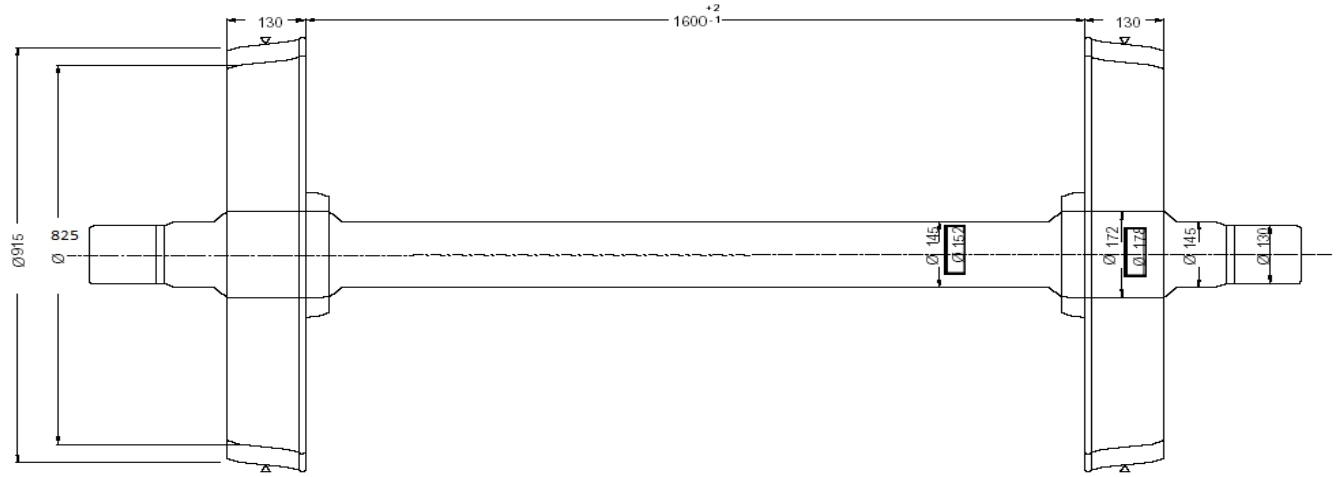
- WHEEL SET
  - Wheel Disc
  - Worn Wheel Profile
  - Intermediate Wheel profile
  - Wheel Defect
  - Wheel shelling.

STC/NBQ

WHEEL SET ASSEMBLY.

The railway wheel set is an assembly of an axle and two wheel discs on both sides of the axle. The wheel sets used in railways are named as per the rolling stocks where it is used. Example BG ICF wheels, LHB wheels, Wagon wheels, Loco wheels, DEMU wheels etc. These wheels differ in particularly by dimensions and geometry etc..



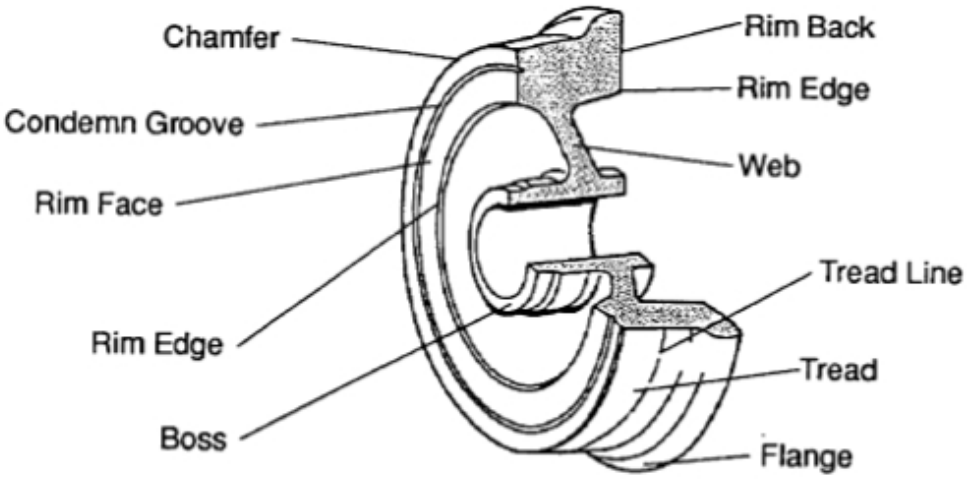
3. THE VARIATION ON DIA UNDER THE SAME COACH SHOULD NOT EXCEED 13 mm.

WHEEL AND AXLE COMPLETE

Type of Wheel Discs- At present in Indian railways only Solid Wheel discs are used. These solid wheel discs are classified according to their method of manufacturing as

- Forged wheel – These wheel discs are manufactured as per IRS specification R- 19/93 Pt. –II (Rev-4).
- Cast Wheel - These wheel discs are manufactured as per IRS specification R- 19/93 Pt. –III.

WHEEL DISC TERMINOLOGY



ADVANTAGES OF SOLID WHEEL

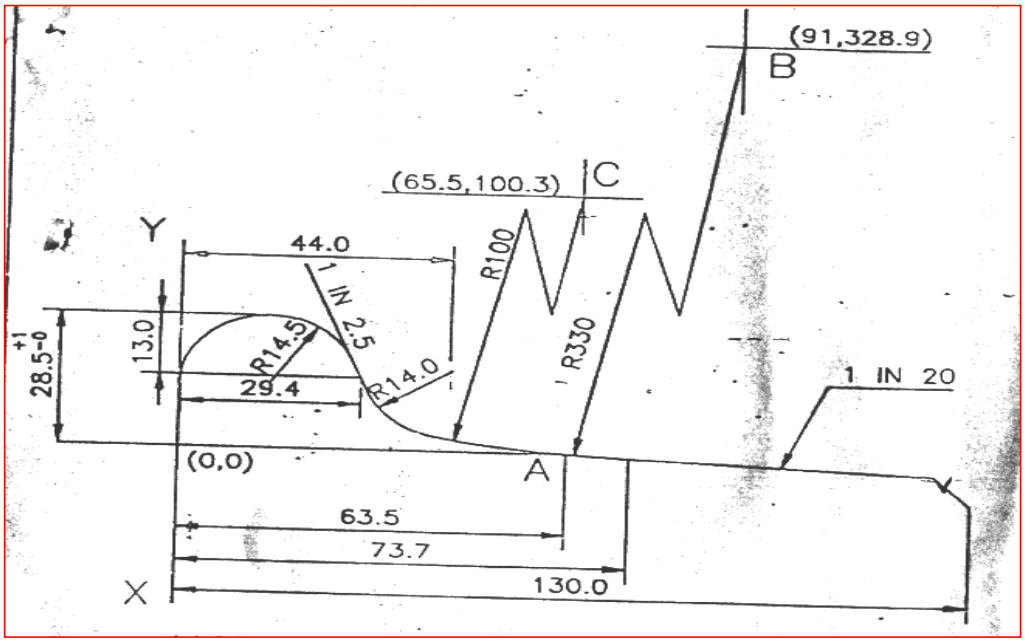
- Lighter in weight
- Very strong
- No danger of tyre getting loose.
- Life is longer than tyred wheel
- It can be reclaimed after it has worn beyond condemning limit
- Heat caused due to breaking and service run is dissipated faster

WHEEL PROFILE- The geometrical configuration of outer periphery (tyre) of wheel is called wheel profile. It is checked with profile gauge.

WORN WHEEL PROFILE

Worn wheel profile is a special profile on wheel tyre derived out of standard wheel profile suitable to worn shape of rail head of which are of 80% track. This is to minimise the condemnation period to avoid frequent wheel changing, re profiling and enhance the life of the wheel.

For C& W wheels this profile is totally replacing the IRS standard wheel profile as standard wheel profile found not economical and not surviving for more number of kms due to the fact that it has to run on worn rail heads which is mismatch to standard wheel profile.



Worn wheel profile

SOLID WHEEL PROFILE

- Tyre : Although tyred wheels are obsolete in Indian railways the term ‘tyre’ refers peripherial portion of a wheel disc.
- Tyre tread : This portion of profile comprises 1 in 20 inclination , radius 100mm, 330mm etc, generally comes contact with rail.

- Flange Thickness: In wheel profile flange is the bulging portion that starts after root radius. 29.4 mm (Worn Wheel Profile), Cond.- 16 mm & 22mm(High Speed),
- Flange Height: New- 28.5 mm
- Radius at the root of Flange: New Radius- 14 mm, Condemning- 13 mm
- Radius at top of Flange – 14.5 mm
- Inclination of 1 in 2.5 on Flange
- Inclination of 1 in 20 on Tread
- Diameter of wheel : Diameter of wheel is measured at tread at a distance 66.5mm from rim face (or 63.5 mm from flange end)
- 'V' groove : It is the marker for condemning limit.
- Thickness of Tyre : It is the radial thickness of tyre.

ADVANTAGES OF TAPER OF 1 IN 20 IN TREAD PROFILE

- Wheels remains in central position on any speed.
- Side thrust and frictional resistance of flanges are of the lowest order.
- Smooth rolling of the wheels is achieved
- With the help profile inclination, a rolling stock can negotiate curve of varying degrees at different speed.

INTERMEDIATE WORN WHEEL PROFILE – To have optimum removal of metal during wheel tyre turning some additional wheel profiles other than the new (max) are adopted based on flange thickness is called intermediate wheel profiles.

Intermediate worn wheel profile (drg no.SKETCH-92082).

i.

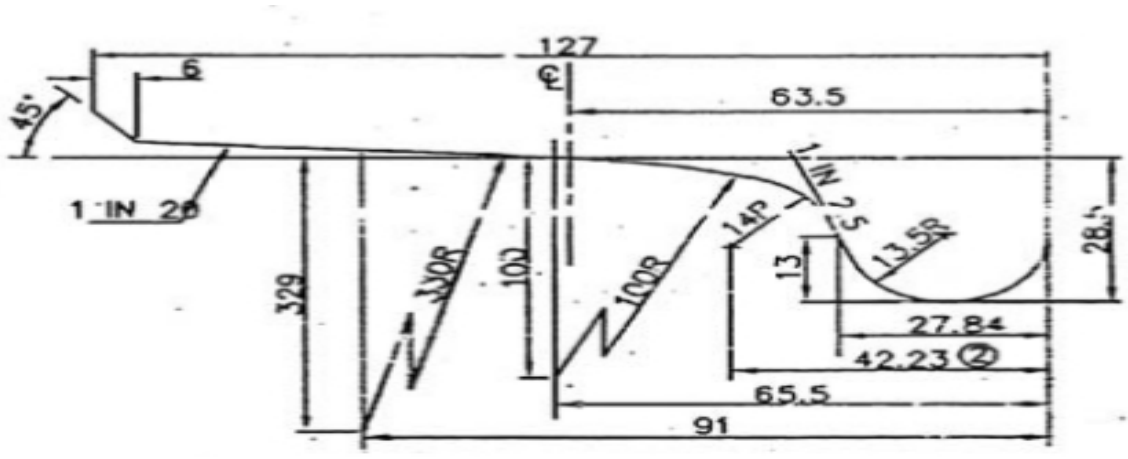


Fig. 28 mm Thick Flange

ii.

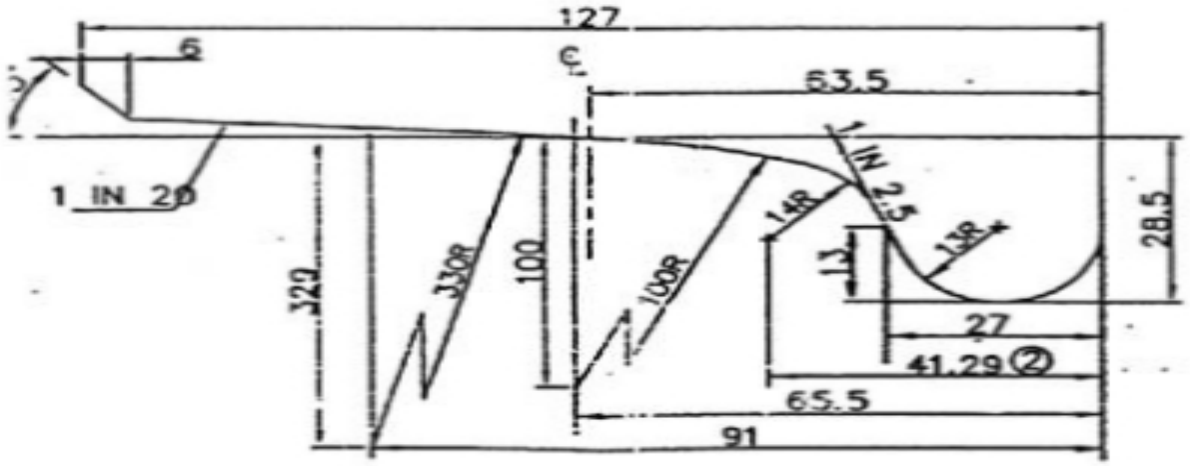


FIG.8: 27mm THICK FLANGE

iii.

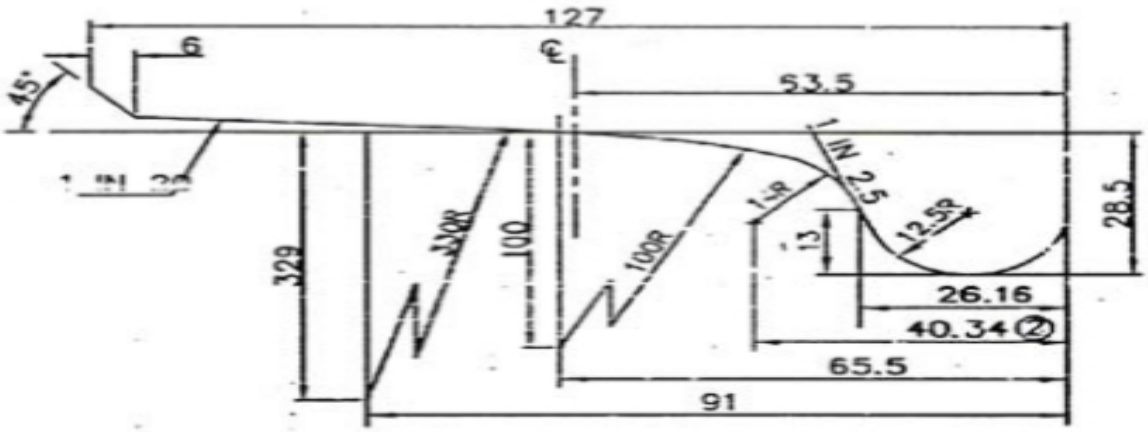


FIG.7: 26mm THICK FLANGE

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iv.

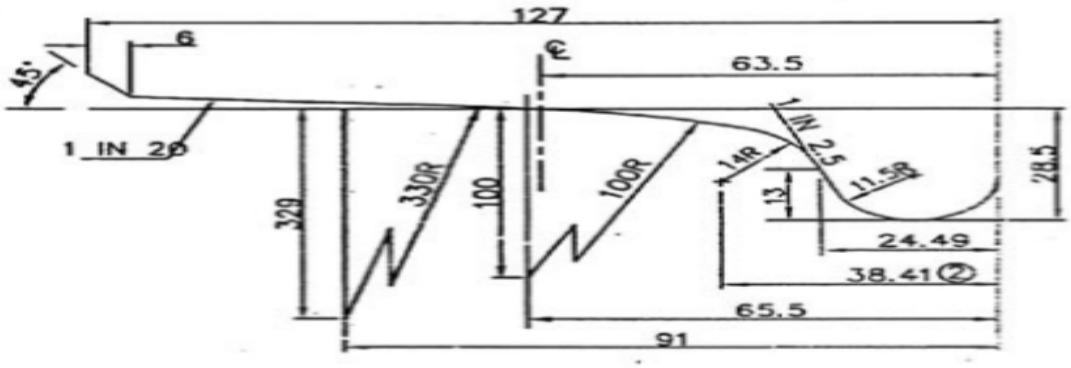

FIG.6: 25mm THICK FLANGE

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v.

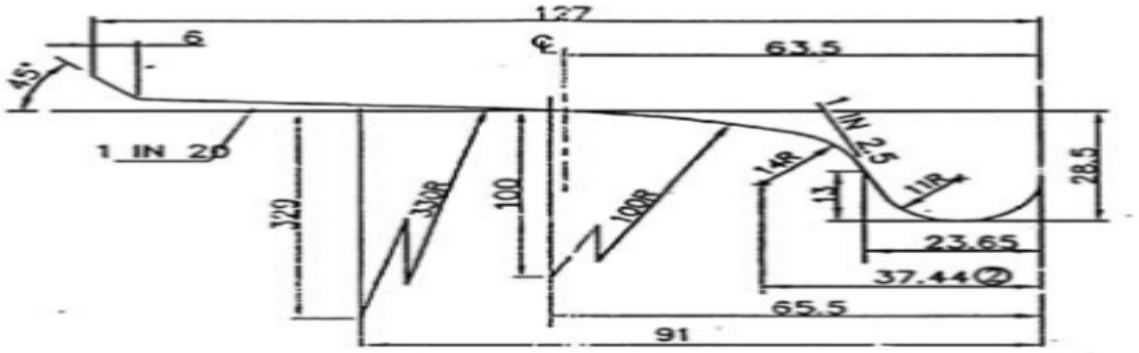

FIG.5: 24mm THICK FLANGE

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vi

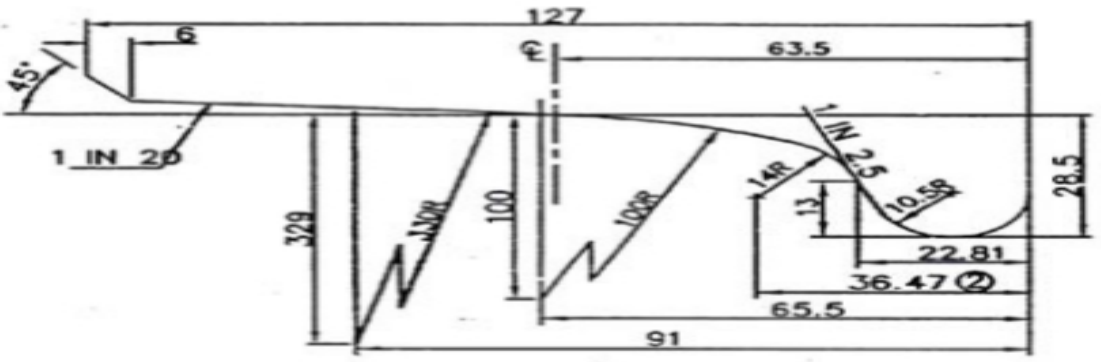

FIG.4: 23mm THICK FLANGE

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vii

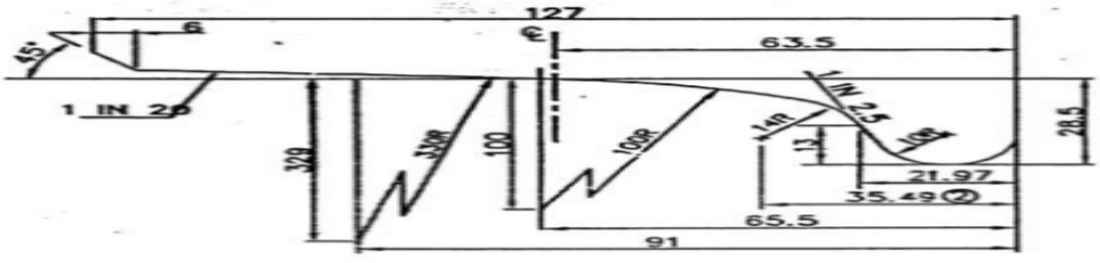

FIG.3: 22mm THICK FLANGE

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viii

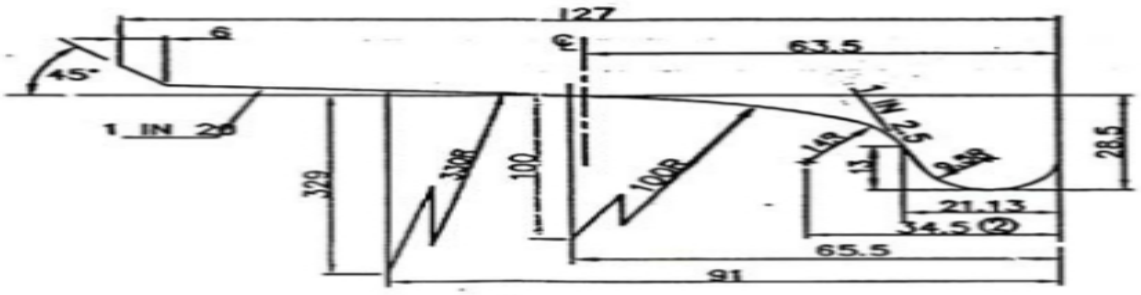


FIG.2: 21mm THICK FLANGE

ix.

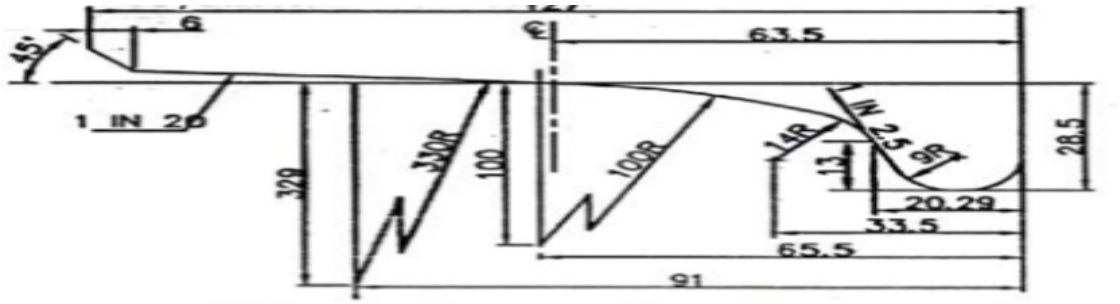


FIG.1: 20mm THICK FLANGE

N.B – Intermediate profile 25, 26, 27, 28 mm should be used for exclusively coaches of 110 km and above.

WHEEL GAUGE

The shortest distance between the two wheels discs on a wheel set is called the wheel gauge distance. It varies for the different types of gauges like BG, MG and NG. etc.

The wheel gauge distance for BG (C&W) wheel is $1600\ -_{1}^{+2}$ mm.

VARIATION IN WHEEL DIMENSIONS - The variation of wheel tread diameter in various of rolling stock is listed below.

Type of wheel set	On same axle	On same bogie/ trolley	On same coach / wagon
BG/ICF	**0.5**	**5**	**13**
BCN/BOXN(CASNUB)	**0.5**	**13**	**25**
BG (diesel)	**0.5**	**8**	**15**
DEMU	**0.5**	**5**	**13**
LHB	**0.5**	**5**	**13**

WHEEL TREAD DIAMETER(All dimensions are in mm)

Types of Wheel	Initial dia.	Last shop issue dia.	Cond. Limit	Drg. No,
BG/ICF solid	915	837	825	W/WL-1600/R
BCN/BOXN(CASNUB)	1000	919	906	WD-97037 S-01
BLC	840	793	780	*CONTR-9404-S/13
BG (diesel)	1092	1020	1016	W/WL-4849/R, W/WL-6061/R
DEMU	952	885	877	SKETCH-K4004
LHB	915	862	855	LW- 02001

WHEEL DEFECTS

- The different defects that can come on a wheel are;

Flange Defects

- Sharp flange
- Thin flange
- Deep flange
- Root of flange

Tyre Defects

-Hollow tyre

-Flat tyre

- **The other defects that can be seen on a Wheel set are;**
  - Bias Wear
  - Grooved wheel

WHEELS DEFECTS

Wheel defects	Standard	Condemning Limit
Sharp Flange	14.5 mm	5 mm or Less
Thin Flange	29.4 mm	16mm or Less, 22mm (High Speed)
Less radius at root of flange	14 mm	13 or Less
Hollow Tyre	-----	5 mm or above
Deep Flange	28.5 mm	35mm or more
Flat Tyre	-----	50 mm or more-Coaching 60 mm or more –Goods

a. LESS RADIUS AT ROOT OF FLANGE

When radius given at the root of flange is reduced to 13 mm is called less radius at root of flange. This defect develops due to one side wear of the wheel tread at the root of flange.

This defect can develop into other defects such as deep flange and hollow tyre.

b. SHARP FLANGE

When the radius given at the tip of flange is worn out to 5mm is called sharp flange. This defect develops either due to running on the same curves for a long period

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.

c. DEEP FLANGE

When the depth of the flange, as measured from the flange tip to a point on the wheel tread 63.5 mm away from the back of wheel becomes greater than 35 mm, the condition is called deep 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 .

d. HOLLOW TYRE

When the projection of the outer edge of the wheel tread below the hollow of the tyre exceeds 5 mm then the outer edge of the wheel is called false flange, and the worn tread is called hollow tyre.

e. THIN FLANGE

When the flange thickness reduces to less than 16 mm, the condition is called thin flange. Thickness of a flange is normally reckoned at a distance of approximately 13 mm from the flange tip.

It leads to breakage of flange under the side thrust of the wheel on a curve

f. 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 its bearings and waste packing.

FLAT TYRE

When wheels skid on account of some defects or continuous application of brakes on ghat section, a particular space on the tyre rubs against the rail causing flat place on the wheel tyre tread. Such wheel is said to have flat tyre.

Flat tyre-

a. causes discomfort to the passengers
b. may damage bearing, journal & rail

- Locomotives- 50 mm
- Coaches - 50 mm
- Wagons - 60 mm (All BG wagons)

The other wheel defects ---

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).

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.

THERMAL CRACKS

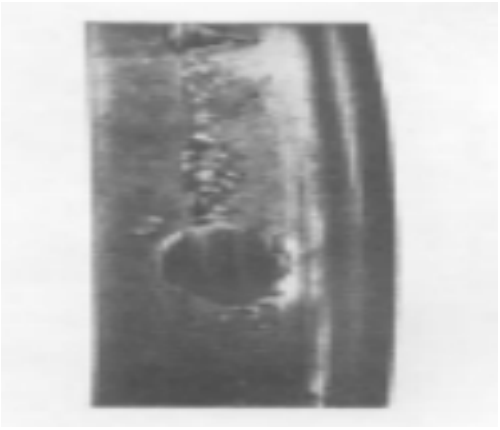
Thermal cracks appear on a wheel tread due to intense heating of the wheel arising out of severe brake binding. Such cracks occur on the tread and generally progress across the tread in a transverse & radial direction. Whenever such a crack becomes visible on the outer face of the rim or tread crack 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.

HEAT CHECK

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.

BUILT-UP TREAD

This is caused by metal from the tread or the brake shoe being heated to the plastic state and then dragged or built - up around the tread. The condition is generally associated with sliding on the rail. Figures illustrate example of built up thread defect



Wheel shelling

Wheel shelling, separation of metal from wheel, is a rolling contact fatigue phenomenon that leads to damage on the wheel tread and eventually small pieces of the wheel tread break off.
Shelling can be identified by pieces of metal breaking out of the tread surface in several places more or less continuously around the rim.

Wheel shelling and spalling are metallurgical phenomena due to rail wheel interaction, which happens in all railways systems.This requires frequent tyre turning at small intervals which involves high cost of repair and replacement. The damaged wheels inflict tremendous load on rails and other components of the coach, causing undesirable noise and vibration, adversely affecting passenger comfort.

Possible reasons-

Generally wheels tend to slide over rail during braking.Whenever a wheel slides, wheel temperature increases as a result of frictional heating and the surface temperature increases tremendously (above the lower critical temperature of steel). This causes pearlite in the contact patch of the wheel material to transform to, martensite, which is brittle.

Preventive measures for Wheel Shelling.

- Close visual check of wheel treads during trip maintenance
- Wheel tapping to be done on pits during trip schedule maintenance.
- Visual check for damage/crack, corrosion or any foreign body of brake callipers.
- Ensure free movement of brake callipers by shaking them manually.
- Close visual check of brake discs for damage/cracks/wear etc., and verify for any axial movement of brake disc
- Check condition of brake pads for any damage/crack/wear.
- If any brake pad warrants replacement, then replace all the brake pads as a set.
- Check for any breaks/damage on earthing cables and Speed sensor cables and rectify if found damaged/broken.
- Check for any defects /breakage in hand brake equipments.
- Functional tests for air brake system, WSP should be done as per laid down procedure (as per OEM maintenance manual)
- Generally leakage of oil from primary damper indicates wheel shelling/skidding. Special attention is to given for this wheel.

- Control arm bolts slackness checking to avoid dropping of control arm to be carried out.
- Control arm bolts checking for slackness (Torque should be 170 Nm) to be done.

Various instruction issued by raiways regarding wheel shelling ---

RDSO – Letter No. SC/WH/SHL dt. 23.09.2009

- Depth of shelling marks has reached 1.5mm.
- Length of shelling mark has reached 40mm.
- Depth of Hollow tyre has reached to 3mm.

RDSO – Letter No. MC/WA/Genldt. 24.01.2018

- Revised drawing for Wheel - increasing the thickens of "WEB" from 14mm to17mm
- Revised the specification for wheels *IRS R-19/93 Part-II (Rev-04)*: Incorporated the requirements for LHB Solid forged wheel and issued Corrigendum No. 1 in August 2015

RB L/NO: No.2006/M (C) /137/13 Part (i) New Delhi, dated, 26.2.2018

- ✖ It has been decided by Board (MRS) that Cast wheels will not be fitted on LHB stock, since non AC LHB trains are also planned to » run at speeds in excess of 110 kmph. Use of Cast wheels on fleet of LHB Coaches will become a major bottleneck in future speeding up of these trains.

RDSO – Letter No. MC/LHB/Brake dt. 15.01.2018

- Special drive should be taken for checking Phonic Wheel Assembly.
- M8 size Screw to IS 1367 Pt III Class 10.9 along with Spring washer to IS 3063 type B should be used.
- Non-Standard fasteners should be replaced.
- The Phonic wheel screws should be tightened with 21N-m Torque
- The clearance between the phonic wheel and the sensor should be 0.9 to 1.4mm and this gap should be checked every quarter

RB L/NO: No.2007/M(C)/137/16 Vol. (xii)Pt. New Delhi, dated: 05.04.2018

1. For M/s KBIL system exhaust choke of 7 mm to be removed from dump valve while retaining 5 mm charging choke. This configuration to be put on trial in 10 LHB coaches each at SDAH/ER, LKO/N'R and BCT/VV'R for 3 months.
2. For M/s FTIL system exhaust choke 9 mm to be removed from dump valve while retaining 6 mm charging choke. This configuration to be put on trial in 10 LHB coaches each at SDAH/ER, LKO/N'R and BCT/WR for 3 months.
3. M/s FTIL to switch over to polyamide self lubricating bushes as proposed in the report.
4. RDSO to study the design of connector of WSP system and suggest ways & means to overcome problem of loosening of connections.
5. Centres of excellence on WSP system to be set up at STC/ Secunderabad, Jhansi and Lucknow. The work is to be completed within next 2-3 months. Action as per above may kindly be ensured

RB L/NO: No 2007/ M(C) /137/16 Vol (xii) PT (i) dated 04.05,2018

1. RDSO vide their letter under reference has recommended change in the minimum permissible diameter of 14+ 3mm web thickness LHB wheels in service be increased to 855mm and the last shop issue size for such wheels be laid down as 862mm. RDSO has further suggested that the wheels of 14 + 3mm web thickness running in service below 855mm diameter be removed from service in a phased manner.

2. Board (MRS) has approved the above recommendation to RDSO. Necessary guidelines may be circulated to the Zonal Railways for implementation on priority under advise to Railway Boards.

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