Wheels

STC/SBC
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 Wheel

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

### Material of Wheel

<table>
<thead>
<tr>
<th>Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.47% to 0.57% for type A used for carriage stock&lt;br&gt;0.57% to 0.67% for type B used for wagon stock</td>
</tr>
<tr>
<td>Mn</td>
<td>0.60 to 0.80%</td>
</tr>
<tr>
<td>P</td>
<td>0.03% max</td>
</tr>
<tr>
<td>S</td>
<td>0.03% max</td>
</tr>
<tr>
<td>Cr</td>
<td>0.15% max</td>
</tr>
<tr>
<td>Ni</td>
<td>0.25% max</td>
</tr>
<tr>
<td>Mo</td>
<td>0.06% max</td>
</tr>
<tr>
<td>Combined % for Cr, Ni &amp; Mo must be 0.40% max</td>
<td></td>
</tr>
</tbody>
</table>
# Mechanical Properties of Cast Wheel

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

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

- Hub
- Disc
- Tyre
Wheel

Diagram showing parts of a wheel:
- Tyre
- Hub
- Disc
• 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

Tread

Flange

Gauge face
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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 tonne axle</td>
<td>68.8 to 103.2 t</td>
</tr>
<tr>
<td>16.25 tonne axle</td>
<td>71.2 to 106.8 t</td>
</tr>
<tr>
<td>BOXN &amp; BLC</td>
<td>85 to 127 t</td>
</tr>
</tbody>
</table>
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

DATE AND INITIALS OF WORKSHOP & ITS CODE WHERE REAXLING IS DONE

One end of axle

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

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 PILLET 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 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.

PCD OF STAMPING OF DIFFERENT WHEELS

<table>
<thead>
<tr>
<th>TYPE OF WHEEL</th>
<th>PCD OF STAMPING ON RIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>COACHING</td>
<td>788 mm</td>
</tr>
<tr>
<td>T-9-2-622</td>
<td>788 mm</td>
</tr>
<tr>
<td>W/WL-1660</td>
<td>788 mm</td>
</tr>
<tr>
<td>W/M-1702</td>
<td>610 mm</td>
</tr>
<tr>
<td>WAGEN</td>
<td>570 mm</td>
</tr>
<tr>
<td>W/WL-4764</td>
<td>780 mm</td>
</tr>
<tr>
<td>W/M-4771</td>
<td>630 mm</td>
</tr>
<tr>
<td>W-90025/5-5</td>
<td>980 mm</td>
</tr>
<tr>
<td>W-90025/5-9</td>
<td>980 mm</td>
</tr>
<tr>
<td>CONTAINER LUG</td>
<td>755 mm</td>
</tr>
<tr>
<td>84004-4/5</td>
<td>842 mm (FOR WC)</td>
</tr>
<tr>
<td>84004-1/3</td>
<td>832 mm (FOR WC)</td>
</tr>
</tbody>
</table>

SOLID WHEEL FOR ENGINES

SCALE P

SUPERSEDES

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

<table>
<thead>
<tr>
<th>Flange Thickness (X)</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 mm</td>
<td>42.23 mm</td>
<td>13.5 mm</td>
</tr>
<tr>
<td>27 mm</td>
<td>41.29 mm</td>
<td>13.0 mm</td>
</tr>
<tr>
<td>26 mm</td>
<td>40.34 mm</td>
<td>12.5 mm</td>
</tr>
<tr>
<td>25 mm</td>
<td>38.41 mm</td>
<td>11.5 mm</td>
</tr>
<tr>
<td>24 mm</td>
<td>37.44 mm</td>
<td>11.0 mm</td>
</tr>
<tr>
<td>23 mm</td>
<td>36.47 mm</td>
<td>10.5 mm</td>
</tr>
<tr>
<td>22 mm</td>
<td>35.49 mm</td>
<td>10.0 mm</td>
</tr>
<tr>
<td>21 mm</td>
<td>34.5 mm</td>
<td>9.5 mm</td>
</tr>
<tr>
<td>20 mm</td>
<td>33.5 mm</td>
<td>9.0 mm</td>
</tr>
</tbody>
</table>
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 - 0.01 mm (max)
- Difference in dia of wheels on the same axle should not exceed 0.5 mm
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

<table>
<thead>
<tr>
<th>Defect</th>
<th>Std</th>
<th>Cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin flange</td>
<td>28.5</td>
<td>22 (Coaches)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 (Wagons)</td>
</tr>
<tr>
<td>Deep flange</td>
<td>28.5</td>
<td>35</td>
</tr>
<tr>
<td>Sharp flange (radius)</td>
<td>14.5</td>
<td>5</td>
</tr>
<tr>
<td>Less radius at root of flange (radius)</td>
<td>14 (wwp)</td>
<td>13</td>
</tr>
<tr>
<td>Hollow tyre</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Thin tyre</td>
<td></td>
<td>Based on wheel dia</td>
</tr>
<tr>
<td>Flat tyre</td>
<td></td>
<td>50 (Coaches)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60 (wagons)</td>
</tr>
</tbody>
</table>
Tyre Defect Gauge

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.
When X is parallel to Y, if there is a 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.
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.
If there is no gap between the gauge and the wheel tread at “A”, the wheel is rejectable.

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Std</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach MG</td>
<td>930</td>
<td>932</td>
<td>929</td>
</tr>
<tr>
<td>ICF coach BG</td>
<td>1600</td>
<td>1602</td>
<td>1599</td>
</tr>
<tr>
<td>LHB coach</td>
<td>1600</td>
<td>1601</td>
<td>1599</td>
</tr>
<tr>
<td>Wagons</td>
<td>1600</td>
<td>1602</td>
<td>1599</td>
</tr>
</tbody>
</table>
## Wheel Diameter

<table>
<thead>
<tr>
<th>Description</th>
<th>Std</th>
<th>Cond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach MG</td>
<td>915</td>
<td>825</td>
</tr>
<tr>
<td>ICF coach BG</td>
<td>915</td>
<td>845</td>
</tr>
<tr>
<td>LHB coach</td>
<td>915</td>
<td>845</td>
</tr>
<tr>
<td>BOXN</td>
<td>1000</td>
<td>906</td>
</tr>
<tr>
<td>UIC</td>
<td>1000</td>
<td>860</td>
</tr>
<tr>
<td>BLC</td>
<td>840</td>
<td>780</td>
</tr>
</tbody>
</table>
Wheel Changing

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

<table>
<thead>
<tr>
<th>Type</th>
<th>On the same bogie</th>
<th>On the same coach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach MG</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Coach BG</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Wagons</td>
<td>13</td>
<td>25</td>
</tr>
</tbody>
</table>

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