Axle guard.

2A. Horn cheek.

2B. Bridle bar

3. Primary springs (laminated).
4. Auxiliary rubber block (or spring).
5. Bogie frame (rivetted).
6. Swing links.
7. Spring plank.
8. Secondary springs (helical)
9. Bolster.
10. Centre pivot.
11. Side bearers.
12. Check guides (connected to bogie frame).

Suspension arrangement of IRS (B. G.) bogie.

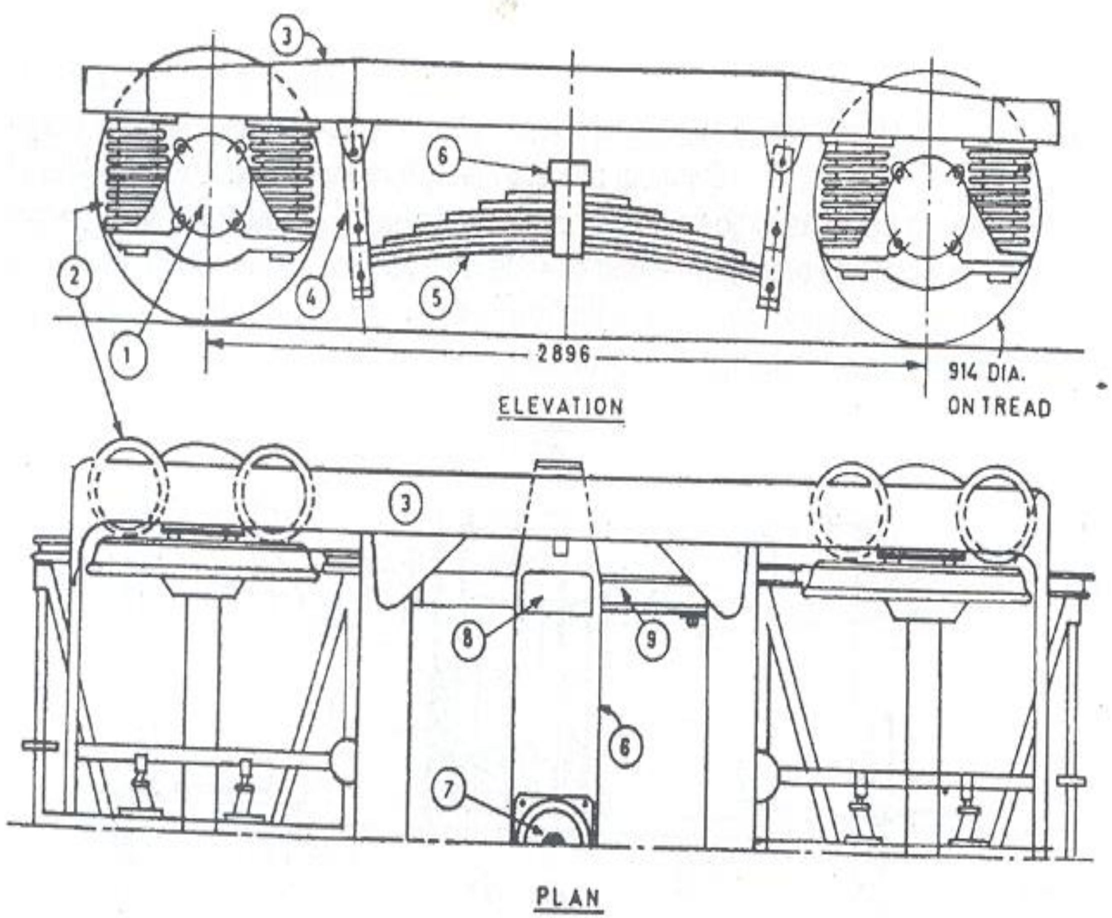
IRS Bogie

Developed / Built by: British Make

Introduction to Railway : Since 1930 – 31

Status: Productions abolished and use discontinued on Mail / express service.

SCHLIEREN Bogie
(ICF Laminated Bogie)



1. Wing type roller bearing axle box.
2. Primary springs (helical), with dash-pot inside.
3. Bogie frame.
4. Swing links.
5. Secondary springs (laminated).
6. Bolster.
7. Centre pivot.
8. Side bearers.
9. Anchor links.

Suspension arrangement of ICF Laminated bogie.

SCHLIEREN Bogie
(ICF Laminated Bogie)

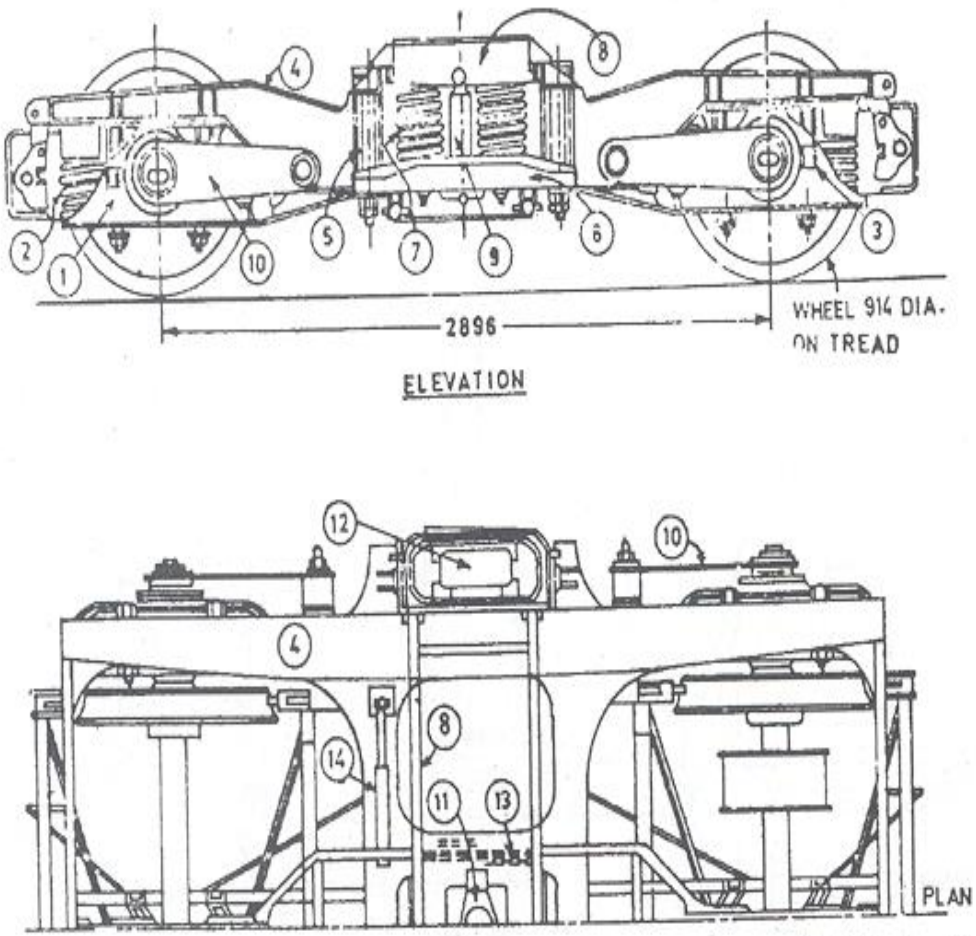
Developed / Built by:

M/S Swiss Car and
Elevator manufacturing corporation Ltd,
Schlieren, Zurich

Introduction to Railway : Since 1951

Status: Productions abolished and use discontinued on Mail / express service.

MAN-HAL Bogie
(BEML Bogie)



1. Wing type roller bearing axle box.
2. Primary springs (helical).
3. Axle guide rollers (16 Nos. per bogie i. e. 32 Nos. per coach).
4. Bogie frame.
5. Swing links.
6. Spring plank.
7. Secondary springs (helical).
8. Bolster.
9. Vertical shock absorber (hydraulic).
10. Axle link (or axle holding arm).
11. Centre pivot.
12. Side bearers.
13. Anchor links.
14. Lateral shock absorber (hydraulic).

Suspension arrangement of BEML bogie :

MAN-HAL Bogie
(BEML Bogie)

Developed / Built by:

M/S HAL Banglore

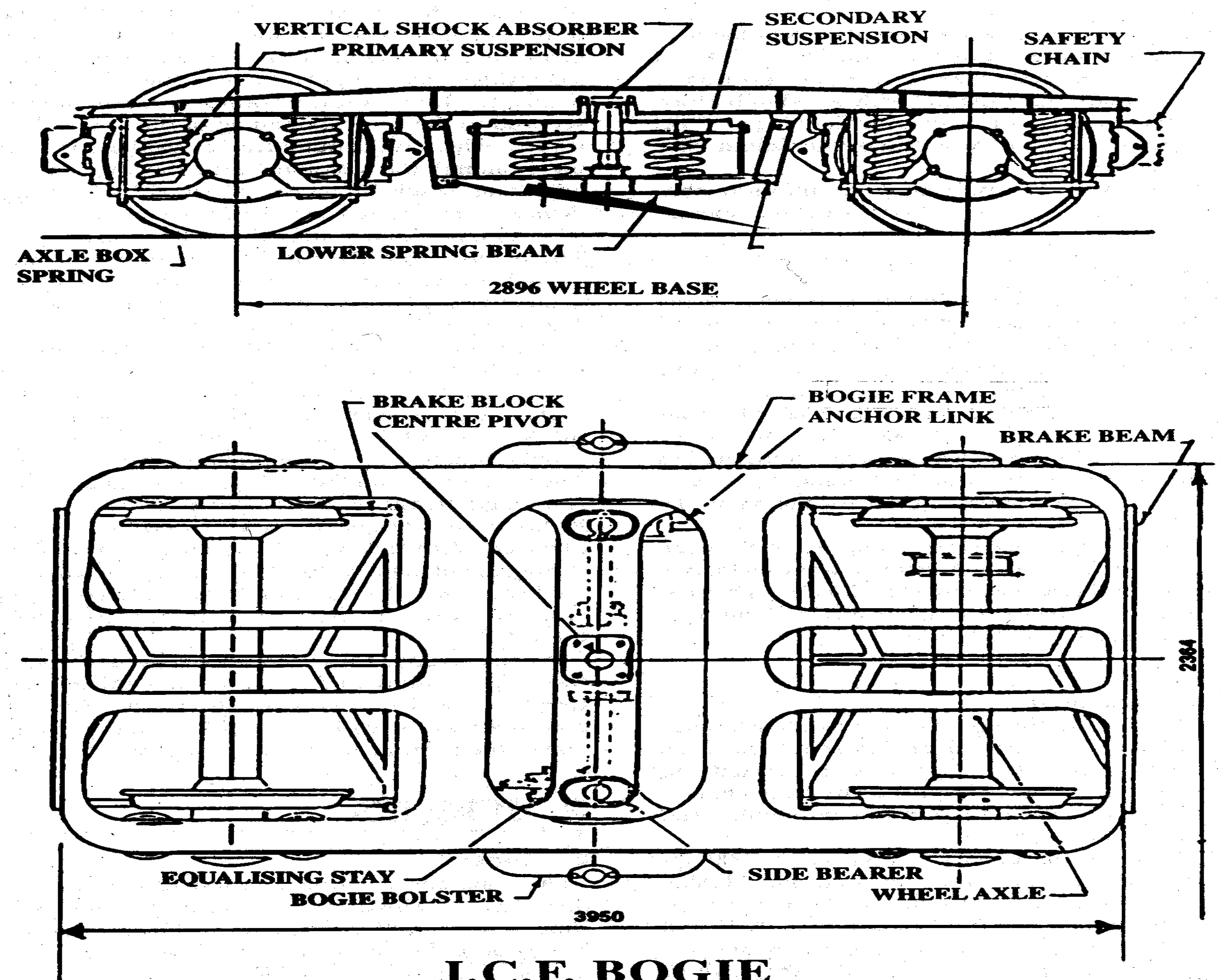
in collaboration with

M/S MAN Nurnberg (West Germany)

Introduction to Railway : Since 1958-59

Status: Productions abolished and use discontinued on Mail / express service having speed more than 105 KMPH.

ICF All Coiled Bogie



I.C.F. BOGIE

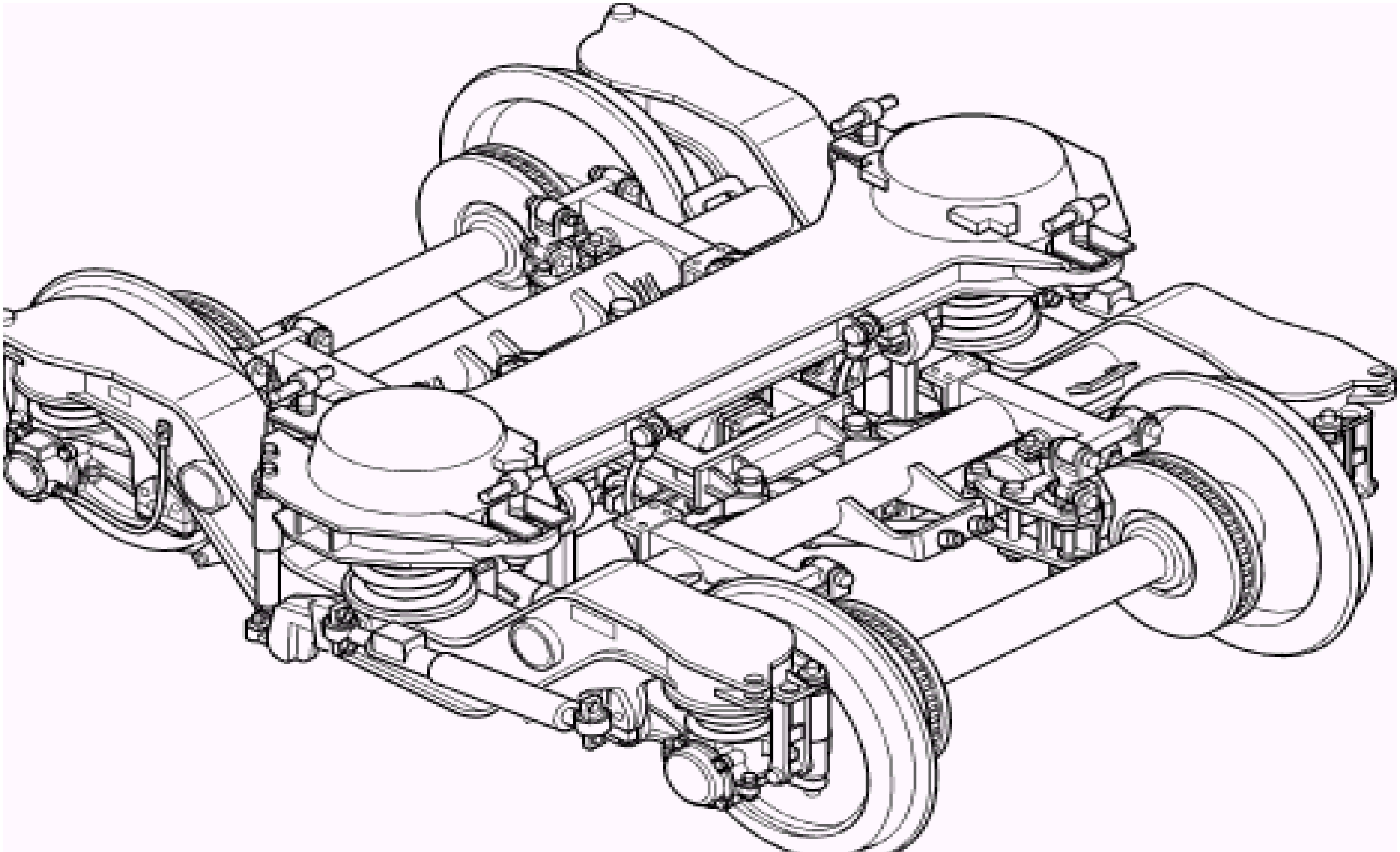
ICF All Coiled Bogie

Developed / Built by: ICF & RCF

Introduction to Railway : Since 1965

Status: Productions continue by ICF & RCF.

Fiat Bogie
(Similar to IR-20 Bogie)



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IR-20 Bogie

Developed / Built by: RCF

Introduction to Railway : Since 1998

Status: Used in few coaches and production abolished due to introduction of FIAT bogie.

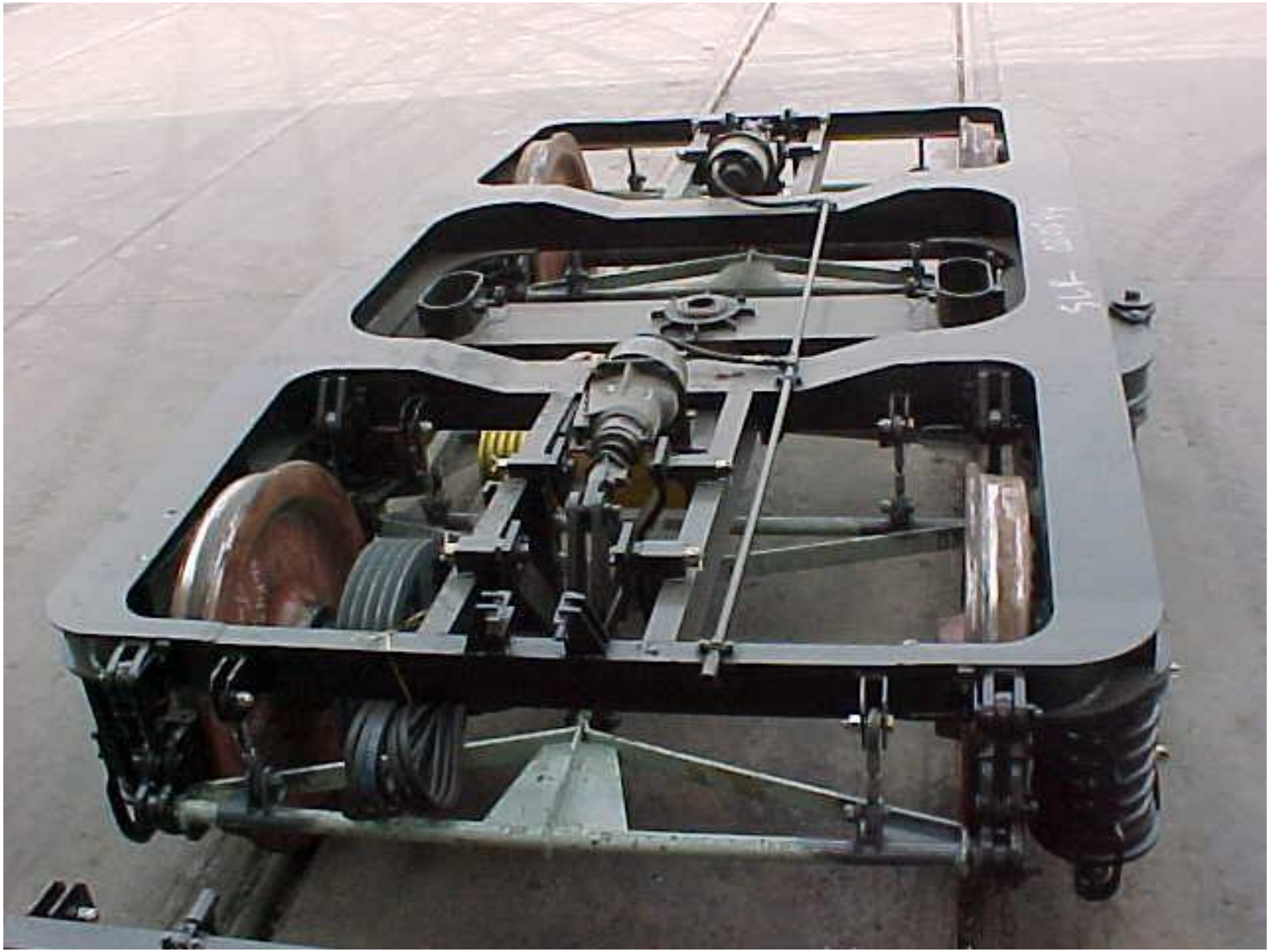
FIAT Bogie

Developed / Built by: **24 Coaches imported from Switzer land in 2000- 01.**

Introduction to Railway : **Since 2001**

Status: **Productions started in RCF.**

ICF BOGIE (Top View)



ICF BOGIE (Side View)

ICF Bogie

S. No.	Description	Parameters
1.	Maximum Axle load bearing capacity	16.25t, 13t
2.	Wheel base	2896mm
3.	Wheel diameter (New)	915mm
4.	Axle guidance	Telescopic axle guide with oil damping
5.	Primary suspension	Coil spring
6.	Secondary suspension	Coil spring
7.	Shock absorbers	i) Vertical dashpot in primary suspension. ii) Hydraulic double acting vertical shock absorber in secondary suspension.
8.	Transfer of coach body weight	Through bogie side bearer pitched at 1600mm.

ICF Bogie

- Manufactured by ICF/RCF
- Helical coil springs are used in both the primary and the secondary stages.
- The axle guide device provides viscous damping across primary springs while hydraulic dampers are provided across the secondary stage.

ICF Bogie

- Rigid axle box guide arrangement eliminates any longitudinal or transverse relative movement between the axles and the bogie frame.

- 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.

ICF Bogie

- Isolation of vibration is effected by rubber pads in primary and secondary suspension.

- The wheel sets are provided with self-aligning spherical roller bearings mounted in cast steel axle box housings.

ICF Bogie

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

ICF Bogie

- 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 standardised for both.

ICF Bogie

- Side-bearers consist of lubricated metal slides immersed in oil baths.

- The ends of the bogie bolsters rest on the bolster helical springs placed over the lower spring beam suspended from the bogie frame by the inclined swing links at an angle 7 degree.

ICF Bogie

- **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.

ICF Bogie

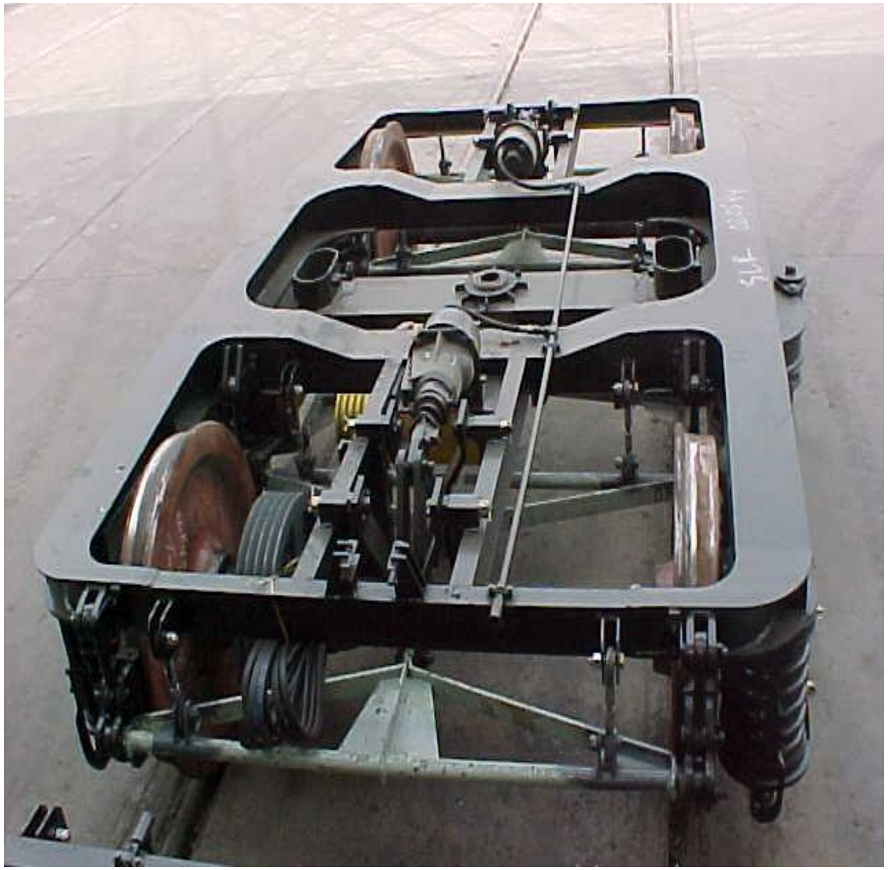
- The two anchor links diagonally positioned are provided with silent block bushes. The links prevent any relative movement between the bogie frame and coach body.

ICF

- **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 centralise the bogies with respect to the body and, to some extent, control and damp the angular oscillations of the bogies.

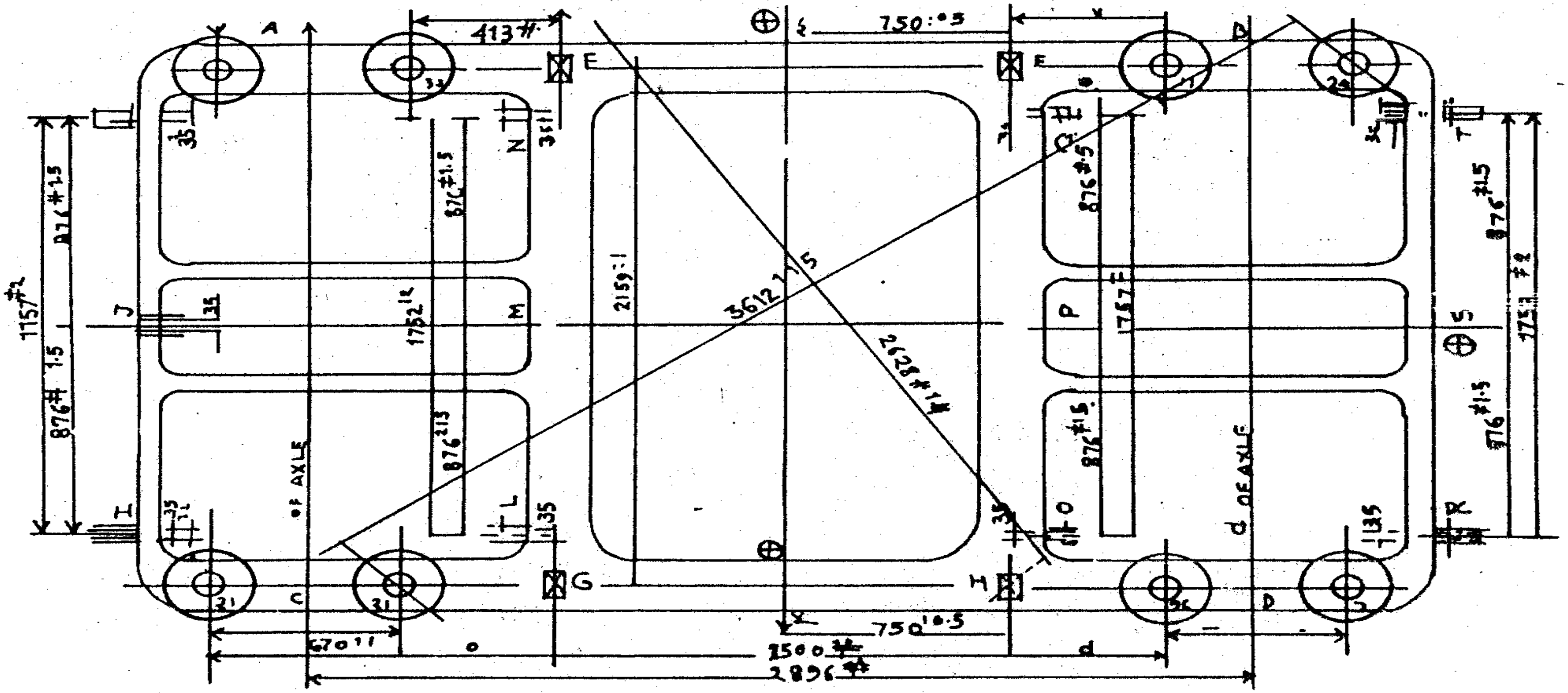
Bogie Frame



Bogie Frame

- All welded light weight construction.

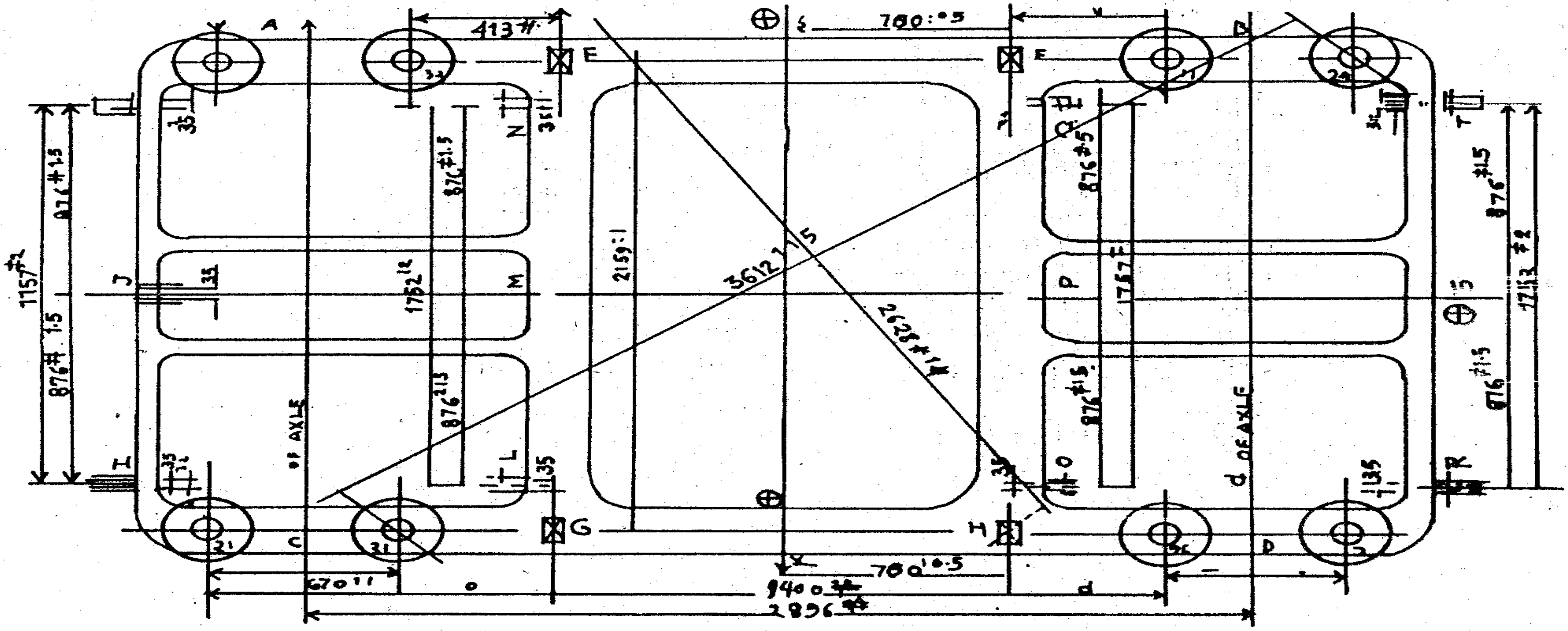
Bogie Frame



DIMENSIONAL CHECK REPORT

FOR AC- AND POWER CAR BOGIE FRAME

1. SOLEBAR & HEAD STOCK CENTRES OF BOGIE FRAME WILL BE PERMANENTLY PUNCH MARKED IN CONSPICUOUS MANNER.
2. REPRESENTS LOCATION OF AXLE GUIDES.
3. RIPRESENTS LOCA TION OF BOLSTER SPRINGS SUSPENSION BRACKET.
4. BOLSTER SPRING SUSPENSION BRACKET PIN HOLES E,F,G,H, SHALL BE LOCATED AT 750 + 0.5 mm FROM THE TRANSVERSE CENTRE LINE PUNCH MARKS ON SOLEBAR & CHECK IF.
5. WELDING JOINT SHALL NOT COME UNDER THE AXLE GUIDE.



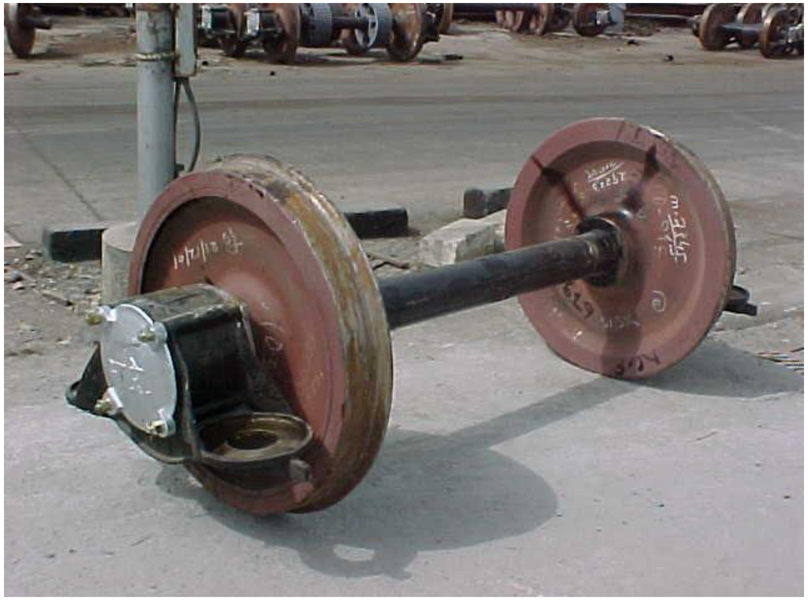
DIMENSINAL CHECK REPORT

FOR NON AC BOGIE FRAME

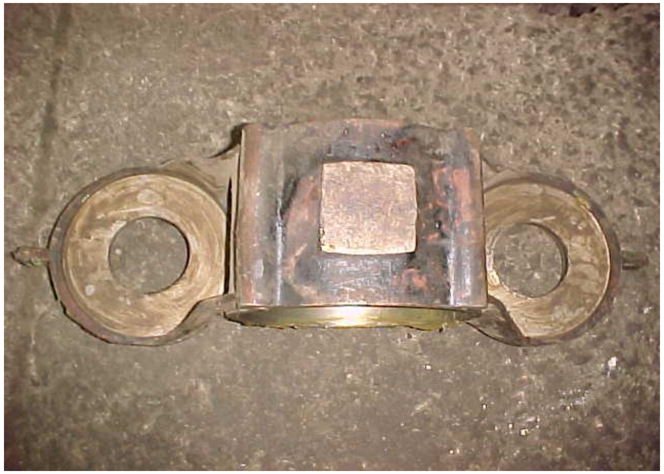
1. SOLEBAR & HEAD STOCK CENTRE OF BOGIE FRAME WILL BE PERMANENTLY PUNCH MARKED IN CONSPICUOUS MANNER.
2. REPRESENTS LOCATION OF AXLE GUIDES.
3. REPRESENTS LOCA TION OF BOLSTER SPRINGS SUSPENSION BRACKET.
4. BOLSTER SPRING SUSPENSION BRACKET PIN HOLES E,F,G,H, SHALL BE LOCATED AT 700 + 0.5 mm FROM THE TRANSVERSE CENTRE LINE PUNCH MARKS ON SOLEBAR & CHECK IF.
5. WELDING JOINT SHALL NOT COME UNDER THE AXLE GUIDE.
6. NO INACCURACY IN ALLIGNMENT OF HOLES IN THE BRACKETS WILL BE PERMITTED.

Suggested BSS bracket and axle guide alignment gauges	**13t bogies**	**16.25t bogies**
Longitudinal gauge for BSS brackets	**1400±1.0 mm** (**700±0.5 mm** from longitudinal center-line)	**1500±1.0 mm (750±0.5 mm** from longitudinal center-line)
Transverse gauge for BSS brackets	**2159 ±1.0 mm**	**2159 ± 1.0 mm**
Diagonal gauge for BSS brackets	**2573 ±1.0 mm**	**2629 ± 1.0 mm**
Longitudinal gauge for axle guide	**570±1.0 mm** (equidistant from center-line of axle)	**570 ± 1.0 mm** (equidistant from center-line of axle)
Transverse gauge for axle guide	**2159±1.0 mm**	**2159±1.0 mm**
Diagonal gauge for axle guide	**3612±1.0 mm**	**3612±1.0 mm**
Distance between BSS bracket and adjacent axle guide	**463±1.0 mm**	**413±1.0 mm**
Longitudinal gauge for suspension strap	**870±1.0 mm** (equidistant **from center-line of axle)**	**870±1.0mm** (equidistant from center-line of the axle)

Wheel & Axle



Axle Box Housing

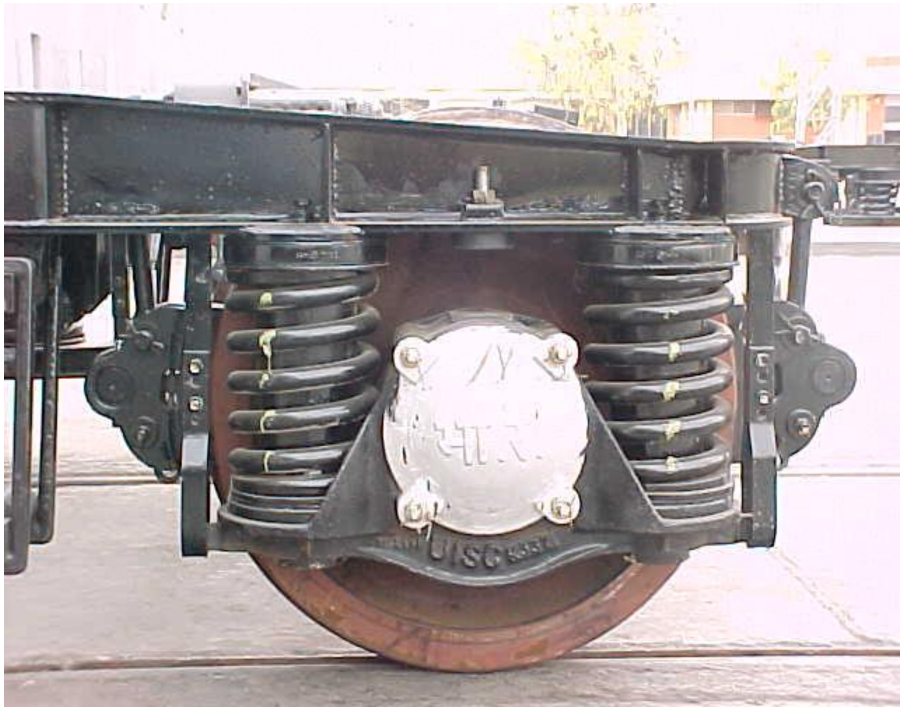


Roller Bearing

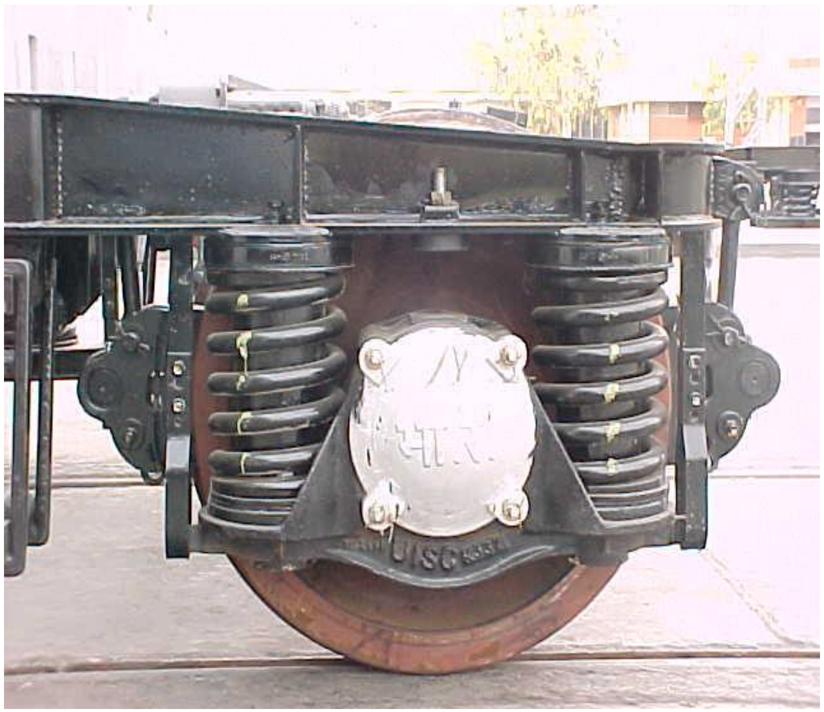
Wheel & Axle

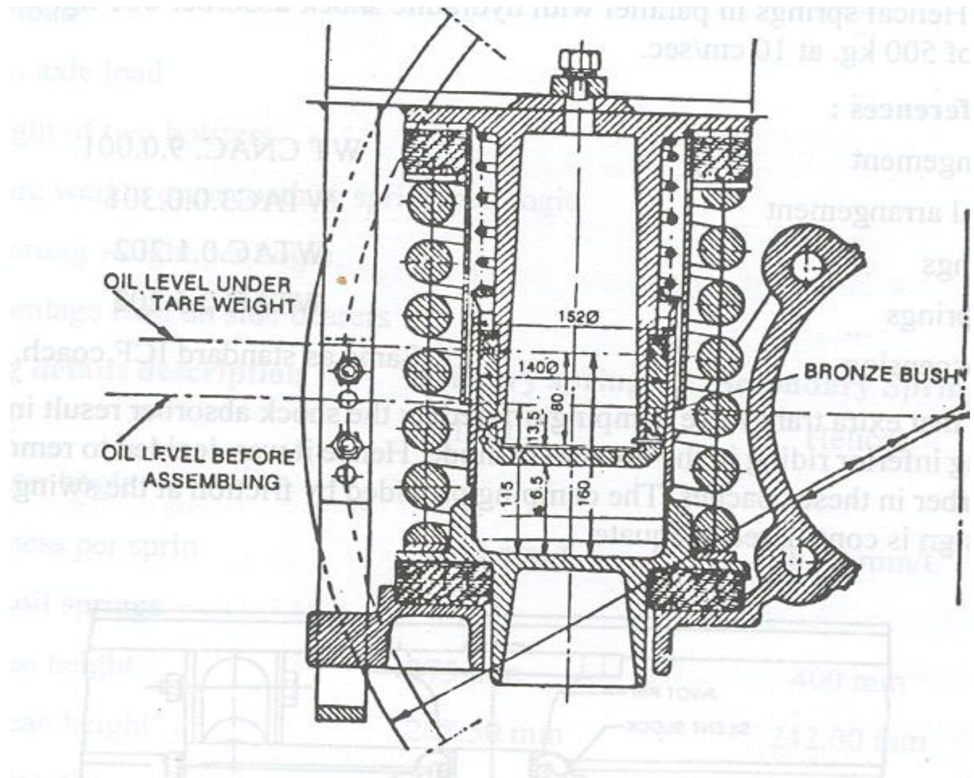
- Axles are located on the bogie by telescopic dash pot and axle guide assemblies.

Axle Box Spring

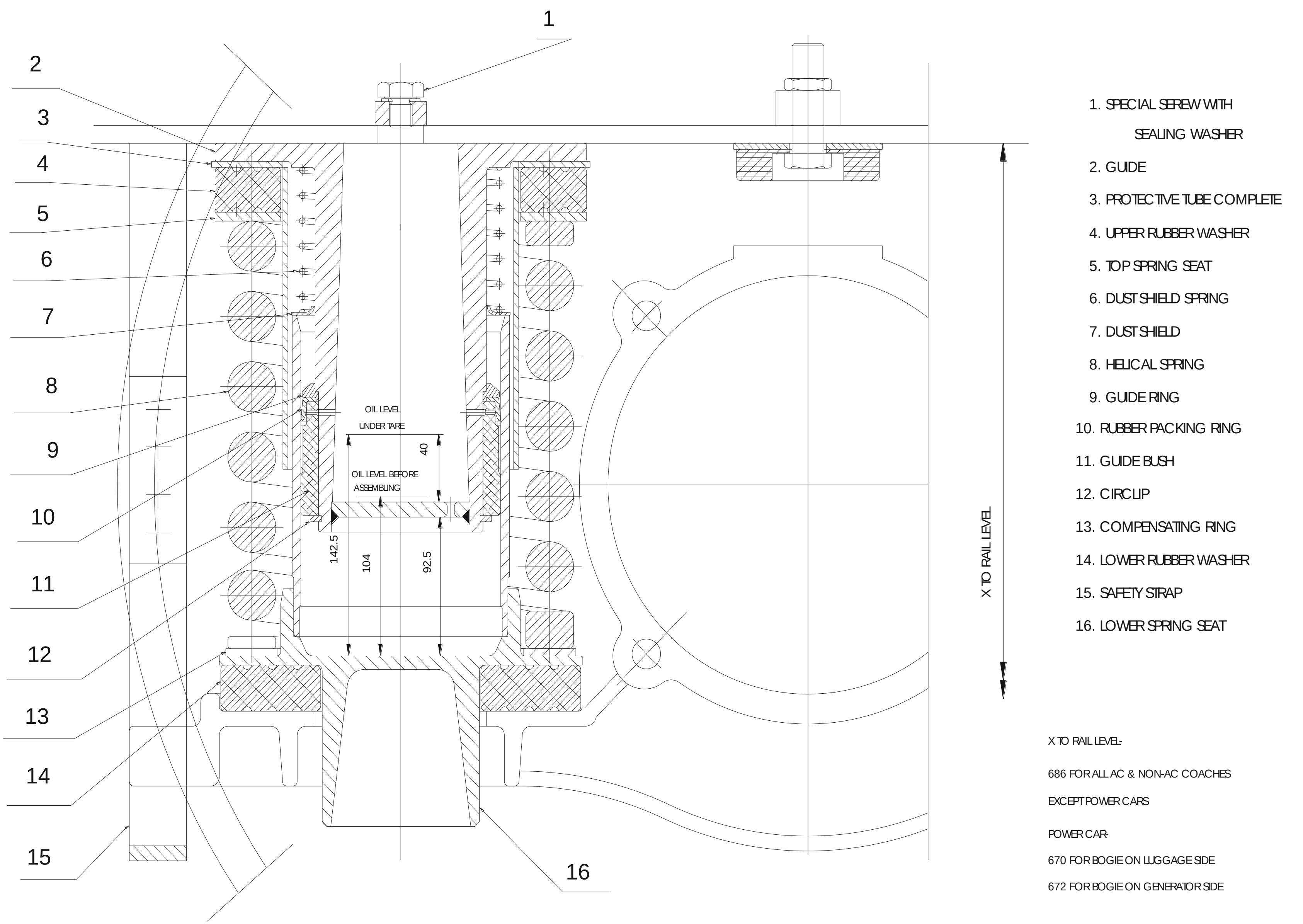
 

Dashpots and Axle Guide Assembles





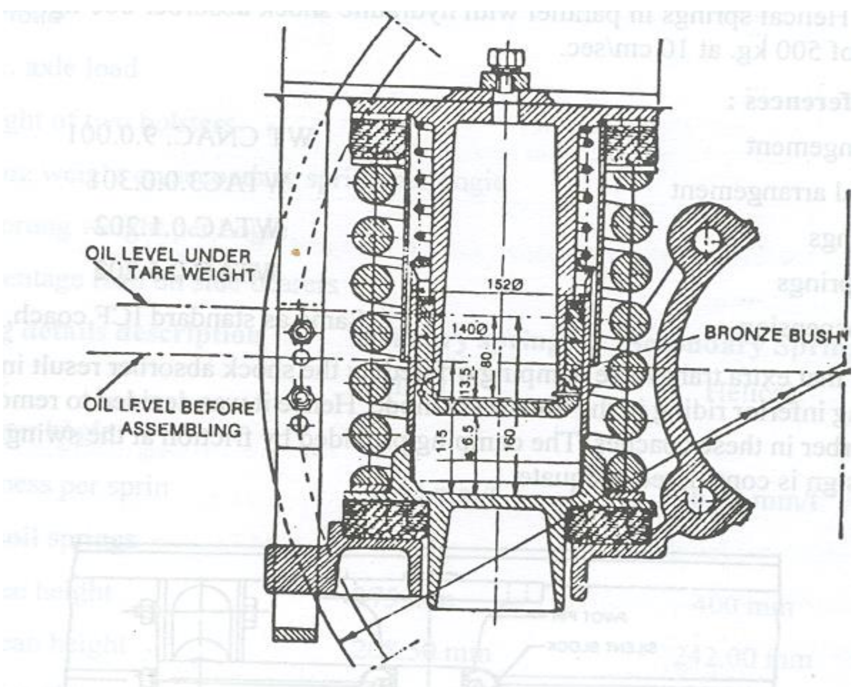
Axle Box Guide Arrangement of ICF All Coil Bogie



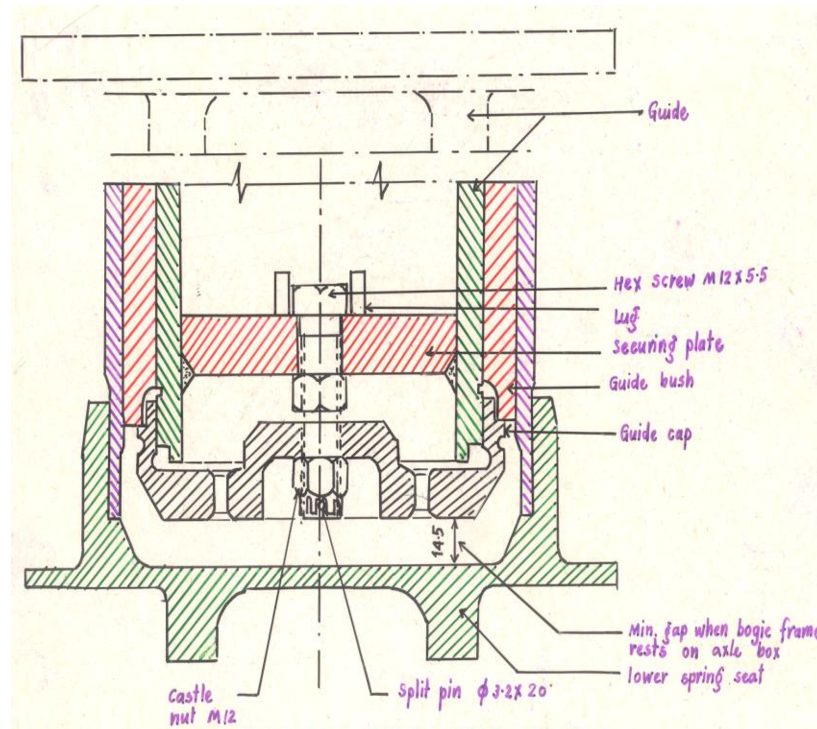
MODIFIED AXLE BOX GUIDE ARRANGEMENT

Figure 3.2a

Dashpots and Axle Guide Assembles

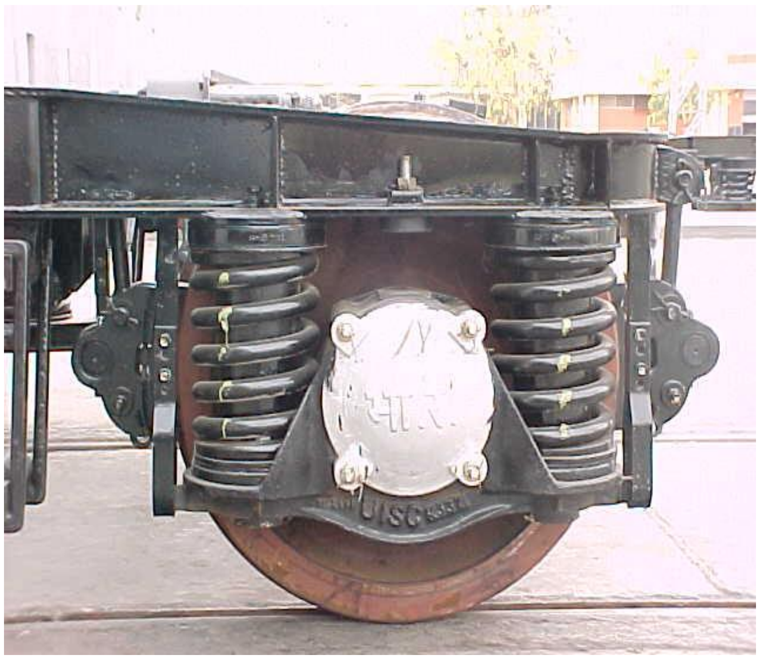


Axle Box Guide Arrangement of ICF All Coil Bogie



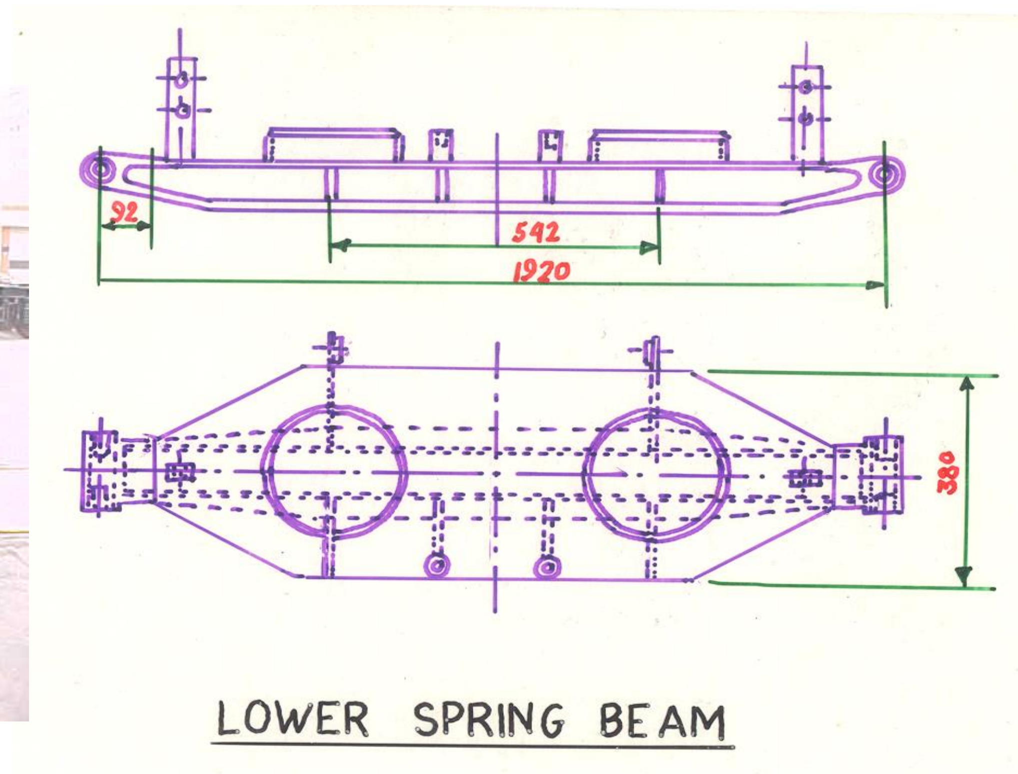
METHOD OF SECURING GUIDE CAP TO THE AXLE GUIDE

Dashpots and Axle Guide Assembles



Bolster Springs

Lower Spring Beam / Seat



Drawing code of springs for ICF BG coaches (Reference RDSO Amendment slip no. 5 of September 2001 to STR WD-01-HLs- 94 (Rev.1 May 95)

<table>
<tr><th>Type of spring</th><th>Type of bogies</th><th>ICF Drg. No</th><th>Drg. Code No.</th></tr>
<tr><td rowspan="6">Axle box</td><td>All Non AC ICF type</td><td>F-0-1-006</td><td>A01</td></tr>
<tr><td>All AC ICF type</td><td>WTAC-0-1-202</td><td>A03</td></tr>
<tr><td>Power car</td><td>WLRRM2-0-1-202</td><td>A04</td></tr>
<tr><td>Double decker</td><td>DD-0-1-001</td><td>A06</td></tr>
<tr><td>High capacity Power Car</td><td>WLRRM8-0-1-802</td><td>A09</td></tr>
<tr><td>High capacity parcel van</td><td>RDSO /SK-98017</td><td>A10</td></tr>
<tr><td rowspan="4">Bolster</td><td>All Non AC ICF type</td><td>F-0-5-002</td><td>B01</td></tr>
<tr><td>All AC ICF type</td><td>WTAC-0-5-202</td><td>B03</td></tr>
<tr><td>Power car</td><td>WLRRM2-0-5-202</td><td>B04</td></tr>
<tr><td>Double decker</td><td>DD-0-5-003</td><td>B06</td></tr>
<tr><td rowspan="4">Bolster</td><td rowspan="2">High capacity Power car</td><td rowspan="2">WLRRM8-0-5-802</td><td>B11</td></tr>
<tr><td>B13</td></tr>
<tr><td rowspan="2">High capacity Parcel van</td><td rowspan="2">RDSO /SK-98018</td><td>B15</td></tr>
<tr><td>B16</td></tr>
</table>

Load deflection testing and grouping of Axle box spring (B.G Main line coaches)

Code	Wire dia	Free height	Test Load	Acceptable height under test load	Groups as per loaded spring height		
					A	B	C
					Yellow	Oxford Blue*	Green
A01	33.5	360	2000	279-295	279-284	285-289	290-295
A03	33.5	375	2800	264-282	264-269	270-275	276-282
A04	35	372	3000	265-282	265-270	271-276	277-282
A06	36	337	2400	269-284	269-273	274-279	280-284
A09	37	360	3000	277-293	277-282	283-288	289-293
A10	39	315	1800	276-289	276-279	280-284	285-289

Load deflection testing and grouping of Bolster spring (B.G Main line coaches)

Code	Wire dia	Free height	Test Load	Acceptable height under test load	Groups as per loaded spring height		
					A	B	C
					Yellow	Oxford Blue #	Green
B01	42	385	3300	301-317	301-305	306-311	312-317
B03	42	400	4800	291-308	291-296	297-303	304-308
B04	47	400	6100	286-304	286-291	292-297	298-304
B06	36	416	4200	280-299	280-286	287-292	293-299
B11	47	386	6700	306-322	306-311	312-317	318-322
B13	34						
B15	40	393	6000	256-272	256-261	262-267	268-272
B16	32.5	286					

Shock absorbers

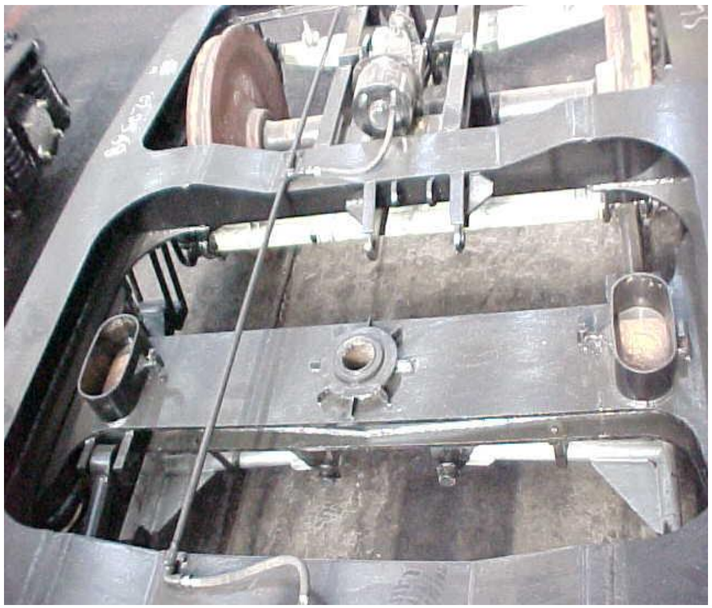
Equalising stays

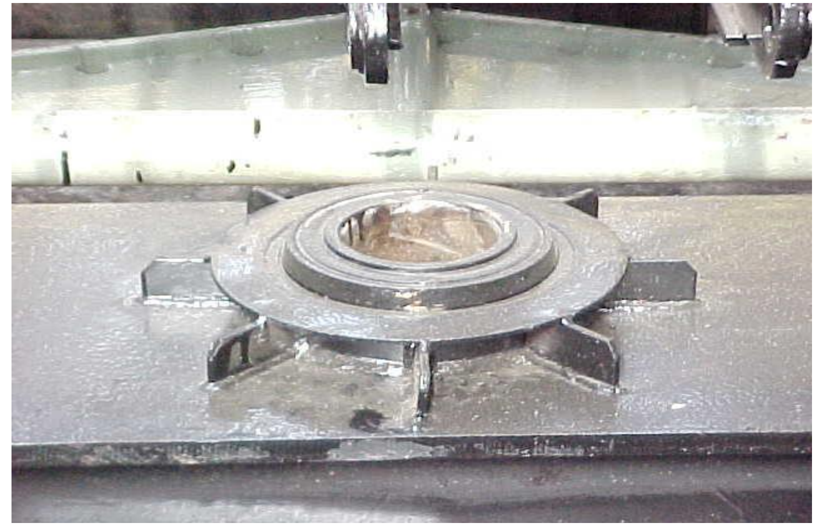
 

Equalising stays

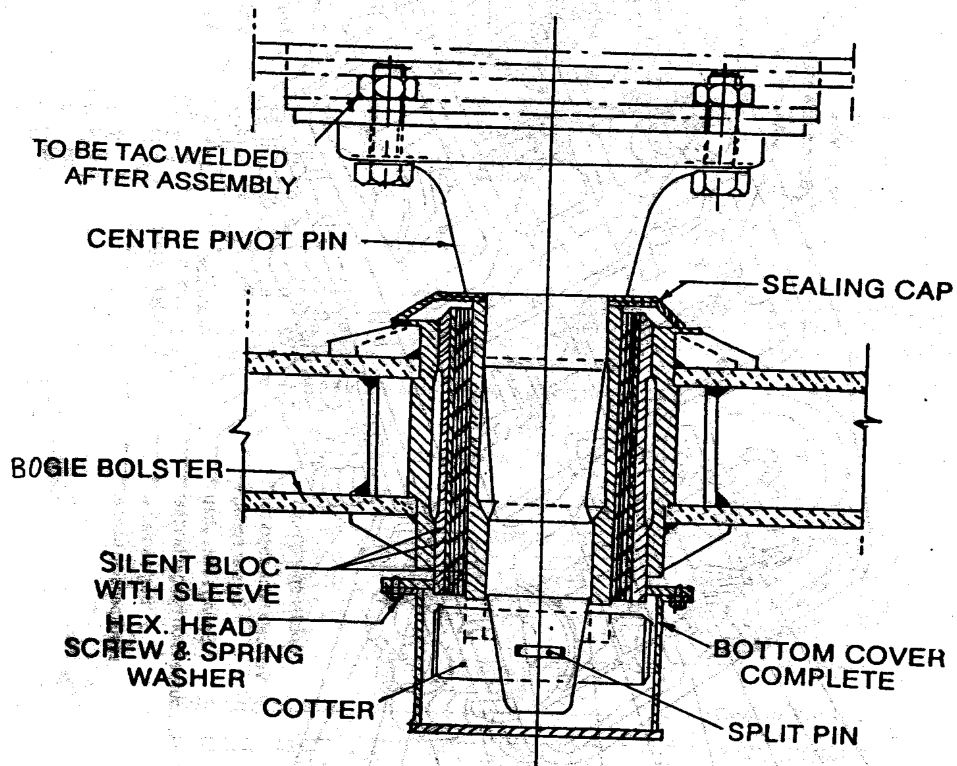
- Provided on bogies between the lower spring plank and the bolster
- To prevent lateral thrust on the bolster springs which have not been designed to take the lateral forces.
- Pin connections at both ends to swivel freely.

Centre Pivot



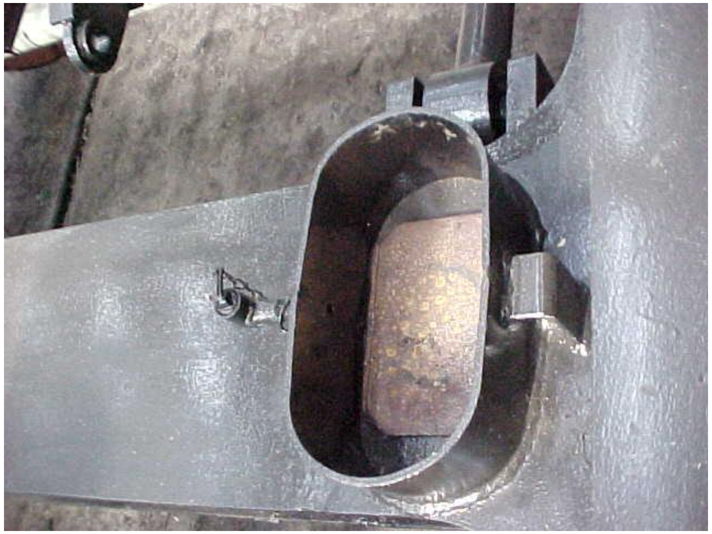


Centre Pivot



Centre Pivot Arrangement (ICF Bogie)

Side Bearers



Side Bearer

- Consists of a machined steel wearing plate immersed in an oil bath
- Floating bronze-wearing piece with a spherical top surface kept in it
- 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.

Side Bearer

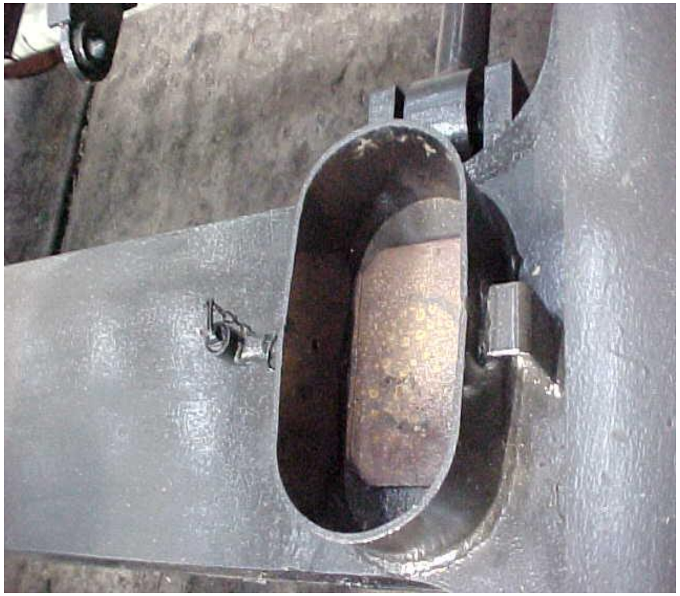
Wear limit for wearing plate

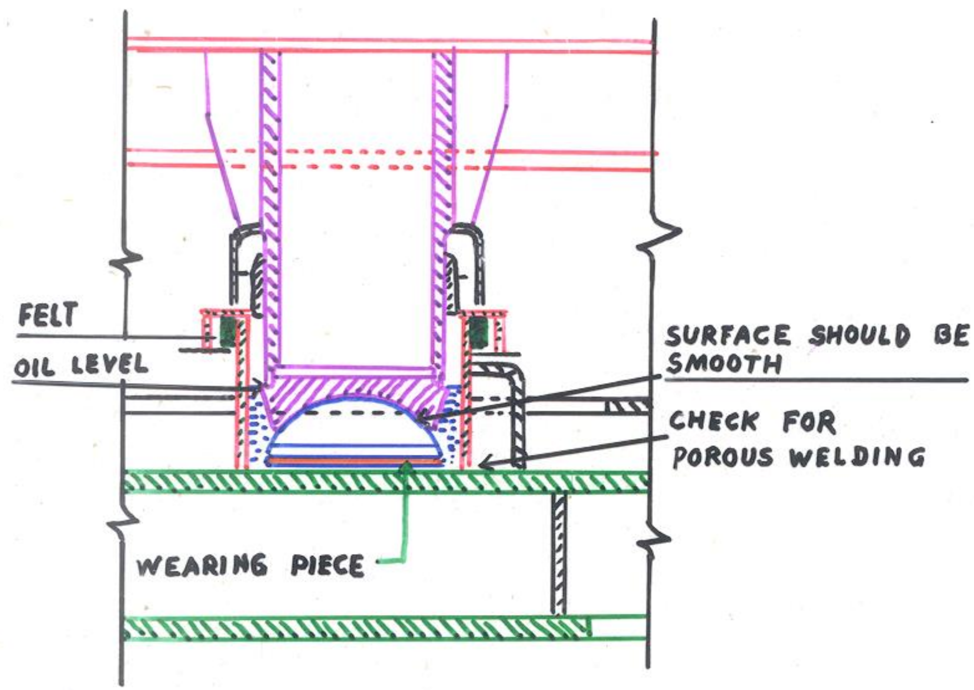
New size	Shop renewal size	Condemning size
10 mm	9 mm	8.5 mm

Wear limit for wearing piece

New size	Shop renewal size	Condemning size
45 mm	43.5 mm	42 mm

Side Bearers





- Bronze wearing piece need renewal when height is less than 42 mm
- Hard ground plate should be renewed when the wear exceeds 1·5 mm.

Side Bearer

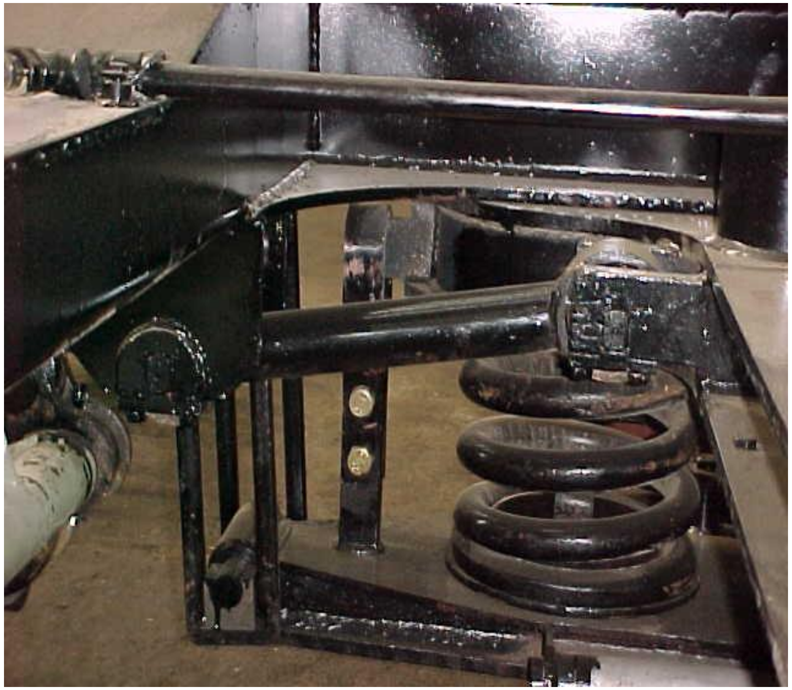
Quantity of oil in Side bearer oil-bath (Each):

2 litres

Approved brands of oils.

- Servoline – 100 of IOC
- Yantrol – 100 of HPC
- Bharat univol – 100 of BPC

Anchor Links



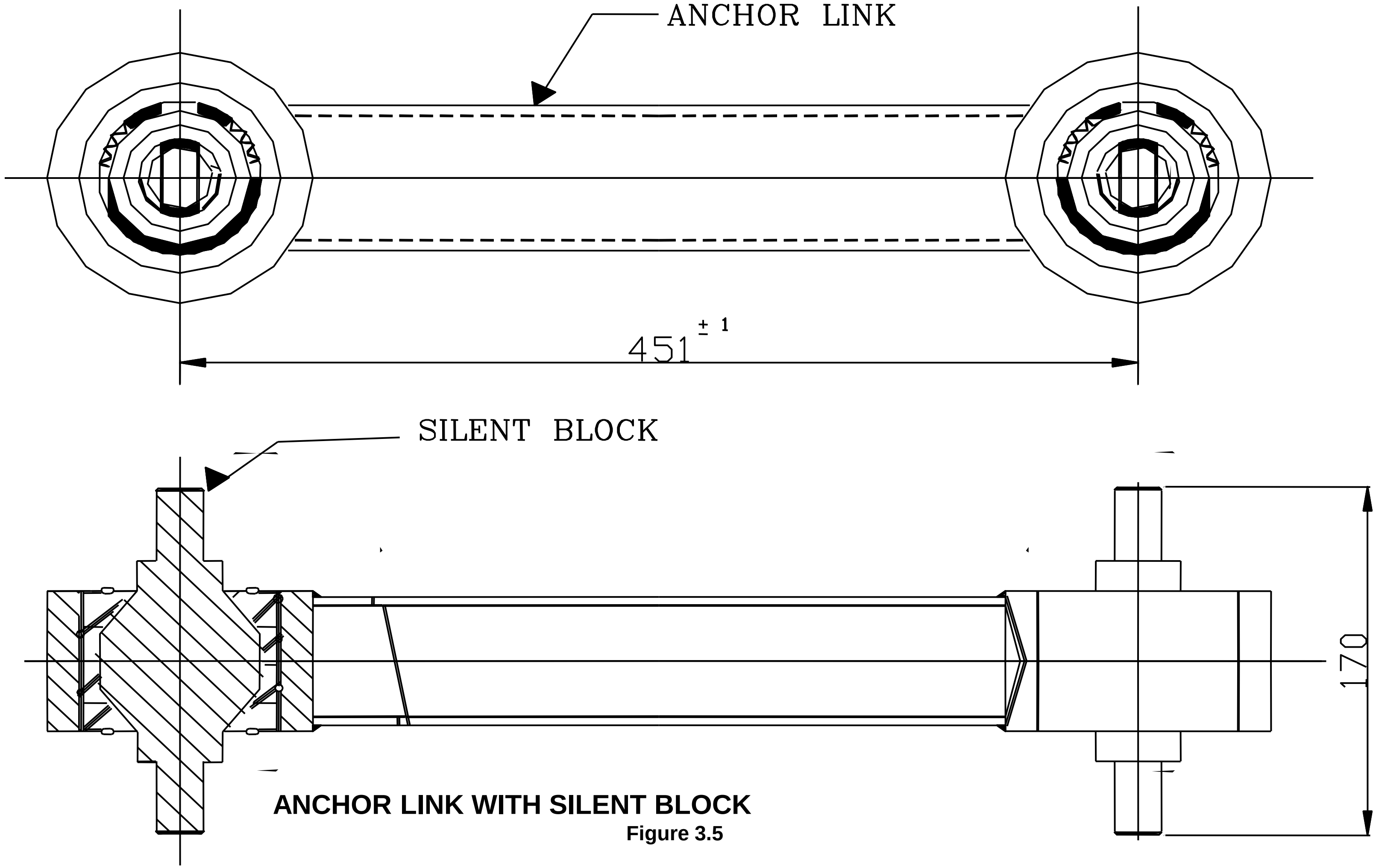
Anchor links

- Pin connection to the Bolster sides and the Bogie Transoms.
- Can swivel universally to permit the bolster to rise and fall and sway side wards.
- One anchor link is provided on each side of the bolster diagonally across.
- Fitted with silent block bushes

Anchor link

- To hold in position longitudinally the floating bogie bolster
- To design to take the tractive and braking forces.

Anchor link

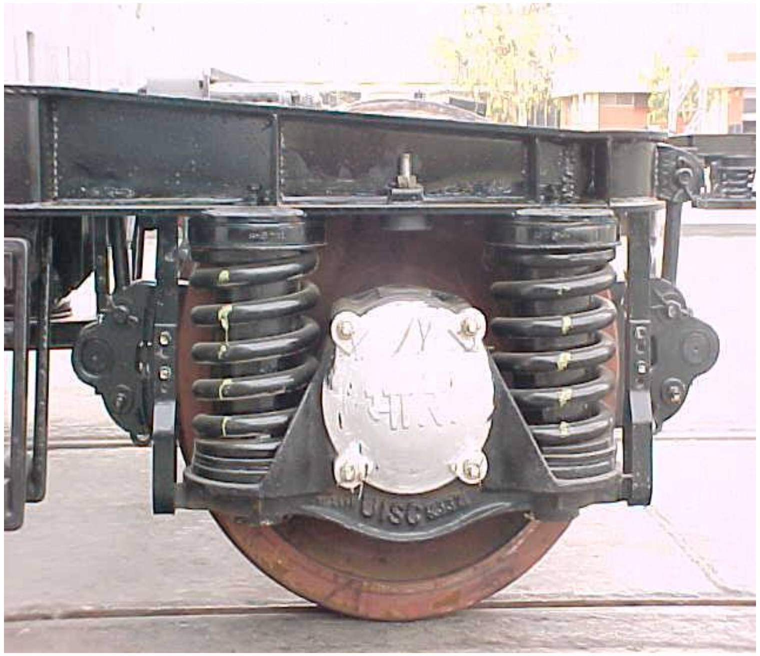


ANCHOR LINK WITH SILENT BLOCK

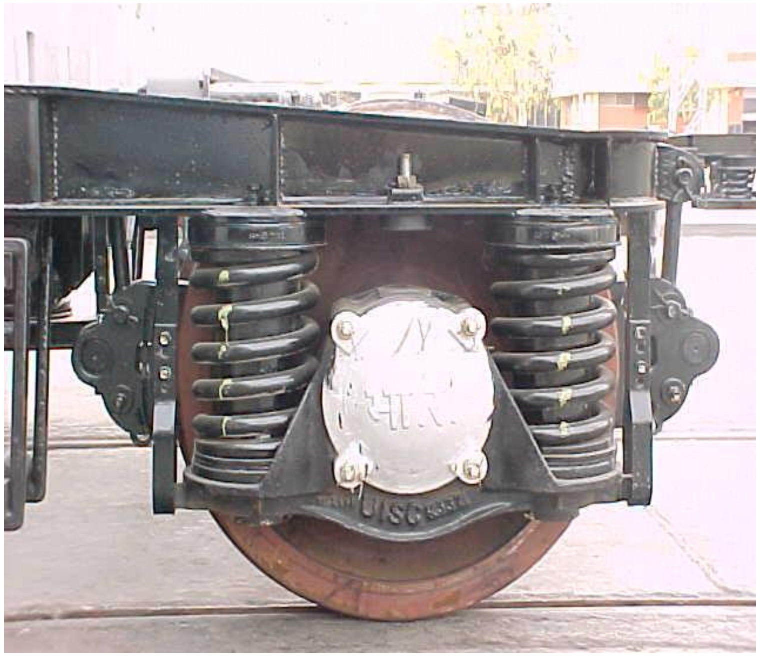
Figure 3.5

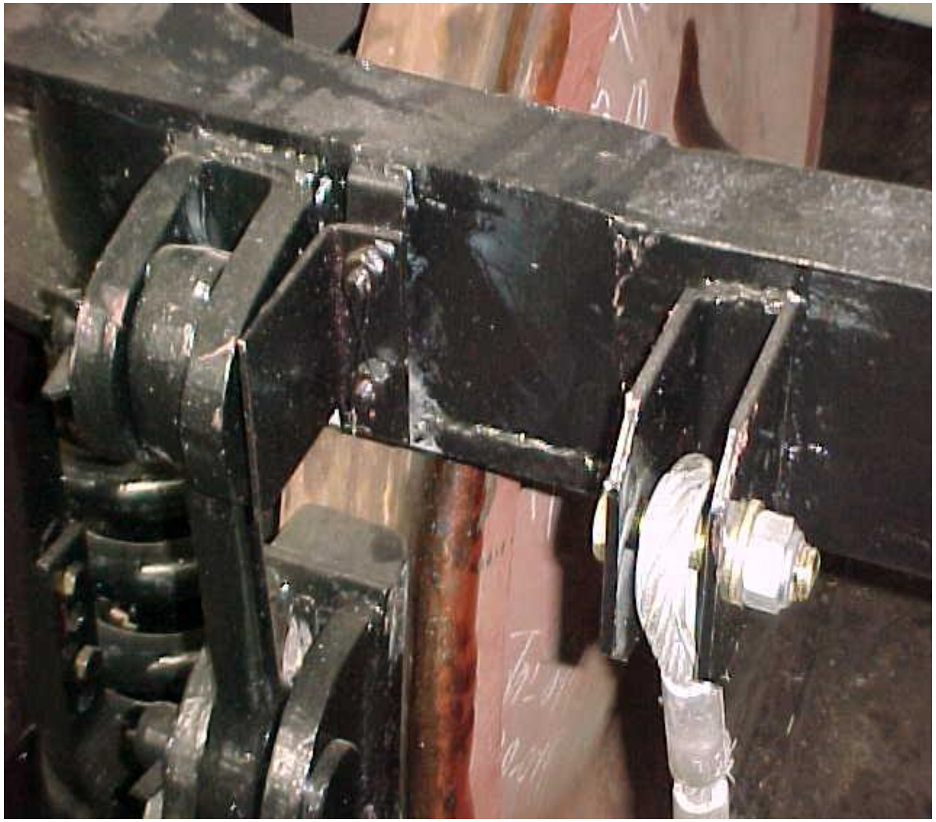
Hanger and Hanger Blocks

Axle Box safety Strap



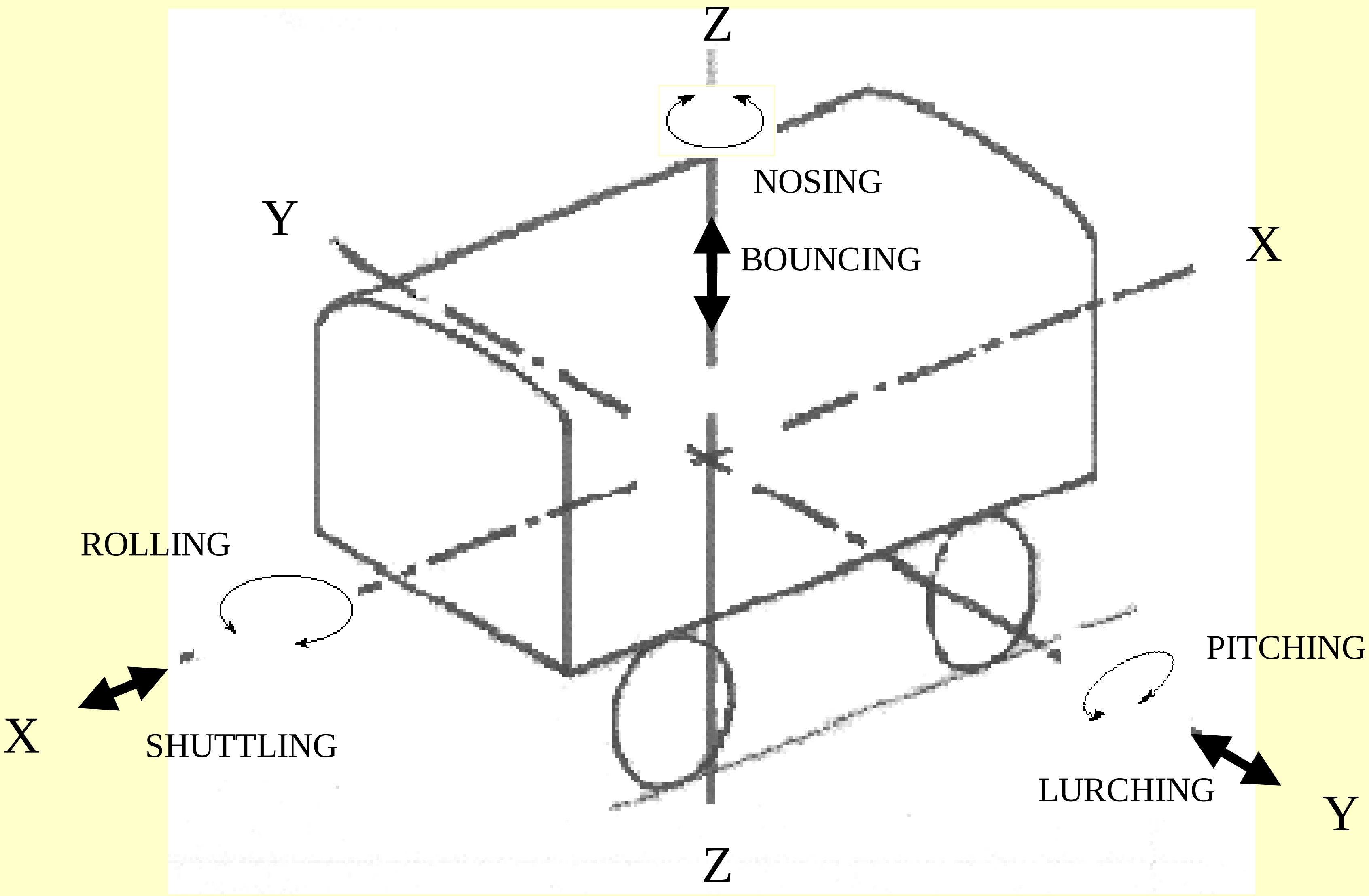
Hanger Pin Safety Stopper





Oscillation modes of vehicles

There are six modes of oscillations:



Limitations of ICF bogie Design

- Longitudinal and transverse flexibilities of the axle guidance cannot be optimised independently as generally required for high-speed bogies.

- There are vertical space constraints to accommodate desirably softer secondary suspension springs and the consequent dynamic movements of the bogie bolster and coach body, as also to increase the length of the swing hangers.

Limitations of ICF bogie Design

- **Friction damping in the transverse suspension is neither amenable to optimisation nor the same can be controlled during service.**

- **Headstocks increase the yaw inertia of the bogie frame and thereby influence the tendency for hunting.**

- **A large wheelbase, as that of ICF bogie, affects curvability and there by increases wheel flange wear.**

Failure

Any part or assembly is considered to have failed when any of three conditions takes place-

- **When it becomes completely inoperable.**
- **When it is still operable but no longer able to perform its intended functions satisfactorily.**
- **When serious detoriation has been made it unreliable and unsafe for continued use.**

Fundamental source of failure

- Deficiencies in design
- Deficiencies in selection of material
- Imperfection of material
- Deficiencies in processing
- Errors in assembly
- Improper service condition
- Improper maintenance

Brake Shoe head

- **In order to fit the brake block snugly in the brake head to avoid any movement between them.**
- **To avoid excessive wear at the ends of the brake head.**

Brake shoe key

- **In order to fit the brake block snugly in the brake head to avoid any movement between them.**

Safety wire rope

- The old arrangement of safety straps is reported to be falling in service due to ballast hitting.
- To improve the safety of brake beam falling on the track safety wire rope introduced.

Brake block hanger

- To avoid brake block climbing over the wheel in case of fully worn out wheels.

Standardization of equalizing stay

- The old equalizing stay had a pin dia of 25 mm. The longer pin is found to be bending in service resulting in removal difficulties.
- In the standardized equalizing stay the dia of pin has been increased to 31 mm.

Pin for brake lever hanger

- To avoid slipping of nylon bush in the lever hanger a washer is welded.

- Castle nut with split pin introduced.

Improved brake beam

- The old brake beam does not cater to the load requirement of air braked coaches and it also bends under extra loads.

Single piece brake block hanger

- **Single piece design will avoid misalignment of brake block with respect to wheel tread.**

Revised side buffer casing

- **To avoid cracks developing from the bolt holes in the U/frame headstock.**
- **Horizontal pitch for bolt holes has been increased from 254 mm to 349 mm.**
- **Vertical pitch for bolt holes has been increased from 127 mm to 170 mm.**

Provision of locking arrangement for guide cap

- To avoid falling of guide cap due to breakage of spring clip.

Rubber stopper axle box crown bolt

- To prevent the breakage of axle box crown hexagonal bolt assembly in service.
- The hexagonal head bolt is prevented from hitting directly. Instead the rubber stopper will be hitting the crown.

Weld joint of bogie side frame with head stock

- The side frame head stock joint below guide in the old design was undesirable as the joint leads to misalignment of guides.
- Shifted to headstock beyond brake hanger brackets.

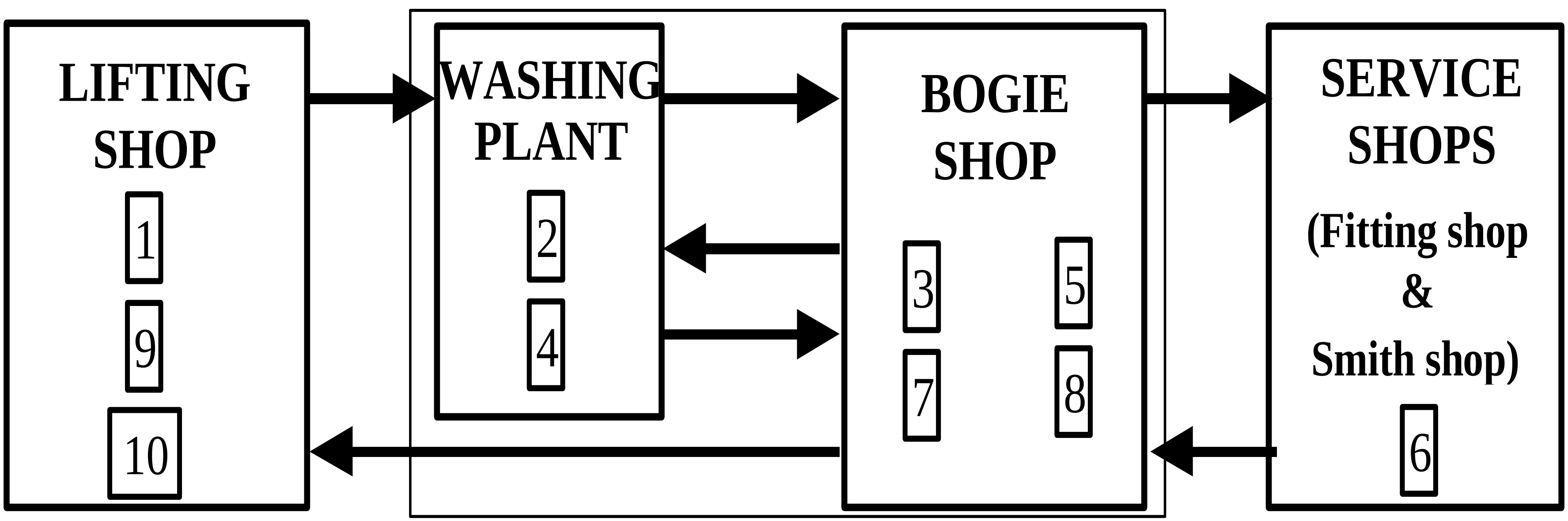
Slack adjuster articulation

- To provide freedom of rotation in horizontal plane an additional pin joint has been provided.
- Freedom of rotation in vertical plane is also ensured at the floating lever end.
- This arrangement is expected to minimize the incidence of slack adjuster spring breakages.

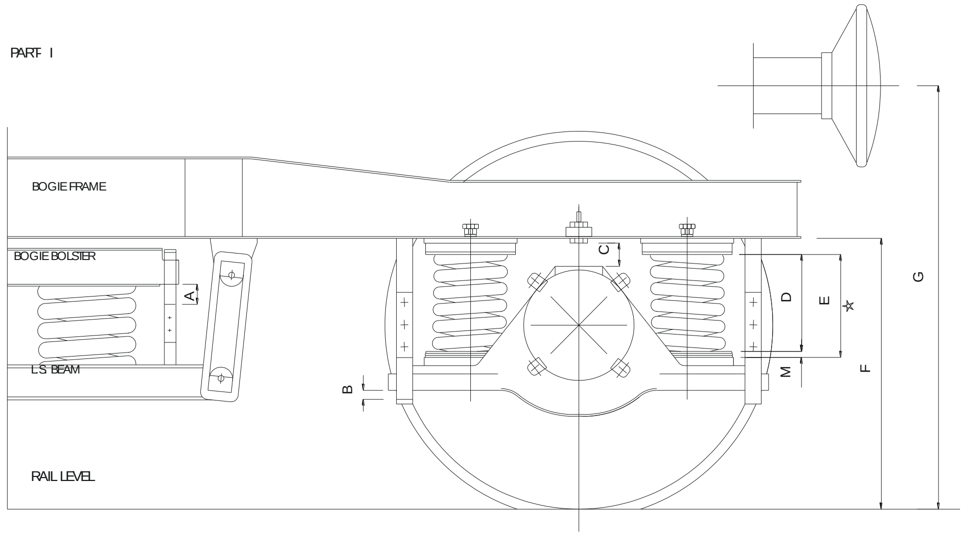
Workshop Activities

1. Coach lifting
2. Bogie cleaning
3. Bogie dismantling
4. Component cleaning
5. Attention to components
6. Repair of components
7. Bogie assembly
8. Load testing and adjustment
9. Lowering of coach
10. Final adjustment

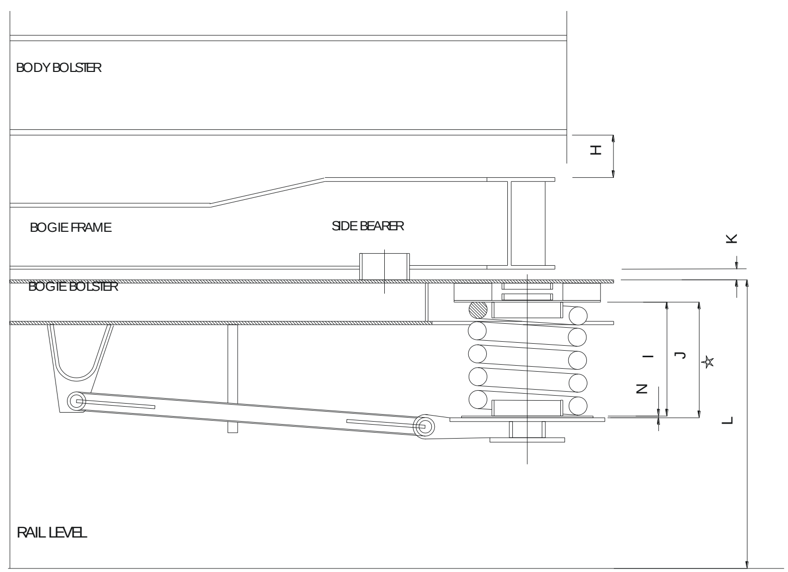
Workshop Maintenance of ICF Bogie- Flow diagram



PART - I



PART - II



NOTE - P1. Dimensions E & J shall be maintained with required number of compensating rings of standard thickness of 4 mm.P2. Axle box springs : WTAC -0-1-202P Bolster springs : WTAC -0-5-202

☆

2

2

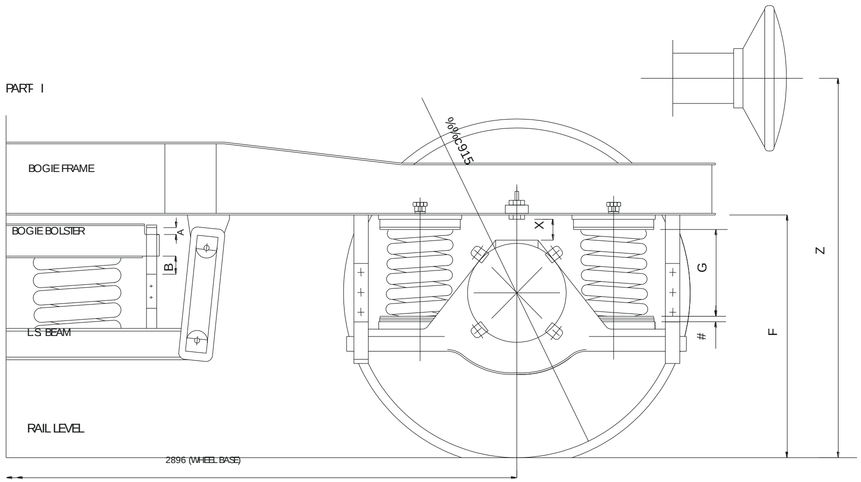
SUSPENSION DIAGRAMMATIC ARRANGEMENT

FOR SELF GENERATING AC COACHES (ICF DRAWING NO. ICF/SK -9-0-126)P

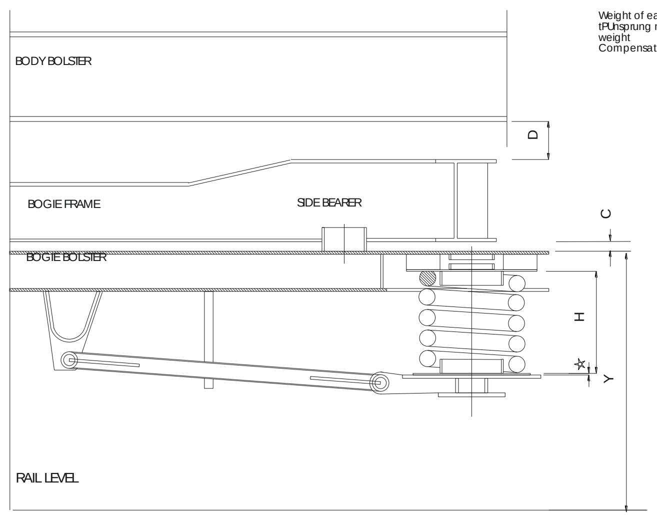
2

FIGURE 1.4a

PART- I



PART- II



Weight of each bogie = 5.9 tPUnsprung mass/bogie = 3.2 tPBolster weight = 0.4 tPC.R = Compensating ring

NOTE - P1. Dimensions A & B marked should be ensured less than dimensions C & D marked respectively.P2. # CR to drawing No.-CC01140 to be provided.P3. * CR to drawing No. - CC05251 to be provided.P4. 'F' the variation in all the four bogie corner heights must be less than or equal to 10 mm.P5. Drawing No. SG90002, SZ90004, SE90011, LB90002 are superseded by this drawing.P6. The height of Axle box spring and bolster spring in tare & gross conditions is for reference only.P7. The requirement of CRs as shown in the columns for primary & 30 mm in secondary suspension.P8. Only blue bend springs both in primary and secondary stage are to be used in postal van coach.

SUSPENSION DIAGRAMMATIC ARRANGEMENT

FOR NON AC COACHES (RCF DRAWING NO. CC90019)P

FIGURE 1.4c

Check List

Type of coach	Tare weight of coach	Normal pay load	Total pay load	Bogie frame bolster clearance		Body bogie clearance		Crown clearance	
AC	In tonnes	In tonnes	In tonnes	B dimension		C Dimension		A Dimension	
				Tare	Gross	Tare	Gross	Tare	Gross
ACCW (EOG)	44.8	3.68	3.68	40±5	50±5	70±3	60±3	28±3	20±3
ACCW (SG)	49.1	3.68	3.68	40±5	50±5	70±3	60±3	30±3	22±3
ACCN (EOG)	48.3	5.12	5.12	40±5	54±5	70±3	56±3	34±3	22±3
ACCN (SG)	52.53	5.12	5.12	40±5	53±5	70±3	57±3	35±3	23±3
ACCZ (EOG)	43.1	5.36	5.36	40±5	54±5	70±3	56±3	32±3	20±3

Check List

Type of coach	Tare weight of coach	Normal pay load	Total pay load	Test load per bogie		Bogie frame bolster clearance		Body bogie clearance		Crown clearance	
AC	In tonnes	In tonnes	In tonnes	Under tare	Under Gross	B dimension		C Dimension		A Dimension	
				In tonnes	In tonnes	Tare	Gross	Tare	Gross	Tare	Gross
ACCZ (SG)	46.83	5.84	5.84	17.22	20.14	40±5	56±5	70±3	54±3	35±3	22±3
FACZ (EOG)	42.6	3.68	3.68	15.10	16.94	40±5	50±5	70±3	60±3	27±3	19±3
RA (NON AC)	41.3	1.20	1.20	14.45	14.05	40±5	44±5	70±3	66±3	20±3	17±3
VP (HIGH CAPACITY)	32	23	23	9.8	21.3	40±5	81±5	70±3	29±3	36±3	11±3
IRQ ACCN (SG)	41.3	5.12	5.12	19.45	22.01	40±5	54±5	70±3	56±3	35±3	23±3
RA AC	46.69	1.20	1.20	17.14	17.14	40±5	43±5	70±3	67±3	22±3	19±3

Check List

Type of coach	Tare weight of coach	Normal pay load	Over load	Total pay load	Test load per bogie		Bogie frame bolster clearance		Body bogie clearance		Crown clearance	
AC	In tonnes	In tonnes	In tonnes	In tonnes	Under tare	Under Gross	B dimension		C Dimension		A Dimension	
					In tonnes	In tonnes	Tare	Gross	Tare	Gross	Tare	Gross
GS	36.99	5.85	100%	11.70	12.6	18.45	40±5	74±3	70±3	36±3	47±3	20±3
SOC	37.00	7.02	100%	14.04	12.6	19.62	40±5	81±5	70±3	29±3	50±3	18±3
SCN	38.03	5.76	-	5.76	13.12	16.00	40±5	57±5	70±3	53±3	31±3	17±3

Check List

Type of coach	Tare weight of coach	Normal pay load	Over load	Total pay load	Test load per bogie		Bogie frame bolster clearance		Body bogie clearance		Crown clearance	
AC	In tonnes	In tonnes	In tonnes	In tonnes	Under tare	Under Gross	B dimension		C Dimension		A Dimension	
					In tonnes	In tonnes	Tare	Gross	Tare	Gross	Tare	Gross
SLR	37.10	10.60	2.6	13.20	12.65	19.25	40 ±5	79±5	70±3	31±3	50±3	20±3
VP	32.00	18.00	-	18.00	10.30	19.30	40 ±5	77±5	70±3	33±3	39±3	11±3
IRQ SCN	37.2	5.76	-	5.76	12.7	15.58	40 ±5	57±5	70±3	53±3	30±3	17±3
Postal Van	36.5	3.0	-	3.0	12.35	13.85	40 ±5	49±5	70±3	61±3	22±3	15±3

Cause – Buffer height low

- Wear on wheel tread .
- Wear on wearing piece and wearing plate of the side bearers .
- Wear on hanger , hanger block and pin of the secondary suspension .
- Loss in free heights of primary and secondary coil springs .
- Load deflection characteristics of the primary and secondary springs not being within the prescribed limit .

AXLE

Rajendra

Instructor C&W/MSTC GKP

An axle is a component of a wheel set to hold the wheel discs in position. The axle box is also mounted on the journal of the axle (**See figure 10.3** for Axle)

The axles are forged from the pre-cast steel blooms of desired specification and length, machined to accuracy after checking for both internal and external flaw detection systems. Blooms are checked for chemical composition and micro/macro properties before they are taken up for forging.

Axles are manufactured to various sizes and specification. Blooms to the desired specification are procured from leading integrated steel plants in sizes specified to obtain the desired reduction ratios. The blooms are thoroughly inspected for their chemical composition and micro/macro properties before they are taken up for forging.

Billets are cut to required unit lengths and heated in a rotary hearth furnace to forging temperatures. The heated billets are then transferred to a CNC controlled precision Long Forging Machine procured from M/s. GFM, Austria. The advantage of the precision forging process is minimised machining allowance, leading to reduced wastage. The fish tail ends of the forged axles are gas cut and the axles hot stamped with a unique number. The forged axles are

then normalised in a walking beam furnace, followed by air-cooling and tempering. For axles meant for traction applications, where higher tensile strength and hardness is required, the axles are quenched after normalising using polymer quenchant.

Samples are drawn from each batch and checked for physical and metallurgical properties tested before being taken up for machining.

The machining line is again a completely automated system with integrated engineering for material transfer from one station to another. The various machining stages include end milling, cup turning and cantering; rough, semi-finish and finish turning, burnishing of wheel drilling and tapping of axle end holes, grinding of axle journal and dust guards. During the course of machining cycle, all axles are ultrasonically checked for internal flaws and Magnetic Particle Testing is done to detect any surface flaws. RWF is procuring a radial scanning equipment to undertake radial probing of the axles required as per UIC standards.

Stage Inspection of Axles

- Chemical Composition and visual/ultrasonic tests on blooms before forging
- Macro and micro properties of forged axles
- 100% ultrasonic including radial scanning and magnetic particle testing
- Measurement of pitch circle diameter, journal diameters, tapped holes and ovality
- Measuring the surface finish.

Axles

A) Loco Application:

Gauge	Description
BG	WDM-2C
	WDM-2
	WAG-7
	WDP-2
	TAO-659
	WDP-1 & WDG-2
	WDG2 & WDG3
	WAP-1, WAP-4
	WAG-9
	WAP-5
	WDP-4
	WDG-4
	X Class
MG	VDM-4

B) Freight Application:

Gauge	Description
BG	BOX N - 22.9T
	25T axle suitable for k class CTRB
	25T axle load axle

C) Passenger Applications:

Gauge	Description
BG	BG EMU axle (MC)
	BG EMU axle (MC) MEMU
	BG EMU TC axle
	EMU axle for Milk Tank Wagon
	16T BG Coaching
	LHB axle
	Kolkata Metro axle (TC)
	Kolkata Metro axle (MC)

Wheelsets

A) Freight Application:

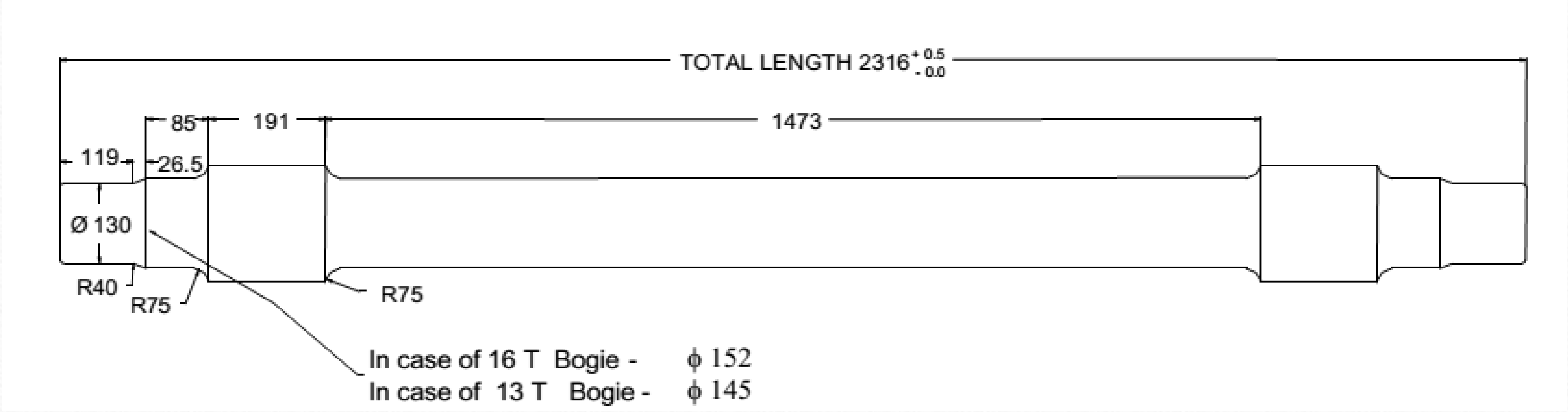
Gauge	Description
BG	Box_N
	840 mm dia container flat wagon wheelset
	840 mm dia for 25T axle load wheelsets

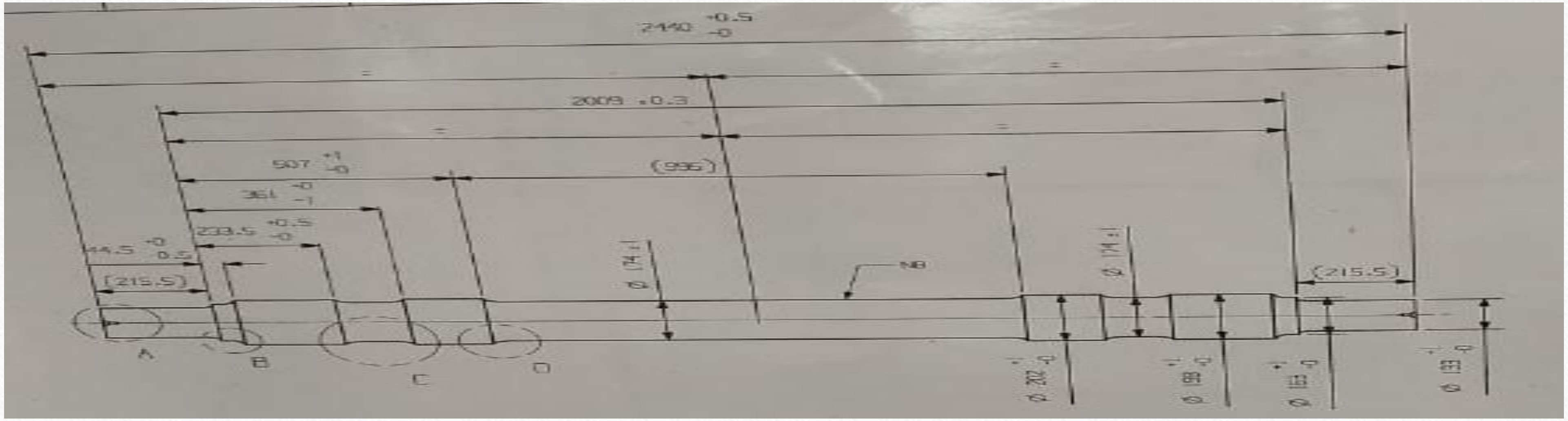
B) Passenger Applications:

Gauge	Description
BG	BG Coaching
	958 mm dia EMU wheelset for Milk Tank Wagon

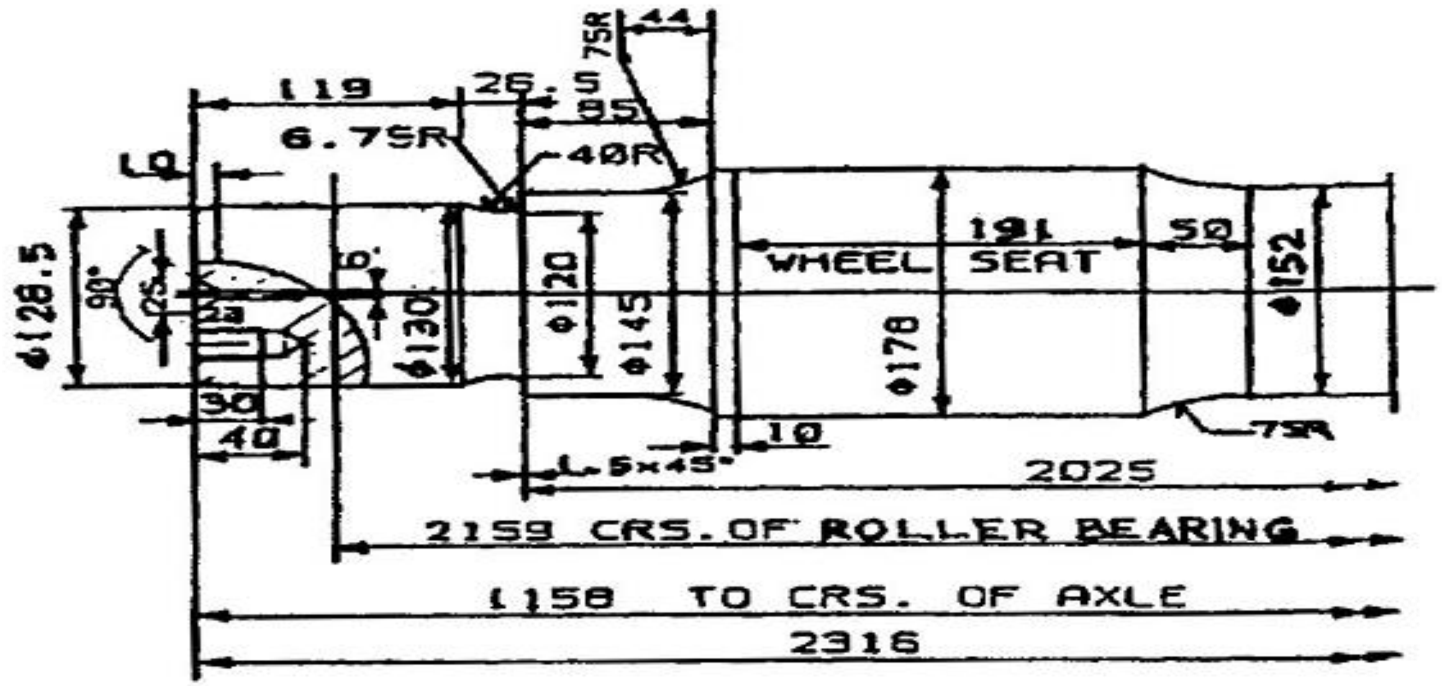
Axle Specifications

Specification	Application	C	Mn	Si	P	S	Hydrogen in Liquid Steel	Ultimate Tensile Strength N/mm2	Yield Strength N/mm2 Min	Elongation Min	Impact U-notch J Min	Grain Size
IRS R-16-95	Passenger & Freight Car Axles	0.37 max	1.12 max	0.15 - 0.46	0.04 max	0.04 max	< 3 ppm	550 - 650	320	22%	25	5 - 8
IRS R-43-92	Traction Axles	0.40 - 0.55	0.60 - 0.90	0.15 min	0.045 max	0.045 max	< 2 ppm	570 - 685	Not less than 50% of UTS	17 - 21%	25	6 - 8


TOTAL LENGTH 2316 +0.5 -0.0
85
191
1473
119
26.5
Ø 130
R40
R75
R75
In case of 16 T Bogie - ϕ 152
In case of 13 T Bogie - ϕ 145


(996)
(215.5)
(215.5)
A
B
C
D

16.25 t Axle for ICF coach



ICF DRG. NO. WTAC$_3$-0-2-301

Press fit of wheel on axles

- Wheel disc is pressed to axle with interference fit (the bore of the wheel should be 0.304 mm to 0.355 mm less than the outer dia of the wheel seat on the Axle)
- Wheel Gauge should be in between 1599 and 1602 mm
- Axial off centre should be within 1.0 mm (wagon) & 0.8 mm (coach)
- Radial off centre should be within 0.5 mm (wagon) & 0.25 mm (coach)
- The Journals should be protected with bituminous black to IS:9862
- All Axles fitted by workshop during POH or despatched to depot should be Ultrasonically tested

Press fit of wheel on axles

Hydraulic press is used for assembly of the wheel with a force of 400 to 500 Kgs per mm dia of wheel seat (approximate force used for different wheels are given below)

Description	Tonnage
13 tonne axle	68.8 to 103.2 t
16.25 tonne axle	71.2 to 106.8 t
BOXN & BLC	85 to 127 t

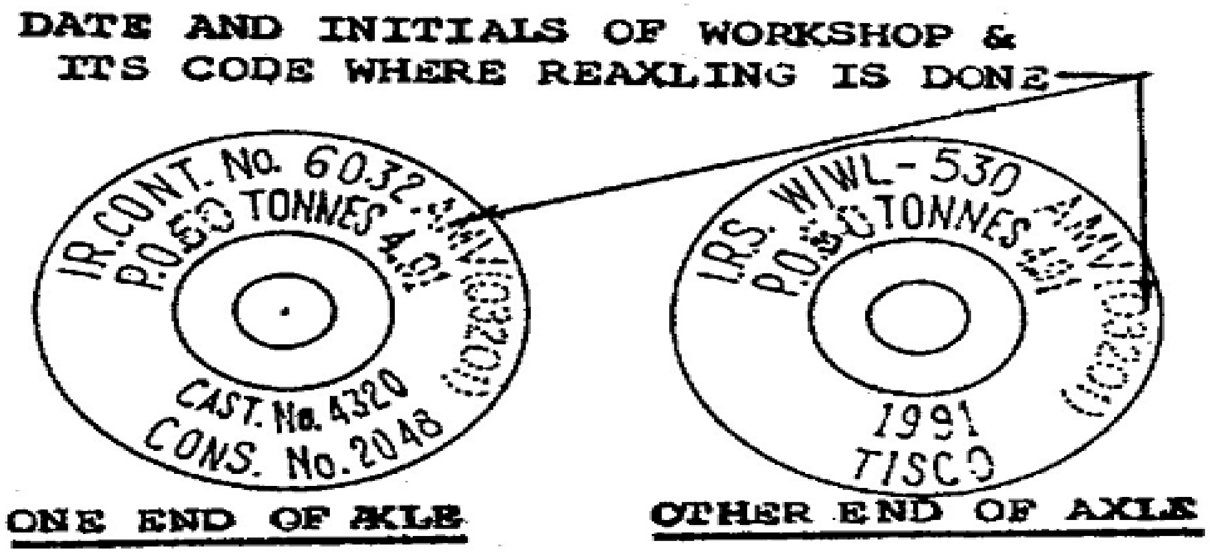
Stamping of particulars

Whenever axles are renewed the workshop shall punch in 5 mm letters the following particulars on the journal face

- Place of pressing
- Date of pressing
- Pressure of pressing

Whenever UT is done the details shall be stamped cold on the inner hub fillet with 6 mm punch not more than 1.5 mm depth

Stamping of particulars



NOTE:
ALL STAMPING TO BE DONE WITHIN 63 DIA.
ON BOTH JOURNAL FACES.

DEFECT OBSERVED ON THE AXLES AND THEIR ORIGIN

The defects arising on the axle are therefore primarily due to short comings during manufacture and also during manufacture and also due to a variety of service conditions to which they are subjected.

The sources of various defects are –

a) steelmaking and shaping operation

b) machining operation

c) heat-treatment operation

d) assembly operation

e) Repair Practice

f) maintenance practice and g) corrosion.

Loose Axle

- While assembling wheel with axle proper interference should be maintained between wheel and axle. Due to improper selection of interference the wheel may shift outwards or it may come out completely. Loose axle is a rejectable defect.
- Axles involved in Accidents should be magnaflux tested in addition to Ultrasonic test.
- Axle having notch should be withdrawn from service

ULTRASONIC TESTING OF AXLES

All incoming wheel sets are tested for flaw detection test of axles in the shop before sending them to service. Following techniques are adopted to test the axles.

i. Far end scanning
ii. Trace delay
iii. Near end low angle scanning
iv. High angle scanning

HOT AXLE-

An axle, which has run hot, should be distinguished by stamping 5-mm size star on the face of the affected journal as shown in Plate 25; wheel sets with such axles must not be used in passenger carrying vehicles. If journal or end of axle has any discolouration due to over heating or if circumferential cracks determined by magnetic crack detection are found in the journal, the axle may be scrapped and mutilated to prevent re-use.

Note: - Wheels with discoloured journals due to overheating should be sent to workshops for checking cracks in the journal.

WHEEL & AXLE COMPLETE
AXLE FINISH MACHINED
SEMI FINISHED AXLE
5S
Modern Coach Factory
FINISHED AXLE
Modern Coach Factory
SEMI FINISHED AXLE
(PL NO-33509037)
(QPC-04)
(DRAWING NO-LW02149 ALT-C)

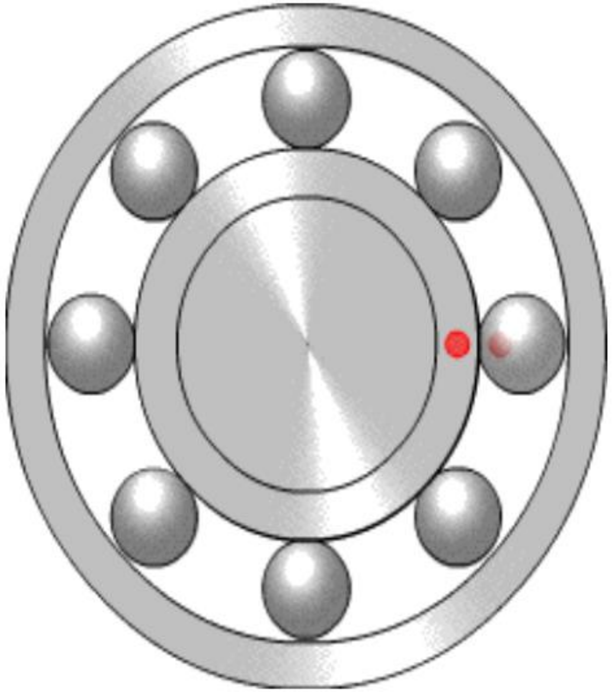
Material of Wheel

The chemical composition of the steel for Cast Wheel	
C	0.47% to 0.57% for type A used for carriage stock 0.57% to 0.67% for type B used for wagon stock
Mn	0.60 to 0.80%
P	0.03% max
S	0.03% max
Cr	0.15% max
Ni	0.25% max
Mo	0.06% max
Combined % for Cr, Ni & Mo must be 0.40% max	

The procedure to calculate chemical composition will be in accordance to IS:228

THANK YOU

Roller Bearing



Rajendra
Instructor
C&W/MSTC/N.E.Railway

Introduction

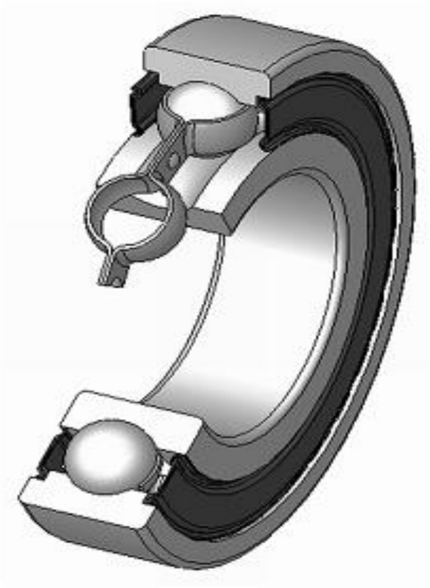
- A bearing is a device to permit constrained relative motion between two parts, typically rotation or linear movement.
- Bearings may be classified broadly according to the motions they allow and according to their principle of operation

CLASSIFICATION OF BEARINGS

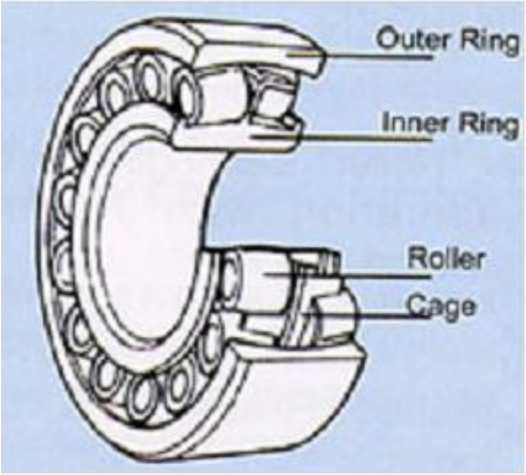
BEARING

ANTIFRICTION BEARING

FRICTION BEARING

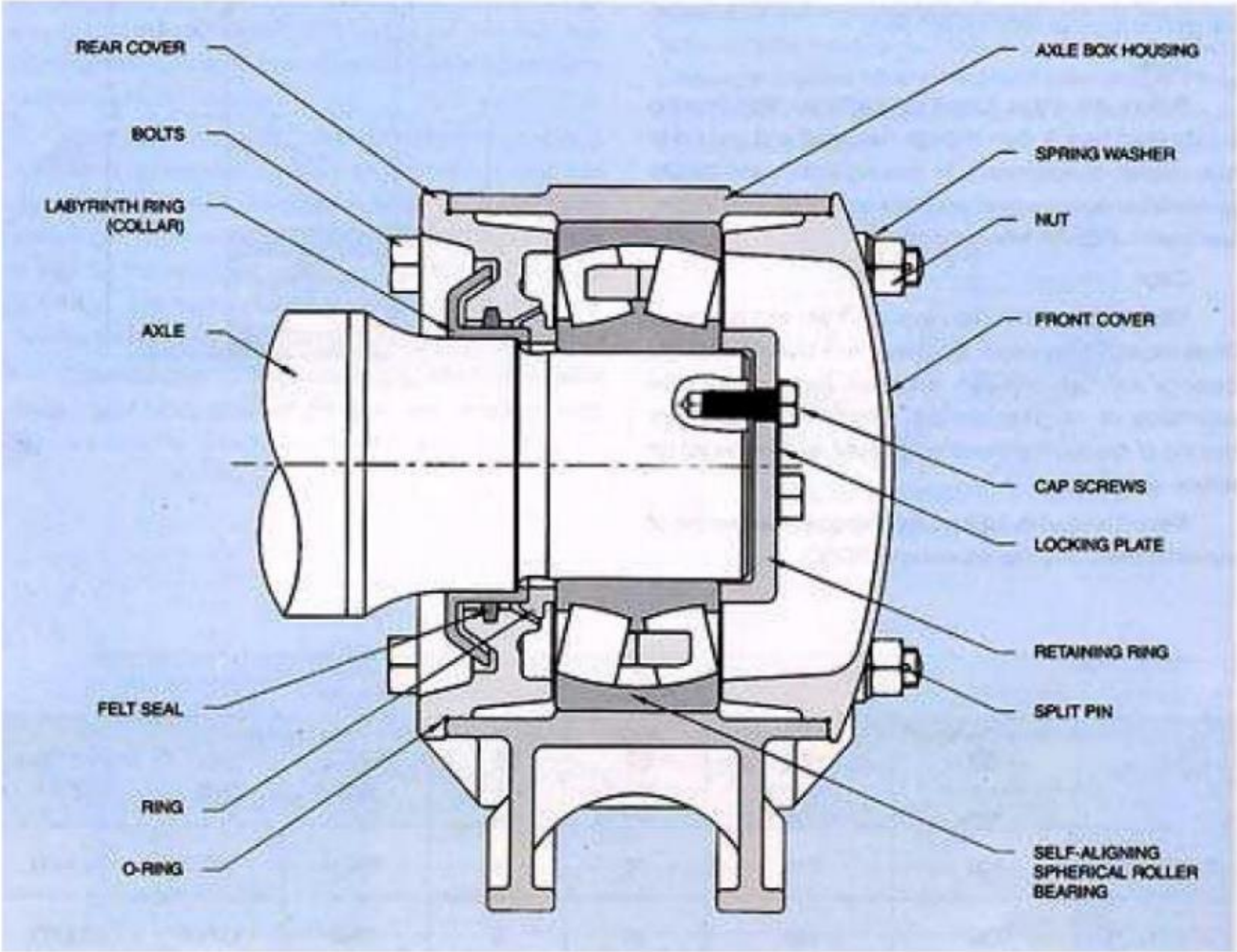


spherical roller bearing

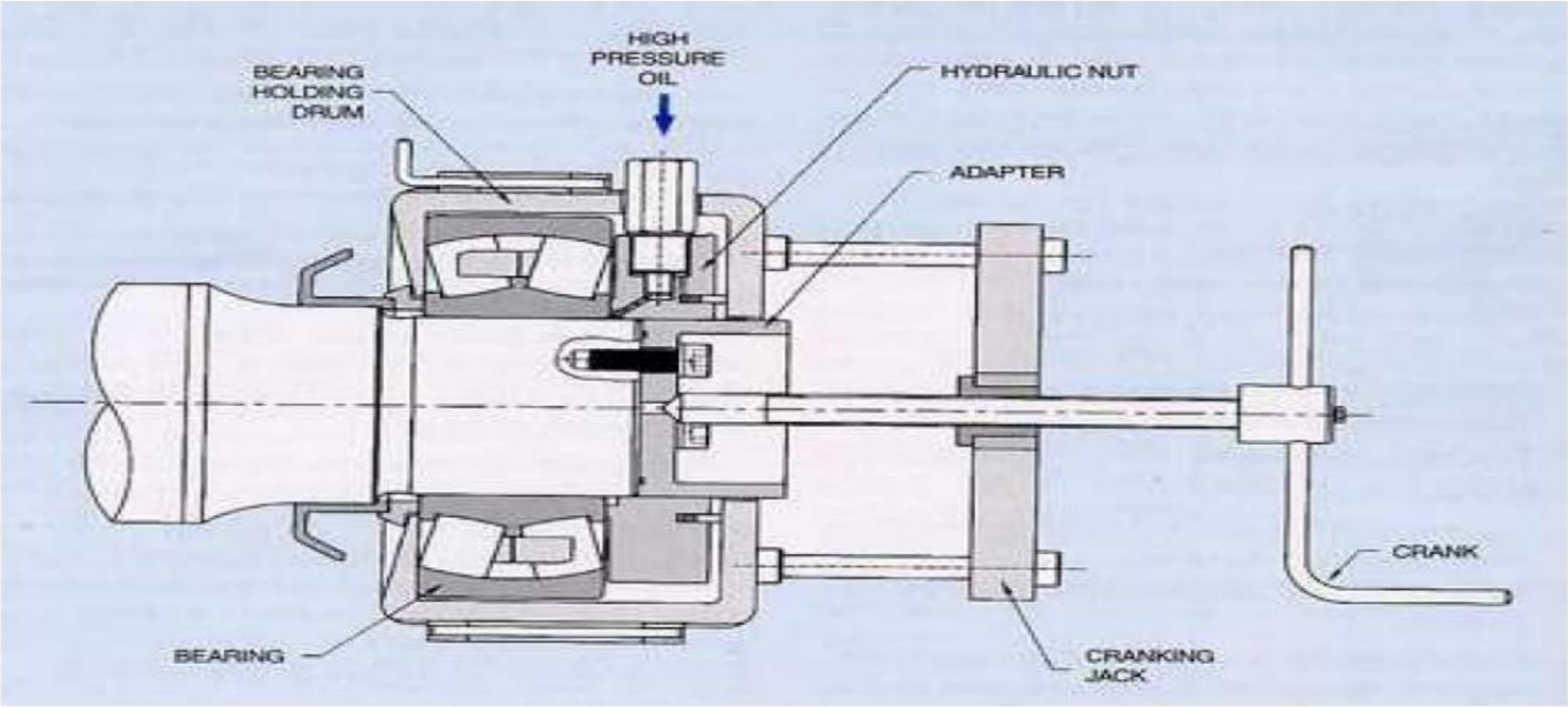


SPHERICAL ROLLER BEARING

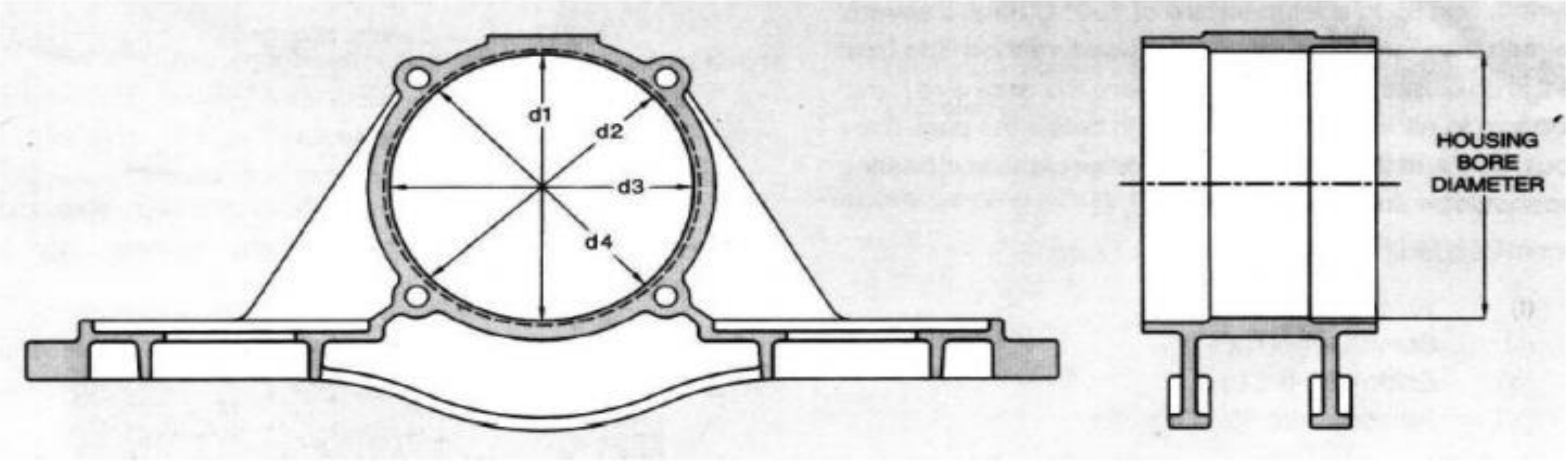
- Spherical roller bearings have a large capacity for radial loads, axle loads in either direction, and complex loads.
- They are suited for the applications such as railway rolling stocks where vibrations and shock loads are encountered.
- Roller Bearings are named according to the shape of rollers. Roller Bearings with spherical rollers are called as Spherical Roller Bearings
- Spherical Roller bearing no. **22326/C3 with 130 mm** parallel bore on the inner ring is being used on ICF type coaches.
- They are directly **shrunk fit on the axle journals**.


REAR COVER
BOLTS
LABYRINTH RING (COLLAR)
AXLE
FELT SEAL
RING
O-RING
AXLE BOX HOUSING
SPRING WASHER
NUT
FRONT COVER
CAP SCREWS
LOCKING PLATE
RETAINING RING
SPLIT PIN
SELF-ALIGNING SPHERICAL ROLLER BEARING

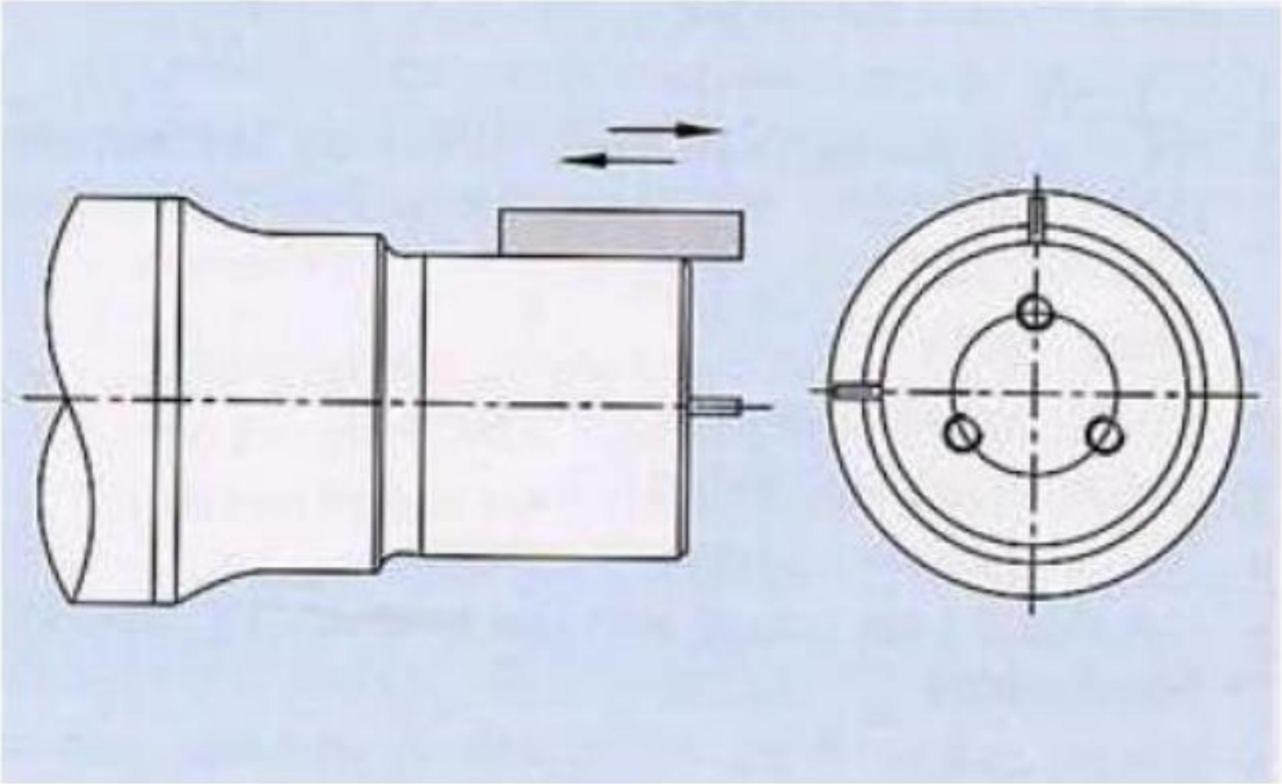
ICF self aligning Spherical Roller Bearings : Dismounting -



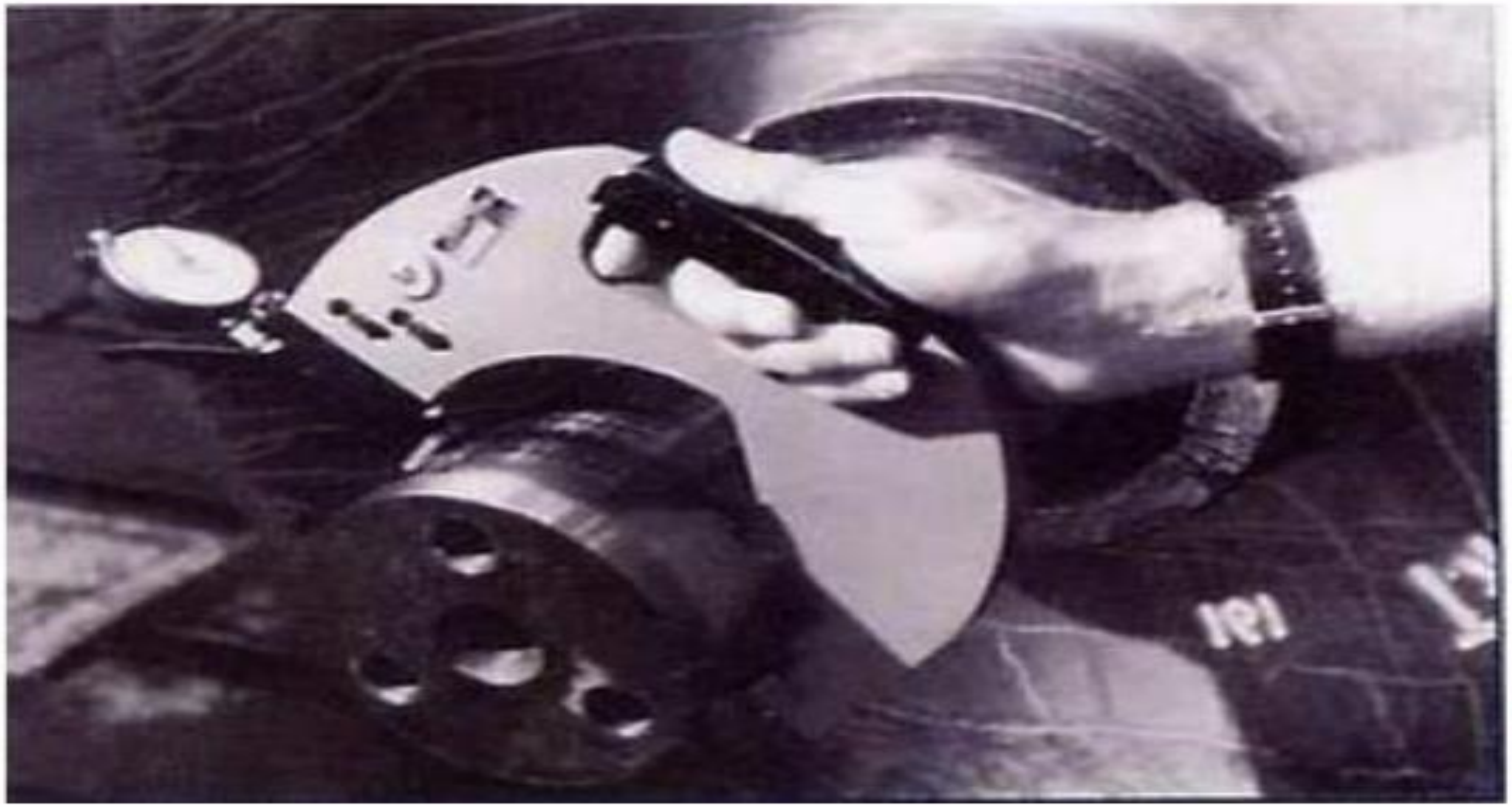
ICF self aligning Spherical Roller Bearings : Mounting housing image -



ICF self aligning Spherical Roller Bearings: Straight edge Journal checks-



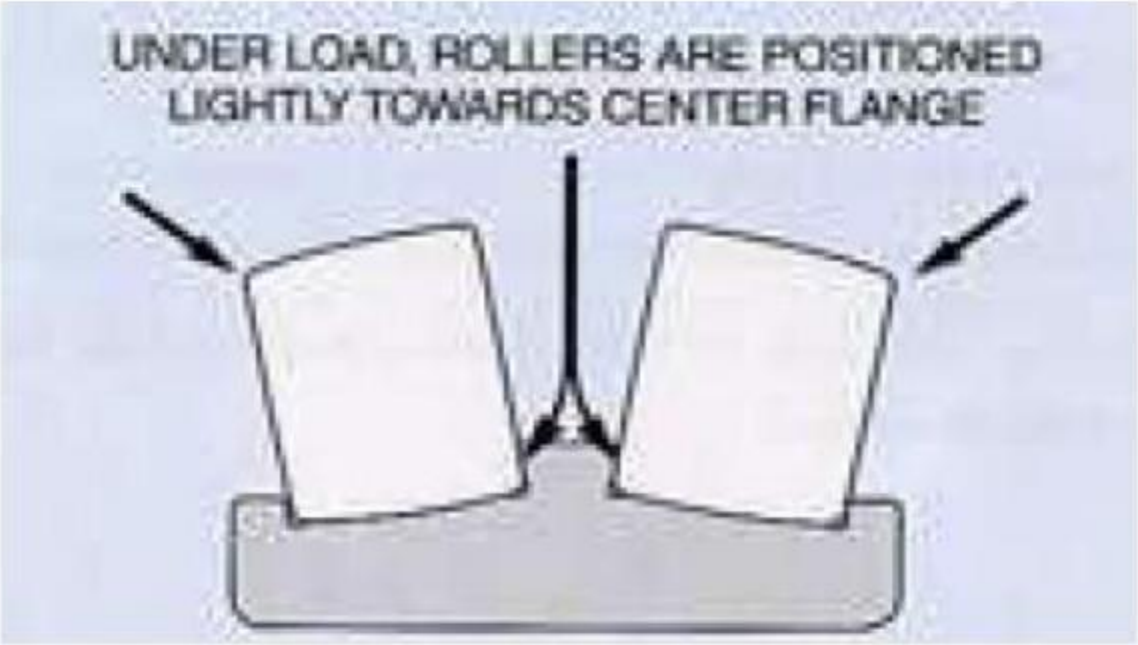
ICF self aligning Spherical Roller Bearings: Dial Snap Gauge Journal Diameter checks-



Journsl = Journal.

Journsl Diameter ØA(Max/Min)	Maximum permissible out of roundness (mm)	Maximum permissible taper (mm)
130.068 /130.043	0.015	0.015

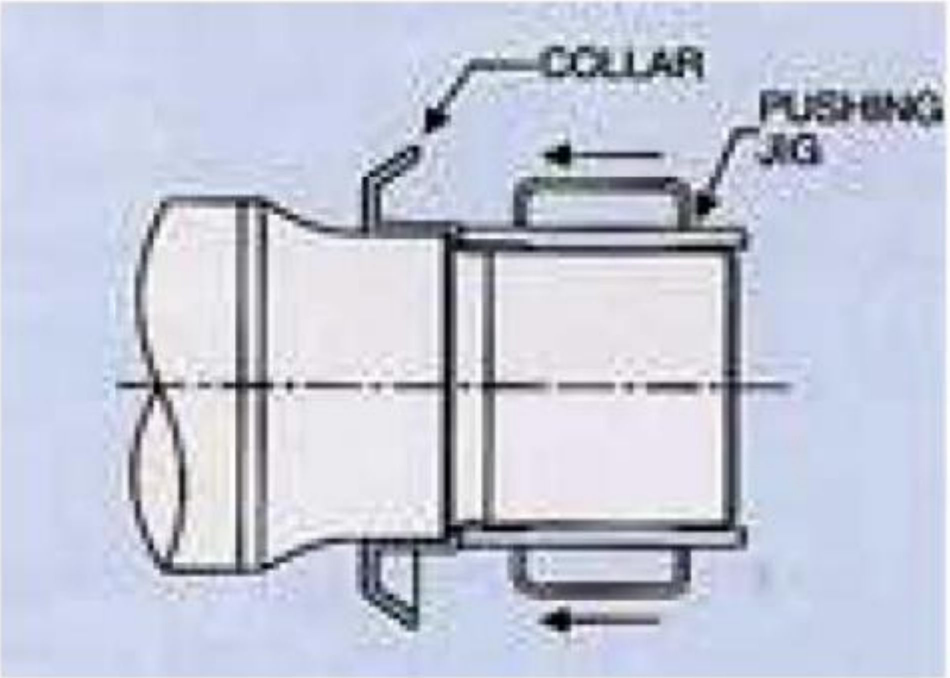
ICF Spherical Roller Bearings : Functions -



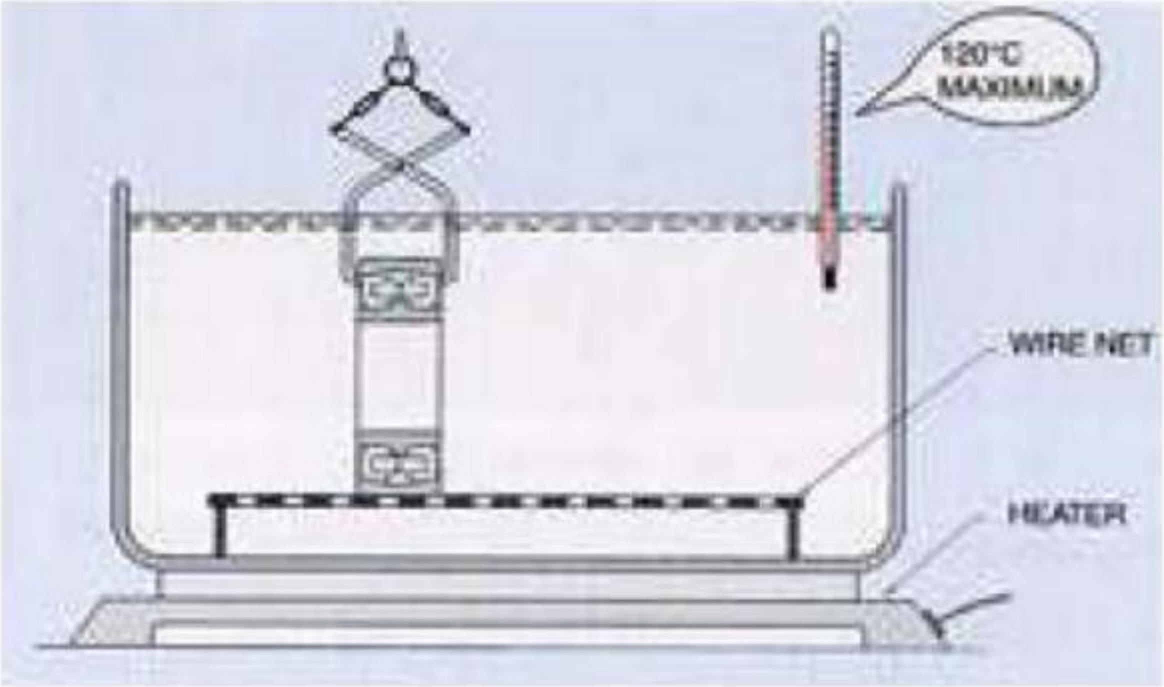
ICF Spherical Roller Bearings : Inspections -

ICF Spherical Roller Bearings : Clearances -

ICF Spherical Roller Bearings : Mounting -



ICF Spherical Roller Bearing : Oil bath Heating during mounting -



ICF Spherical Roller Bearing : Induction heating during bearing mounting -

ICF Spherical Roller Bearing : Radial clearance checks on mounting -

ICF Spherical Roller Bearings : Radial Clearances in mounted bearings -

Bearing make	Radial clearance in mounted condition (in mm)	
	New Bearings	In service bearings
FAG/NORMA	0.080-0.160	0.220 max.
NEI/NBC	0.080-0.160	0.245 max.

ICF Spherical Roller Bearing : Incorrect mounting failures – Effects & Reasons.

Damage during mounting	Possible Cause
Score marks on rings	Bearing inner ring not properly aligned with axle during mounting. Forcible entry on axle box during mounting.
Surface cracks	Rapid or excessive heating of bearing (temperature more than 120 ^{O}C)
Discolorated surface	Excessive heating temperature (more than 120^{O}C)
Axial cramping of bearing	Faces of bearing and associated part not flush with one other.
Radial cramping of bearing	Oversize or undersize journal diameter.
Excessive fretting of outer race	Oversize housing bore
Grease oozing from rear cover	Used or poor quality of felt seal

ICF Spherical Roller Bearings : Peak Operating temperature – 80 deg. Cel. {Li based grease filled/Axlebox = 1.75 Kg}

HOT AXLES

IN CORRECT FIT

IMPROPER MOUNTING

IMPROPER HANDLING

POOR LUBRICATION

CONTAMINATION

EXCESSIVE HEATING

EXCESSIVE LOAD

Hot Axles : Reasons & Effects -

Defect	Effect on Bearing
Felt ring perished	1. Grease may ooze out from rear cover 2. Dust and water may enter the axle box
Rubber 'O' rings of cover perished	Dust and water may enter the axle box

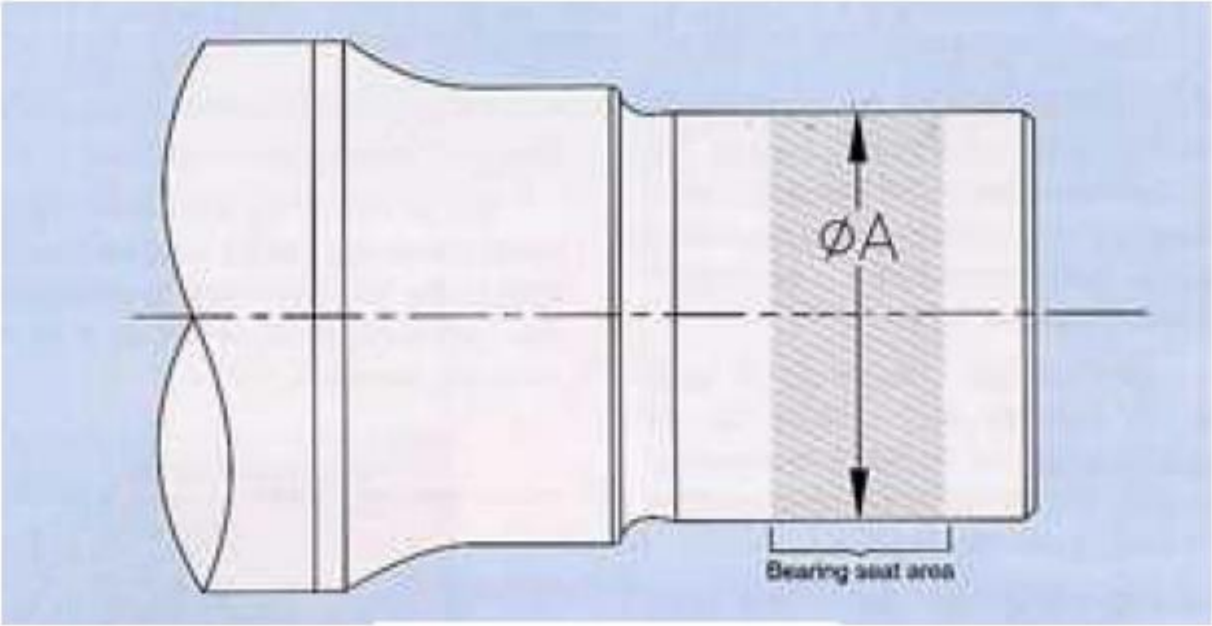
ICF Spherical Roller Bearings : Hot Axles Continued -

'V' grooves on rear cover, front cover and axle box faces not filled with grease.	Dust and water may enter the axle box.
Improper and/or excessive / inadequate grease.	Excessive temperature, seizing or complete failure of Roller Bearing.
Bearing clearance not within prescribed limits.	Excessive wear of rollers and races leading to bearing failure.

ICF Spherical Roller Bearings : Hot Axles Continued -

End locking screws not tightened properly.	End locking arrangement may fail.
Journal finish and Diameter not as prescribed in the drawing.	Bearing may become loose/inner ring cracks causing serious damage to the bearing leading to bearing failure.
Excessive or inadequate lateral clearance between axle box covers and bearings.	1. Excessive clearance may damage roller bearings or covers. 2. Inadequate clearance may result in gap between axle box housing and bearings.

ICF self aligning Spherical Roller Bearings: Journal Diameter-



ICF Spherical Roller Bearings : Hot Axles Concluded -

Fitment of substandard/ improper size end locking bolts/ screws.	Bolt may fail in service cause damage to front cover and bearings
Improper locking of end locking screws.	Screw may get loose in service and cause damage to front cover and bearings
End locking screws not tightened properly.	End locking arrangement may fail.

BEARING COMPONENTS

Outer ring

Outer ring for spherical roller bearings are manufactured from forged and rolled rings from bearing quality steel. It is through hardened and precision ground all over. The track or roller surface of bearing outer ring is spherical in shape for self-aligning.

Inner Ring

Inner ring for spherical roller bearing are also made from bearing quality steel which is forged and rolled. Inner rings are also precision machined heat treated and precision ground. Inner rings have two rolling surface which are ground together with high accuracy.

Roller

Roller are either forged or machined from bearing quality steel bars & then through hardened and ground to high degree of accuracies.

Cage

Spherical roller bearings are fitted with machined brass cages. These cages are made from brass centrifugal castings and then precision machined. Brass cages have advantage of assuring positive lubrication and cooler running of the bearing therefore are best recommended for railway applications.

GENERAL INSTRUCTIONS AND PRECAUTIONS

1. Do no drop the bearing.
2. Bearing should not be unpacked until it is ready for mounting.
3. All plastic wedges inserted between rollers to protect from any damage during transportation, must be removed prior to fitment on axle journal.
4. Spherical Roller bearings are designed, manufactured and assembled to provide a specific amount of radial clearance. Therefore, components of any spherical roller bearings should never be interchanged with other bearing. This can lead to poor performance or failure of the bearing.
5. Mounting, dismounting, inspection and maintenance work of bearings must be done by trained/ qualified persons as per laid down procedures/ specifications.
6. Use only recommended tools for mounting / dismounting and maintenance work.

Contd..

7. Use only those parts, which are new or otherwise satisfactory to reach the next

reconditioning interval after service.

8. Bearing parts of different roller bearing units or different manufacturers must

never be mixed or interchanged. This can disturb the radial and axial clearances,

which can lead to poor performance of the bearing during service.

9. Never mix two different brands of grease or used grease with fresh grease.

10. Lubricate both new and used cap screws prior to installation.

Periodicity of Inspection of Roller Bearing

All roller bearings should be cleaned, inspected and re-lubricated with fresh grease during each attention to the wheel set /bearings in the workshop.

The roller bearings should be dismounted from the wheel set during every alternate attention in the workshops for thorough inspection of the components,

rear cover and renewal of the felt sealing ring. The wheel bearing should however necessarily be dismounted and overhauled in case of any warranted out of course of attention in the workshop.

Radial Clearance In Bearings

Bearing make	Radial clearance in un-mounted condition. (mm)		Radial clearance in mounted condition. (mm)	
	New Bearings	In service bearings	New Bearings	In service bearings
FAG/NORMA	0.145–0.190	0.270 max.	0.080-0.160	0.220 max.
NEI/NBC	0.145–0.190	0.295 max.	0.080-0.160	0.245 max.

Fig: 3.0 Checking Bearing radial clearance in mounted condition

Life of Spherical Roller Bearing

The codal life of spherical roller bearings type 22326 (16.25 t) used on BG main line coaches is fixed as 20 years.

Lubrication

- **The quantity of grease filled per axle box**

  FAG/NBC/other make bearings **1.75 kg**

- Only lithium base grease of approved brands should be used

Brand Name Of Grease	Supplier
Servogem RR3	Indian Oil Corporations
LL3 (Balmerol multigrease)	M/s Bamer Lawre & Co. Ltd. Corporation Limited
Bharat RR Grease-3	M/s Bharat Petroleum Corp. Ltd.

Bearing should be rejected for the following defects

- Pitted or flaked roller tracks and rollers.
- Cracked or deformed or badly worn out cage.
- Cracked inner or outer ring.
- Scored or damaged outer surface of the outer ring.
- Indentation on rings or rollers.
- Scoring of roller tracks or rollers.
- Rust/corrosion, damage or excessive fretting corrosion.
- Brinelling or false brinelling.
- Rings exhibiting deep straw or blue or purple colour indicating heat effect.
- Excessive or less radial clearance.

Rust and corrosion

Surface becomes partially or fully rusted. Sometimes rusted at spacing equal to distances between rolling element

Fretting

Fretting Surfaces wear producing red coloured particles that form hollows.

Flaking/ Spalling

Flakes form on the surfaces of the raceway and roller elements. When the flakes fall off, the surface becomes rough and uneven.

Seizure

Bearing heats up, becomes discolored and eventually seizes up.

Cracking

Splits and cracks in bearing rings and rollers

Cage damage

Breaking or wear of cage.

Smearing and scuffing

Surface becomes rough with small deposits. "Scuffing" generally refers to roughness of the bearing ring ribs and roller end faces.

Rolling Path Skewing

Roller contact path in raceway surface strays or skews.

Indentations

Hollows in raceway surface produced by solid foreign objects trapped or impacts (False brinelling)

Electric Current Damages

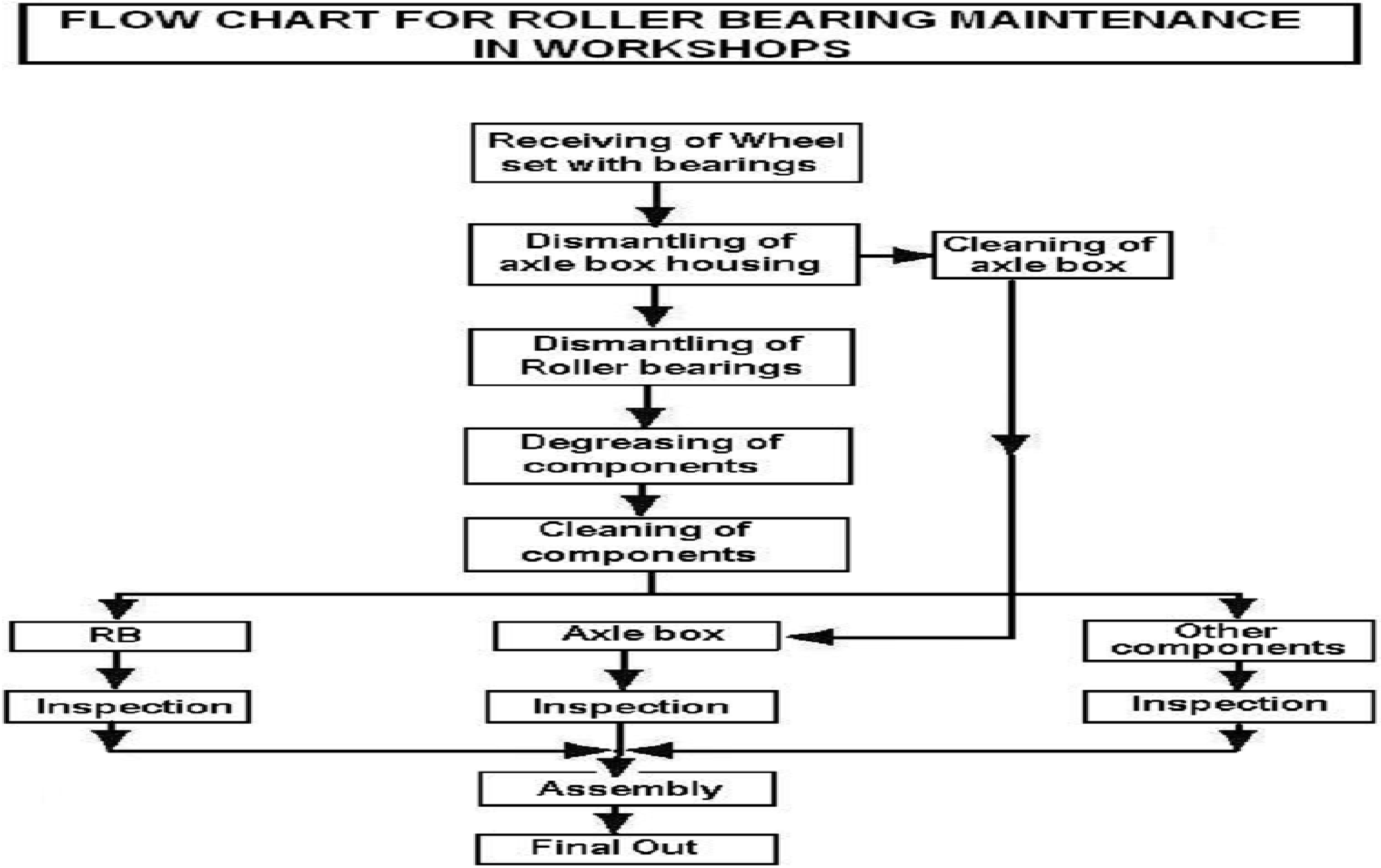
Pits form on raceway and develop into ripples.
Further development leads to corrugated surface. Some times spot or localized burns are also noticed.

Discoloration

Change of raceways / roller colour

Peeling

Peeling is a cluster of very small spalls. Peeling can also include very small cracks which develop in to spalls.


FLOW CHART FOR ROLLER BEARING MAINTENANCE IN WORKSHOPS
Receiving of Wheel set with bearings
Dismantling of axle box housing
Cleaning of axle box
Dismantling of Roller bearings
Degreasing of components
Cleaning of components
RB
Axle box
Other components
Inspection
Inspection
Inspection
Assembly
Final Out

MAINTENANCE IN OPEN LINE & PRECAUTIONS TO AVOID HOT AXLE CASES

Visual Examination

During Rolling-in & Rolling out examination, inspect axle box for any indication of hot box. Any wheel set with axle box running hot in the coach, must immediately be removed from service and sent for replacement. Visually inspect the axle box housing, front cover, rear cover and other parts for any damage. Check for any missing or loose fasteners. Watch for any other reason that could be detrimental to the performance of roller bearing and could lead to unsafe condition in service.

Roller bearings and axle boxes damaged due to fire, over heating, water submersion or welding, must be removed from service and sent for detailed internal examination.

Running Temperature

Check operating temperature of axle box by non-contact type thermometers at top of the cast steel axle box (crown) housing. The limit of temperature of the axle box top crown will be 80^0 C. If the temperature of axle box is found above 80^0 C, the affected coach should be detached en-route from the train service.
(RDSO Letter No. MC/AB Dated 21/24.08.2009).

Abnormal sound

In Rolling-in and Rolling-out examination, try to listen for any unusual / abnormal noise or grinding. Detach the coach & remove the wheel set / roller bearing axle box in case it produces abnormal sound and should be sent for internal part examination.

Grease oozing

During service, a small amount of grease leakage could be normal and comes from initial purging of grease and relieving of internal pressures. However, if fresh grease continues to leak, wheel set must be removed from service.

Axle boxes involved in Derailment / Accidents / Flood

All wheel sets of the coaches, involved in accident, fire, flood or submerged in water, must be removed from service.
Bearing and parts must be identified separately by marking “ACCIDENT INVOLVED” and should not be reused. It is recommended that inspection of roller bearing is made together with parts including wheel sets, bogie etc.