

# Wheel set, axle and bearing

Wheel is an important part of rolling stock which contributes for safe running of the trains. The wheel provided in the rolling stock of railways has dual role i.e. to bear the weight as well as guiding the vehicle. So, the defects in the wheel can lead to derailment and accidents.

**Components of a wheel set are-** A wheel set is an assembly mainly of two components:

- Wheel discs (solid) on both sides of the axle
- An axle to hold these wheel discs in position.

**Wheel disc (solid):** The solid wheel disc is manufactured as per IRS Specification No. R - 19/93 Pt. II and drawing No.W/WL/1660.

**Axles:** 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.

**(Note:** - Rly. Bd. vide their letter no. 98/RSF/874/1/SAIL (P) dt. 8/10/1998 has decided that only 16.25t axles would be used for wheel set under 13t bogie also for new wheel sets. The existing wheel set in service may however continue till they are required to be changed).

**Axle boxes with roller bearings:** The axle boxes used on ICF coaches are with under Mentioned spherical roller bearings.

**Spherical Roller Bearings No. 22326/C3:** These roller bearings are with 130 mm parallel bore on the inner ring and are directly shrunk on the axle journals.

## **Maintenance Procedure in the Workshop**

### **Pre-inspection of wheels in the workshop**

During pre-inspection of incoming wheels, the wheel-set is inspected for assessing the condition of the components.

Following measurements are carried out on all the wheels, received in shop for repairs.

#### **a) Measurement of a wheel gauge (distance between two wheels flanges on the same axle)**

The distance between two-wheel flanges on the same axle should be 1600 mm + 2/-1mm. This measurement should be taken at three locations apart with the help of an adjustable PIE gauge. If wheel gauge is not within permissible limits, then the wheel disc(s) have to be pressed off and then pressed on.

#### **b) Measurement of Wheel Diameter (Tread Diameter)/Wheel Flanges**

The wheel diameter is measured with the help of a trammel gauge with a least count of 0.5mm. on both sides. However, a gauge with a least count of 0.1 mm. is recommended as the measurement of a diameter would be more accurate with this gauge.

##### **a) Inspection of wheel disc as per CMI-K003**

The wheel should be inspected for reject able defects in accordance with RDSO's instructions CMI-K003

##### **b) Inspection of Wheel Flanges**

The flanges on both sides of a wheel set are checked with the help of a profile gauge to measure the height and thickness of flanges. Accurate measurement of flange height and flange thickness is not possible with the profile gauge. It is,

therefore, recommended to use a **wheel profile gauge** with which accurate measurement of flange height and flange thickness to the extent of 0.1 mm can be made. After recording the diameters of wheels and wheel flange measurements, the wheel set is nominated for necessary repairs.

**c) Inspection of axle**

Axle journals should be thoroughly cleaned for inspection to detect flaws, pitting, ovality, taper, ridges etc. Each axle should be ultrasonically tested for detecting internal flaws and defects as per the code of procedure issued by RDSO. Axles found flawed, pitted or with under size journals should be replaced.

**On ICF axle journal**

A taper should not exceed 0.015 /0.010 mm.

Out of roundness (ovality) must not exceed 0.015 / 0.020 mm

**CATEGORY OF WHEELS**

The wheels are categorized after pre-inspection as below:

**Normal repair wheels**

If all the components are within the acceptable range of limits, these are taken directly for wheel profiling and servicing of roller bearings.

**Wheels requiring replacement of an axle (RA wheels)**

The wheel is taken for replacement of an axle for the following:

- A bent axle,
- Dimensional deviations on a journal/ wheel seat
- Axle having groove marks in the middle due to rubbing of a pull rod,
- Dents, corrosion, pitting marks on the surface of the axle
- Axles found flawed in the ultrasonic flaw detection test

**Wheels requiring replacement of solid discs (RD wheels)**

The wheel is taken for replacement of discs if found

- It is not possible to turn the wheel to the last shop issue size
- There is a reject able defect as per CMI-K003.

**REPAIR PROCEDURES FOR DIFFERENT CATEGORIES OF WHEELS**

Detailed procedure for carrying out repairs to different categories of wheel sets are described below:

**Normal Repair of Wheel sets**

Normal repair wheels are of two categories.

- a) With roller bearings mounted
- b) With roller bearings removed

**The activities involved in Normal Repair Wheels are as follows:**

- Pre-inspection of incoming wheels.
- Drop axle boxes, clean and inspect axle boxes. If required, repair them.

- Carry out Ultrasonic Flaw detection test of axle.
- If required, dismount roller bearings from journals. (In any case dismount roller bearings in alternate POH)
- If the wheels are sent for re-profiling without dismounting roller bearings from the journals, special protective covers should be fitted on the bearings on either side of a wheel to avoid entry of chips / dust or damage to the bearing during machining.
- Machine wheel profiles to the prescribed dimensions. The wheel tread should be checked and machined to the worn wheel profile and machining standard N11 to IS: 3073.
- Clean roller bearing and assemble components in position, if not dismounted.
- Inspect roller bearing and assembly in position.
- Check radial clearance and confirm it to be within permissible limits.
- Pack fresh grease
- Mount cleaned and inspected axle boxes.
- Fit front cover with new sealing ring.

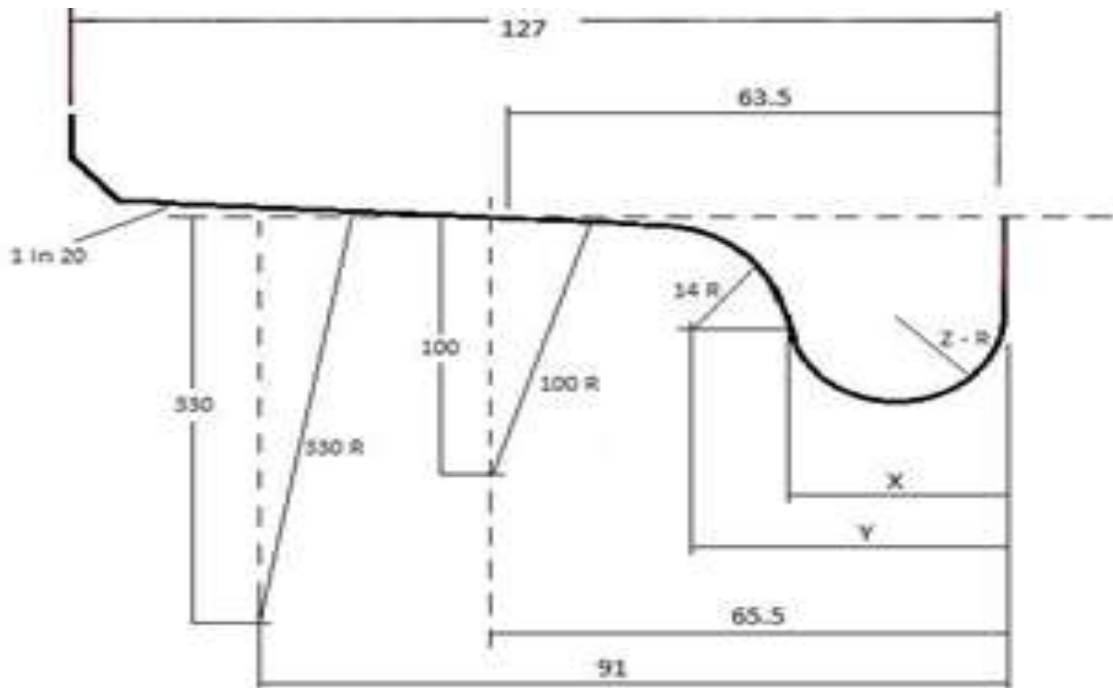
**WHEEL SIZE:**

Type Of Coach	New Diameter (mm)	Condemning Diameter (mm)
ICF Coach	915	825
LHB Coach	915	855

STANDARD WHEEL PROFILE	COACHING WHEEL	GOODS WHEEL
Flange Height	28.5 mm	28.5 mm
Flange Thickness	29.4 mm	28.5 mm
Root Radius of Flange	14 mm	14 mm
Flange Inclination	1 in 2.5	1 in 2.5
Width of Wheel	130mm	127 mm

**Tread inclination-**

Upto 65.5 mm width radius – 100R, then upto a width of 91 mm radius will be 330R and the rest portion of the width i.e.; up to 33 mm inclination will be 1 in 20.



**INTERMEDIATE STAGES OF WORN WHEEL PROFILE:**

In case of turning the wheel it is experienced that the life of wheel set is reduced to a large extent if standard wheel profile is targeted. So to save the life of wheel set three intermediate stages of profiles for turn wheel has been recommended by RDSO to run safely on rails by reducing least possible material from trade.

STAGE	FLANGE THICKNES	FLANGE TOP RADIUS
I	25 mm	11.5 mm R
II	22 mm	10 mm R
III	20 mm	9 mm R

**PAIRING OF WHEELS:**

When wheels are changed, it shall be ensured that the variation in thread diameters does not exceed the permissible maximum limits indicated below -

	On the same axle		On the same Bogie		On the same unit	
	BG m.m.	MG m.m.	BG m.m.	MG m.m.	BG m.m.	MG m.m.
<b>Four wheeled Bogie (Wagon)</b>	0.5	0.5	13	10	13	10
<b>Four wheeled Bogie (Coach)</b>	0.5	0.5	5	5	13	10
<b>Six wheeled Bogies</b>	0.5	0.5	6	6	6	6
<b>Six wheeled Unit</b>	0.5	0.5	6	6	6	6
<b>Four wheeled Unit</b>	0.5	0.5	-	-	25	13

Variation of trade in diameter on the same axle as specified above shall apply only at the time of tyre turning. There is no 'in service' limit for this variation. Rejection during service is governed by Tyre Defect Gauge.

### **Different types of wheel defects:**

The wheel and axle set are required to be withdrawn from service for the following defects.

1. Reached condemning limit.
2. Flat places/skidded.
3. Tread profile defects.
4. Wheel gauge defects (slack/tight).
5. Loose wheels.
6. Flaw in axle.
7. Shattered wheel ( Fractured on Wheel Tread )
8. Shelled tread (Metal braking from tread).
9. Spread Rim (spreading of Rim at a location of Brake binding zone).
10. Thermal crack on wheel tread or flange.

### **WHEEL TREAD PROFILE DEFECTS:**

Tread profile defects are detected with the help of Tyre Defect Gauge.

<b>PARAMETER</b>	<b>NEW(mm)</b>	<b>COND.Limit</b>	<b>DEFECTS</b>
Flange thickness	29.4	<16 (<22 for high speed coach)	Thin flange.
Root Radius	14R	<13 R	Root Radius too deep
Flange top Radius	14.5 R	<5 R	Sharp flange
Depth on tread		>5	Hollow type
Flange height	28.5	>35	Deep flange
Flat place on tread		Goods – 60 max Coach – 50 max	Wheel flat

### **Sharp Flange:**

When the radius given at the tip of flange is worn out to 5 mm, it is called sharp flange. This defect develops either due to running on the same curves for a long period or due to the defects on the rolling stock such as bent axle guide, weak springs, defective axle guides and excessive longitudinal clearance. The wheel is always pushed towards the rail and the flange starts wearing. The root of flange is first affected and then the inclination given on the flange disappears. Slowly the roundness given on the flange is reduced. Sharp flange can take wrong routes at a facing point provided the point itself is slightly defective such as a split, a worn out or damaged switch rail etc.

### **Less radius at Root of Flange (Root Radius Too Deep):**

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

### **Deep Flange:**

When the depth of the flange is increased to 35 mm for BG stock, it is called Deep flange. This happens due to the wear of the wheel tread at the root of the flange.

A deep flange can cause damage to the permanent way by mounting over fish plate, fish bolts, check bolts etc. and also causes derailments especially at check blocks and check rails.

### **Hollow Tyre:**

Due to wear on the wheel tread caused especially by wrong material composition in brake blocks, the inclination given on the wheel tread wears out and forms curve.

Without this inclination on the tyre wheel will have more lateral play on a straight line causing rough riding. It will also find very difficult to negotiate curve.

### **Thin tyre:**

When the thickness of the tyre is reduced to 25 mm for BG is called thin tyre. This happens due to wear and tear in ordinary condition.

Wheel with thin tyre will not be able to withstand the weight of the load. This also will cause low buffer heights.

### **Thin Flange:**

When the thickness of flange is reduced to 16mm is called Thin Flange Thickness must be measured at a point 13 mm from the Tip. It leads to breakage of flange under the side thrust of the wheel on a curve

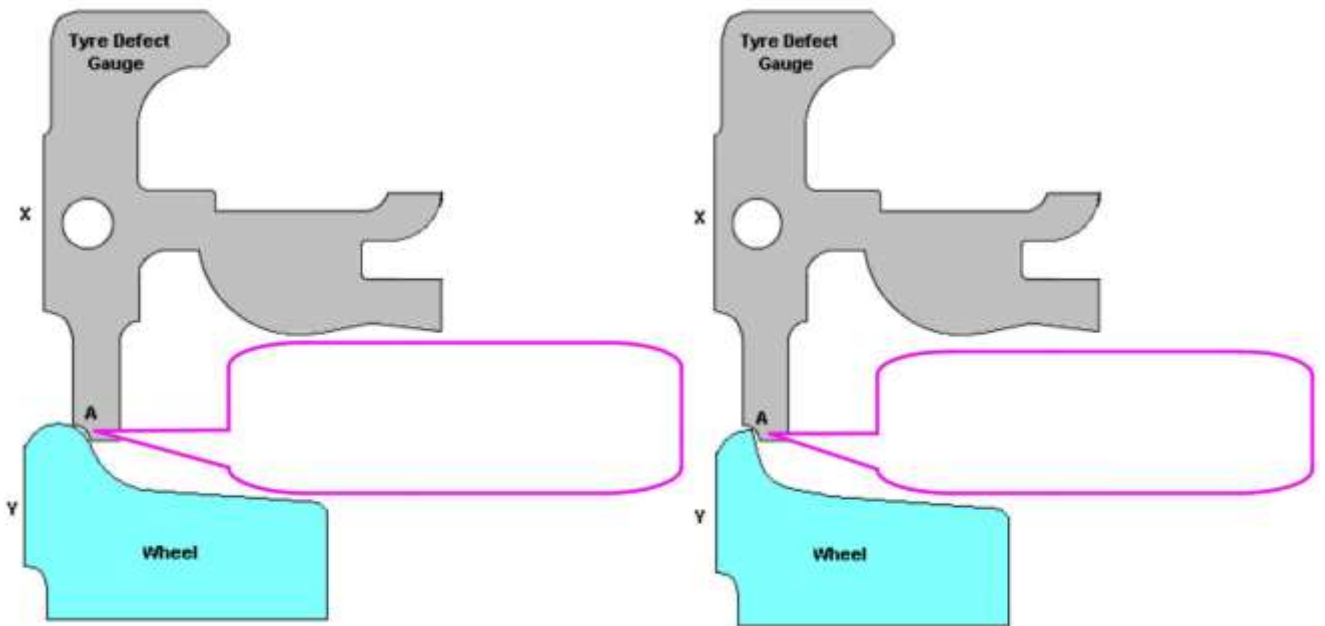
### **Skidded Wheel:**

This happens due to defective brakes or improper releasing of brakes. When a rolling stock is kept running with brakes binding the wheels do not revolve. Instead they slide over the rail surface. This cause heavy friction and wear on a particular spot on wheel tread. These worn out spots or patches will cause heavy noise on run and disturb the passengers. A skidded wheel not only damages the permanent way but also bearings. Limits for flat tyres the limits for permissible maximum flat surfaces on tread for BG ICF coaches is 50 mm (reference Rly. Bd.'s Letter no. 83/M (N)/960/1/Vol I dated 15/18.3.99)

### **Application of Tyre defect gauge;**

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

**SHARP FLANGE:**

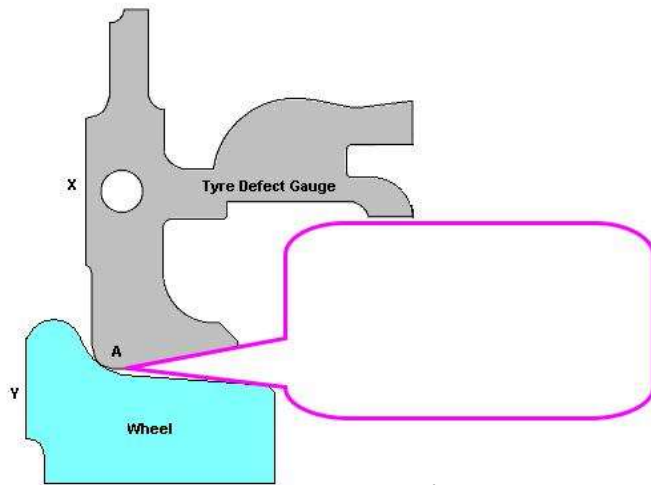


**When X is parallel to Y,  
If there is Gap in the middle  
at A, the Wheel is serviceable.**

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

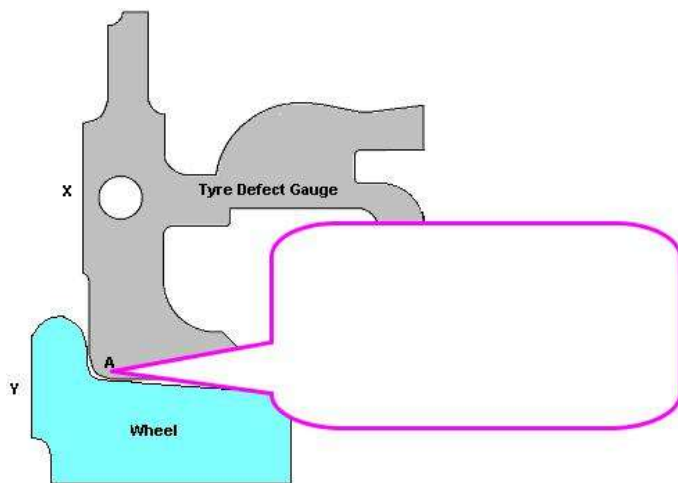


**LESS RADIUS AT ROOT OF FLANGE**



**When X is parallel to Y,**

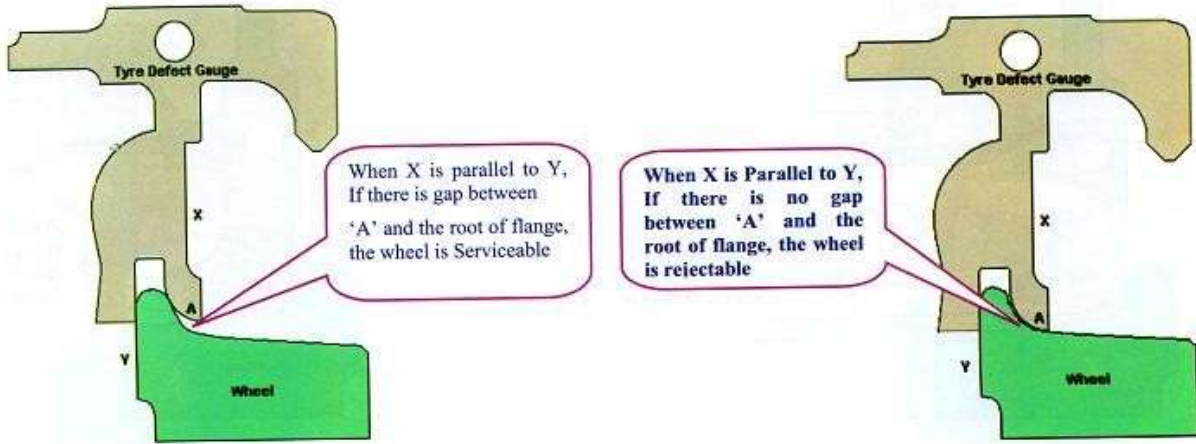
**If the gap is available at either side of 'A', the wheel is serviceable.**



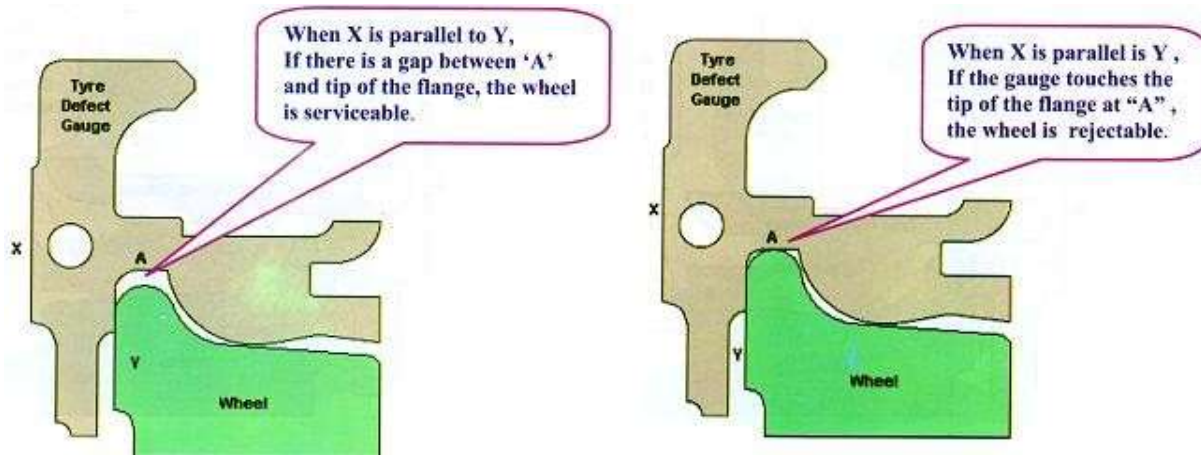
**When X is parallel to Y**

**If there is a gap between gauge and the Root of Flange at A , the Wheel is Rejectable .**

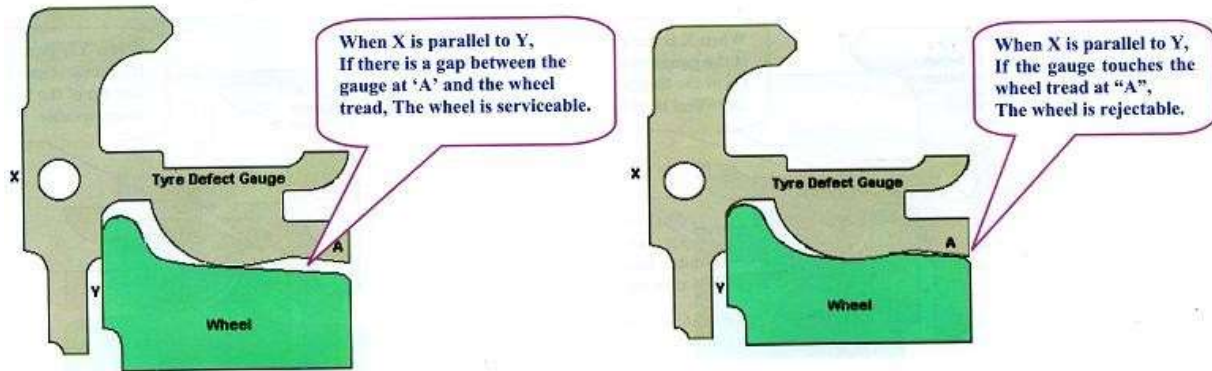
**THIN FLANGE:**



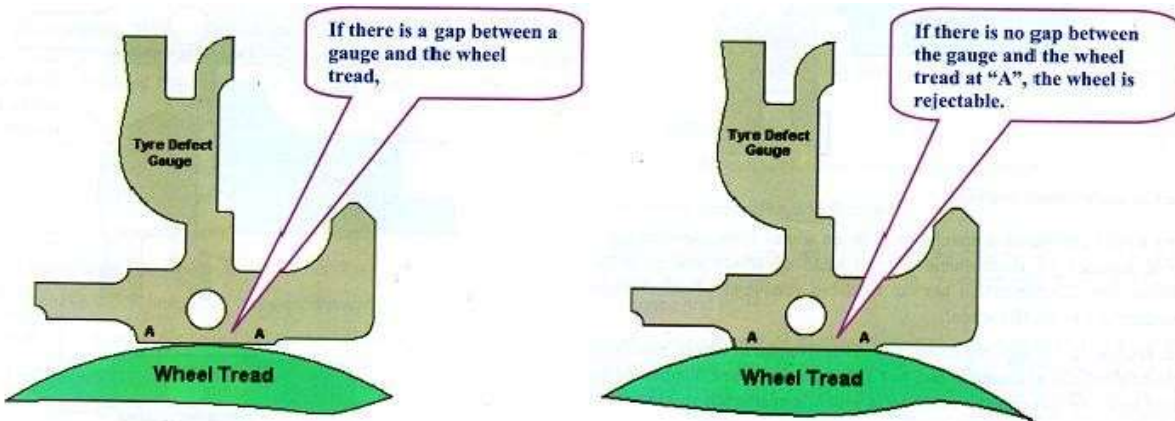
**DEEP FLANGE:**



## HOLLOW TYRE

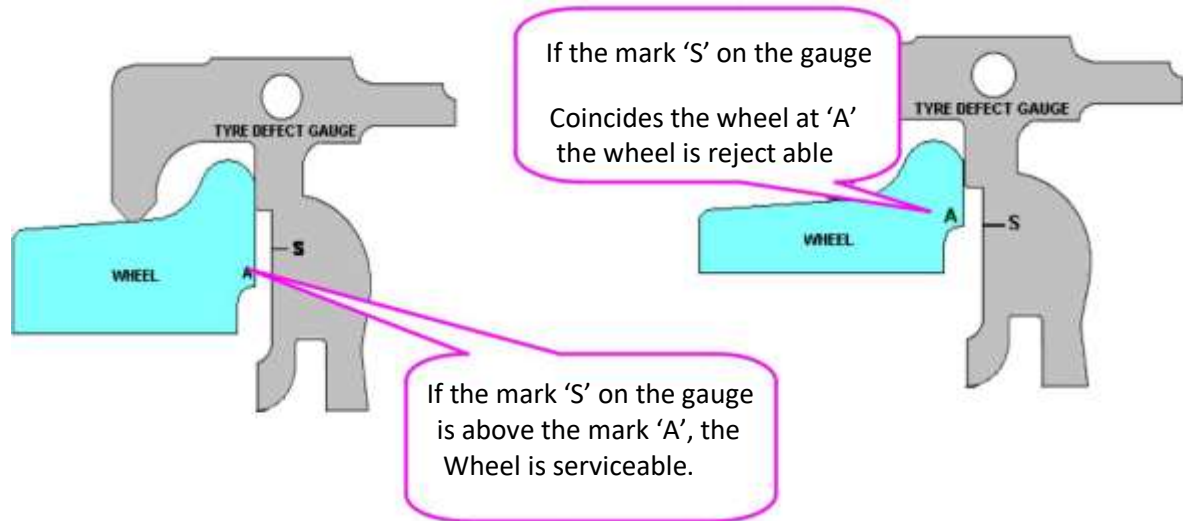


## FLAT TYRE:



## THIN TYRE

If



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

### **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).



**Shattered Rim**

### **Spread Rim.**

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

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



**Spread Rim**

### **Shelled Tread.**

Shelling can be identified by pieces of metal breaking out of the tread surface in several places 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.



**Shelled Tread**

## **Thermal Cracks;**

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

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



**Thermal Crack**



**Heat Crack**

## **Heat cracks.**

**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 reject able thermal cracks.**

### **Disc crack;**

**A crack on the disc due to material failure is called disc crack. The wheel should be withdrawn 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 reject able defect.**

**Note:** All wheel sets withdrawn from service for any of the conditions mentioned above must be sent to the associated workshops for detailed investigations and further disposal. The date and station code of the maintenance depot where the wheels are changed should be stenciled 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 are permitted to be done in the maintenance depot.

**Wheel Shelling (vide Ref: RDSO letter No. MC/LHB/Brake dated 15.04.19)**

Wheel shelling is a burning issue in LHB coaches. Recently numerous of incidents have been noticed on wheel account. In this connection a check list (Annexure-A) has been prepared for LHB coaches found with minor wheel/skid/shelling. The data of such coaches should be monitored on regular basis to check whether such problems are occurring more than once in the same coach. Apart of it instruction from RDSO vide above reference has been issued to prevent wheel shelling which are as: 1. **Brake Cylinder** Pressure Zonal railways/Pus should not resort to alteration in brake cylinder pressure of LHB coaches from specified value of  $3.0 \pm 0.1$  Kg/cm<sup>2</sup> .

2. Dump Valves choke sizes Dump valve choke sizes should be as under.

<b>Brake System Make/Model</b>	<b>Exhaust Choke Size</b>	<b>Charging Choke Size</b>
KBIL (Model MGS2)	Remove existing 7 mm choke	Replace existing 5 mm choke with 9 mm choke
FTRTIL (Model SWKP AS20R)	Remove existing 9 mm choke	Replace existing 6 mm choke with 9 mm choke

3. **Air Brake Pipes & Fittings** All coaching depots should ensure that there should not be any deviation in airbrake pipes and fittings between dump valves and brake cylinders, otherwise which will cause choking of BC air pressure and inadequate dumping action by the WSP.

4. **Self-Lubricating Bushes** for Brake Callipers/Actuators Depots should ensure that there should not be any lubrication/oiling to self-lubricating buses otherwise it will attract dust which may obstruct freeness of calliper.

5. **Ensure Integrity of electrical connections of WSP** and free movement of brake callipers All depots should ensure 110 V DC power connections to the WSP unit for proper functioning of WSP.

**Encl: - Annexure-A**



**CHECK LIST TO BE FILLED FOR LHB COACHES FOUND WITH MINOR WHEEL SHINE/SKID/ SHELLING**

SL. No	Description of Item	Action
1	Condition of slack adjusting mechanism of brake calliper	
2	Check the type of Bushes in brake calliper (metallic/polyamide).	
3	Condition of Brake levers/ pins lubrication (whether free or jammed)	
4	Play of brake pads in brake pad holders	
5	Clearance between brake disc and brake pad ( 1 to 1.5mm )	
6	Uneven wear of brake pads (Yes/No	
7	Any previous history of skidding /shine/shelling	
8	Functioning of PEABP box and check for any leakage	
9	Condition of BP filters (leakage/blockage)	
10	Conditions of dampers (oil leakage/rubber bush worn out).	
11	Clearance between longitudinal bump stop and lateral bump stop.	
12	Fault code of the WSPD (Data download to be taken).	
13	Self-test of the dump valves.	
14	Check the choke sizes of Dump valves whether it is as per	
15	Check the Air gap between phonic wheel and sensor cable probe.	
16	Bogie BC flexible hose washer condition (hole through / perished / shrinkage dia less)	
17	Brake cylinder hose id (through / blocked).	
18	BC pressure in coach also any fluctuation in BC pressure noticed w.r.t last schedule pressure reading.	
19	Check the bogie body BC flexible hose pipe is of Ermeto type or std design.	
20	Check the size of BC flexible hose pipe bogie to body whether fitted correct size. (700 mm ICF hose should not be provided in LHB coaches as id is less).	
21	Whether correct size (id 14mm) of male stud connector fitted in bogie body BC flexible pipe connection.	
22	Check the BC flexible hose pipe for any Twist, bent etc.	
23	Check the fitment of Bite joints in Body bogie flexible pipe line as per drawing. (More no. of bite joints are not allowed)	

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