PROCEDURE FOR VISUAL & PHYSICAL INSPECTION OF WHEELS OF ‘ON’ TRACK MACHINES

REPORT NO. TM-170

JULY-2012
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PROCEDURE FOR VISUAL & PHYSICAL INSPECTION OF WHEELS OF ‘ON’ TRACK MACHINES

Track machine wheels are solid wheels and follows the Wear adopted or Worn wheel profile as per annexure-I.

Following inspections shall be performed on wheels of ‘ON’ track machines.

1. ULTRASONIC INSPECTION

Wheels of ‘ON’ Track Machines shall be tested ultrasonically at the time of initial procurement only. The ultrasonic testing of new wheel shall be done according to the RDSO report no. IRS R-34-2003.

2. VISUAL INSPECTIONS

During service, the wheels of track machines shall be inspected visually at least once in a year or once after every 1000 engine running hours whichever is earlier.

   i. Burnt Rim
   ii. Shattered rim
   iii. Spread Rim
   iv. Shelled Tread
   v. Thermal Cracks
   vi. Built-up Tread
   vii. Cracked or Broken Flange
   viii. Cracked or Broken Plate
   ix. Cracked Hub
   x. Loose Wheels
   xi. Wheels which have been Over Heated

i) BURNT RIM

If a portion of flange or rim breaks off, the wheel must be removed from service. The break shows rough granular fracture, this would indicate, in a wrought steel wheel, that it has been overheated in the process of manufacture.
ii) **SHATTERED RIM**

The wheel that shows a circumferential crack on the front or back face of the rim must be removed from service. Wheels subject to shattered rim failure should be inspected closely for such cracks so that when present, the wheel may be removed before a piece of tread actually breaks out.

![Shattered Rim](image)

iii) **SPREAD RIM**

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 If the rim widens out for a short distance on the front face, an internal defect may be present and the wheel must be withdrawn from service.

![Spread Rim](image)

iv) **SHELLED TREAD**

The wheel has a shelled tread when pieces of metal break out as shown in figure and must be removed from service. Unless this defect has progressed too far, it can generally be turned out taking care that all evidence of the defect is eliminated before putting such wheels in service. Where excessive shelling occurs, it is recommended that remedial measures be taken since poor tracks, excessive speed, excessive loads or use of wheels of insufficient hardness can contribute to such defects.

![Shelled Tread](image)
v) THERMAL CRACKS

Intense brake heating cause thermal cracks which occur cross-wise on the tread and may be confined to tread or flange as shown in fig.1 or in extreme cases, may go through the entire tread and into the plate as shown in fig.2. True thermal cracking is a serious defect and in any stage of development it is the cause for the immediate removal of the wheel from service.

Shallow thermal cracks can, however, be removed by machining, taking extra care to ensure that the crack has been completely eliminated in the operation.

Wheels found with radial cracks on the back or front face of the rim should be removed from service, since such cracks often originate in hot stamp marks, lathe dog or chuck marks or miscellaneous nicks or surface defects on the rim faces which tend to progress and may ultimately lead to wheel failures of the types shown in Fig.2.

Fig.3 shows shelling and spalling between thermal cracks. As compared with true shelling, spalling is the result of small portions of metal breaking out between or adjacent to fine thermal checks which in turn may be associated with small skid marks or "chain sliding". Spalling normally is not considered as a condemnable defect as it can be removed by machining the treads down to sound metal.
vi) **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 examples of built-up tread defects.

![Fig.3](image)

vii) **CRACKED OR BROKEN FLANGE**

The wheel is condemnable and must be removed from service, when cracked or broken flange develop. However, such defects are rare on steel wheels. Fig. below shows a chipped flange on a cast iron wheel.

viii) **CRACKED OR BROKEN PLATE**

Cracks in the plate develop due to stresses from service loads and braking in combination with internal stresses in the wheel and possibly surface defects in areas subject to high stresses. Most plate cracks are progressive in nature and it is important that they be detected in their early stages. Following figure shows one that has progressed through the entire tread section.
ix) **CRACKED HUB**

This failure usually occurs during mounting, due to the causes mentioned below:

a) Stresses set up in the hub during manufacture of the wheel.

b) Defective material.

c) Improper machine shop practice such as

i) Wheels with tapered bore or rough bore

ii) Tapered or short wheel seats on the axle

iii) Excessive allowance for fitting wheels to the axles

d) Hub failures may also originate from thermal cracks on the hub face which are similarly radial in direction. Hub thermal cracks may occur when the hub face is used as a thrust bearing or where there is accidental rubbing on the hub face.

x) **LOOSE WHEELS**

Wheels must be removed from service if they show indications of being loose on the axle. It is important to watch for evidence of any wheel movement on the axle wheel seat.

xi) **WHEELS WHICH HAVE BEEN OVER HEATED**

Wheels which have been over-heated as a result of being in a fire should be scrapped. Wheels which show evidence or severe over-heating in service from stuck or dragging brakes should be removed and scrapped. Such wheels are potentially dangerous because they become highly stressed and, if thermal cracked subsequently, may fail instantaneously.
3. PHYSICAL INSPECTIONS

During service, the wheels of track machines shall be inspected physically at least once in a year, preferably during IOH/POH of the machine for following defects.

i) Thin Flange
ii) Sharp flange
iii) Worn root
iv) Deep flange
v) False Flange/Hollow Tyre
vi) Flat places/skidded
vii) Wheel tread diameter
viii) Wheel Gauge

Reaching of condemning limit for defects i) to vi) mentioned above are checked with the help of tyre defect gauge as shown in annexure-II. Defect as in item (vii) is checked by a wheel dia Gauge (like Trammel gauge) and (viii) with wheel distance gauge.

As far as possible, wheels should be re-profiled to original profile as per annexure-I or any of the intermediate profiles as shown in annexure-IV. Wheel diameter after profiling should not be less than the condemning wheel diameter. Various condemning limits and method of checking, using tyre defect gauge, are detailed below

i) 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. The thin flange is checked as shown in sketch below.
ii) **SHARP FLANGE**

When the radius of flange tip reduces to less than 5 mm, the condition is called sharp flange. The sharp flange is checked as shown in sketch below.

![Sharp Flange](image)

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**SHARP FLANGE**

iii) **WORN ROOT**

When the radius of the root curve reduces to less than 13 mm, the condition is called worn root. The worn root is checked as shown in sketch below.

![Worn Root](image)

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**WORN ROOT**

iv) **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. Deep flange is checked as shown in sketch below.

![Deep Flange](image)
v) FALSE FLANGE/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. False flange/hollow tyre is checked as shown in sketch below.

vi) FLAT TYRE

The maximum permissible length of flat on the wheel tyre is 50 mm. Flat tyre is checked as shown in sketch below.
vii) **DIFFERENCE IN WHEEL TREAD DIAMETERS**

The wheel diameter is measured on the tread at a distance of 63.5 mm from the back of the wheel. These measurements shall be taken at three locations apart for each wheel. If wheel gauge is not within permissible limits, then the wheel disc (s) has to be pressed off and then pressed on. When wheels are changed/turned, it should be ensured that the variation in tread diameters does not exceed the maximum permissible limits indicated below.

<table>
<thead>
<tr>
<th>Location</th>
<th>Limit</th>
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<tbody>
<tr>
<td>On the same axle</td>
<td>0.5 mm</td>
</tr>
<tr>
<td>On the same Bogie</td>
<td>5.0 mm</td>
</tr>
<tr>
<td>On the same Machine</td>
<td>13.0 mm</td>
</tr>
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viii) **WHEEL GAUGE**

Wheel gauge is the distance back-to-back of the wheels on a wheel set. The wheel gauge should be checked with wheel distance gauge as annexed at annexure-III at quarter points.

No variation whatsoever is permitted among the values of wheel gauge measured at quarter points. A variation in the values of wheel gauge measured at quarter points indicates a bent axle. A bent axle on motion will start wobbling causing severe vibrations between the bearing and the journal and consequently greater wear and friction between the two. This would result in the axles, running hot at the journals. Besides, with the white metal fused in hot axle condition off-loading of the wheel will take place. Owing to fatigue, axle could also fracture.

Subject to the above condition, the actual value of wheel gauge can vary between the following tolerances.

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
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<tbody>
<tr>
<td>Standard</td>
<td>1600 mm</td>
</tr>
<tr>
<td>Maximum</td>
<td>1602 mm</td>
</tr>
<tr>
<td>Minimum</td>
<td>1599 mm</td>
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ANNEXURE-I

PROCEDURE OF DRAWING:

1. Draw a vertical line X-Y.
2. Draw semi-circle of 14.5R tangential to line X-Y.
3. Draw line 1:2.5 tangentially to 14.5R semi-circle.
4. Draw a horizontal line at 28.5mm from the top of the flange, and locate point A at 63.5mm from the line X-Y.
5. From point A, locate centre 'B' of arc of 330R on a vertical line at 91mm from X-Y.
6. Draw arc of 330R from centre 'B'.
7. Locate centre 'C' on vertical line at a horizontal distance of 65.5mm from the line X-Y such that BC = (33C-100) i.e. 230mm.
8. Draw arc of 100R with centre as 'C'.
9. Draw arc of radius 14mm tangentially to 100R arc and line 1:2.5.
10. Draw line 1:20 tangentially to 330R arc.
11. Draw a vertical line at a distance of 30mm from the flange end.

NOTE:
CO-ORDINATES OF POINTS B & C ARE BASED ON NOMINAL DIMENSION OF 28.5mm.

WORN WHEEL PROFILE

SUPERSeded BY:

SCALE  P
1:1  C

SUPERSedes:

G.V. Raman

DESCRIPTION DATE

B.G. R.D.S.O. C

SKETCH-91146

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ANNEXURE-II

TYRE DEFECT GAUGE FOR SOLID AND TYRED WHEELS
WHEEL DISTANCE GAUGE

Moving End
Locking Knob
Fixed End

WHEEL DISTANCE GAUGE

Wheel Distance Gauge (Line Gauge)

Spirit Level Indicator