

Railcar Wheel Inspection and Defects Standard

Engineering Standard

Rail Commissioner

PTS-MS-10-XM-STD-00000084

Document Control

Document Status

Document Owner: Rolling Stock Engineering Manager			
Action	Name and Position	Signature	Date
Prepared By:	Name: Kuldeep Zala Title: Engineer Rolling Stock	Digital Approval # 4114 KNet # 15270027	12/03/2020
Reviewed By:	Name: Peter Lindqvist Title: Team Leader Rolling Stock Engineering (Mechanical)	Digital Approval # 4114 KNet # 15270027	13/03/2020
Approved By:	Name: Gary Webb Title: Rolling Stock Engineering Manager	Digital Approval # 4114 KNet # 15270027	23/03/2020
Document Review Schedule: This document is due for review as required			

Document Amendment Record

Revision	Change Description	Date	Prepared	Reviewed	Approved
0	Initial Issue	May 2012	Kuldeep Zala	Peter Haskard	Rob Taverner
1	Updated signatures block and amended tables 5.2,5.4,5.6,5.7,5.8,5.9	February 2013	Keith Charlton	Philip Degenhardt Peter Haskard	Brian Green
2	Updated intervention limits and defects identification for 4000 class railcars	November 2014	Kuldeep Zala Doug Fleming	Peter Haskard	Phil Agnew
3	Section 10.2 - Minimum flange thickness changed to 20 mm and RISSB Gauge 17-4-1 has been removed - ECR0169	September 2015	Kuldeep Zala	Peter Lindqvist	Peter Haskard
4	Condemn Gauge (RS1-DRG-300008) has been modified to accommodate 20 mm flange thickness.	January 2016	Kuldeep Zala	Peter Lindqvist	Gary Webb
5	Condemn Gauge (3EAM918242) has been added for 4000 Class	February 2017	Kuldeep Zala	Shahzada Chowdhury	Gary Webb
6	Rail Vehicle Wheel Record Forms removed, 7/8 wheel profile added, 4000 class drawings added and new section 12 added	November 2018	Kuldeep Zala	Peter Lindqvist	Gary Webb
7	4000 Class flange width minimum limit updated and sections 11 and 13 updated MOC # 1681339 MOC # 1802042	March 2020	Kuldeep Zala	Peter Lindqvist	Gary Webb

TABLE OF CONTENTS

1. Introduction.....	5
2. Purpose	5
3. Scope	5
4. Related Documents.....	5
5. References.....	5
6. Acronyms	6
7. Standard Terminology for Rail Wheel Features.....	7
8. MP2 Wheel Profile	7
9. Wheel Inspection.....	8
10. Wheel Profile Limits.....	9
10.1. Inspection Frequency.....	9
10.2. Flange Width / Thickness.....	10
10.2.1. Method of Measurement.....	10
10.2.2. Intervention Limits and Defects Identification	10
10.2.3. Wheel Condemn Gauge – Thin Flange.....	11
10.3. Flange Angle	13
10.3.1. Intervention Limits and Defects Identification	13
10.3.2. Wheel Condemn Gauge – Steep Flange	13
10.4. Flange Height	15
10.4.1. Method of Measurement.....	15
10.4.2. Intervention Limits and Defects Identification	15
10.4.3. Wheel Condemn Gauge – High Flange	16
10.5. Tread Diameter.....	17
10.5.1. Method of Measurement.....	17
10.5.2. Intervention Limits and Defects Identification	17
10.5.3. Variation in Tread Diameter	17
10.6. Rim Thickness	18
10.6.1. Method of Measurement.....	18
10.6.2. Intervention Limits and Defects Identification	18
10.6.3. Wheel Condemn Gauge – Thin Rim	19
10.7. Tread Hollowing.....	20
10.7.1. Intervention Limits and Defects Identification	20
10.7.2. Wheel Condemn Gauge – Hollow Tread.....	21
10.8. Back face to back face Dimension of Wheel	21
10.8.1. Method of Measurement.....	21
10.8.2. Intervention Limits and Defects Identification	21

11. Classification of Railcar Wheel Defects 22

 11.1. Thermal Cracking 22

 11.2. Spalling..... 23

 11.3. Skidded Wheels (Flats)..... 24

 11.4. Scaled Wheels..... 24

 11.5. Arris 25

 11.6. Rolled Edge 26

 11.7. Damaged / Fractured Wheels 27

 11.8. Overheated Wheels 27

 11.9. Out-of-round Wheels 27

 11.10. Witness Mark..... 27

12. Shock Vibration and Acoustic Emissions 28

13. Action Following Derailments 28

14. Wheel Inspection Records 28

APPENDIX 1 Rail Wheel Profiles – MP2 & 7/8 MP2..... 29

APPENDIX 2 Wheel Profile Gauges 30

App 2.1 Measurement Gauge (RISSB Gauge No.207-661) 30

App 2.2 Condemn Gauge (DPTI Gauge No.300008)..... 31

App 2.3 Condemn Wheel Hollow Wear Gauge (RISSB Gauge No. PTS - 001) 32

App 2.4 Condemn Gauge for Witness Mark..... 33

App 2.5 Condemn Gauge for 4000 Class - Rim Thickness..... 34

App 2.6 Condemn Gauge for 4000 class - Flange Thickness 35

1. Introduction

The Department of Planning, Transport and Infrastructure (DPTI) owns, operates and maintains the Adelaide Metropolitan Passenger Rail Network (AMPRN). This standard forms part of the engineering management system used to ensure safety and customer service levels are efficiently and effectively supported.

2. Purpose

The purpose of this document is to provide technical information about railcar wheel data, defects classifications and wheel inspection.

This document sets the minimum wheel profile standard, allowable defects and response criteria.

3. Scope

This standard applies to the following rolling stock:

- o 3000/3100 Class railcar
- o 4000 Class railcar
- o Infrastructure Maintenance Rolling Stock including road rail vehicles and track machines¹.

This standard applies to staff working in:

- o DPTI Engineering and Maintenance functional areas, including O&M capital projects;
- o DPTI Operations functional areas; and
- o DPTI contractors to the extent specified in their contract.

4. Related Documents

DOCUMENT NAME	DOCUMENT NUMBER
MP2 Tread Profile for 3000 / 4000 Series	243-A3-96-054 (KNet # 6914832)
Tread Thickness Gauge 4000 Class	3EAM918241 (KNet # 8830104)
Train Wheel Profile MP2 Condemn Gauge No. 300008 Details	RS1-DRG-300008 (KNet # 9815786)
3000/3100 Class Rail Car – 7/8th Flange Width MP2 Wheel Profile – Detail Drawing	RS1-RDG-300005 (KNet # 10482488)
Flange Wear Gauge 4000 Class	3EAM918242 (KNet # 11231477)

5. References

- Rail Safety National Law (South Australia) Act 2012
- RISSB Document Wheel Defects Code of Practice
- RS1-DOC-000465 Engineering Standard for Train Wheelsets
- RS1-DOC-000453 Engineering Standard for Train Wheels
- FR-AM-GE-804 Development and Approval of Rail Engineering Standards
- RMA Railcar Maintenance Agreement for 3000 class railcars
- RMA - EMU Railcar Maintenance Agreement for 4000 class railcars

¹ **An advice shall be sought form DPTI Rolling Stock Engineering for any non-compliances or proposed alternative wheel profiles.**

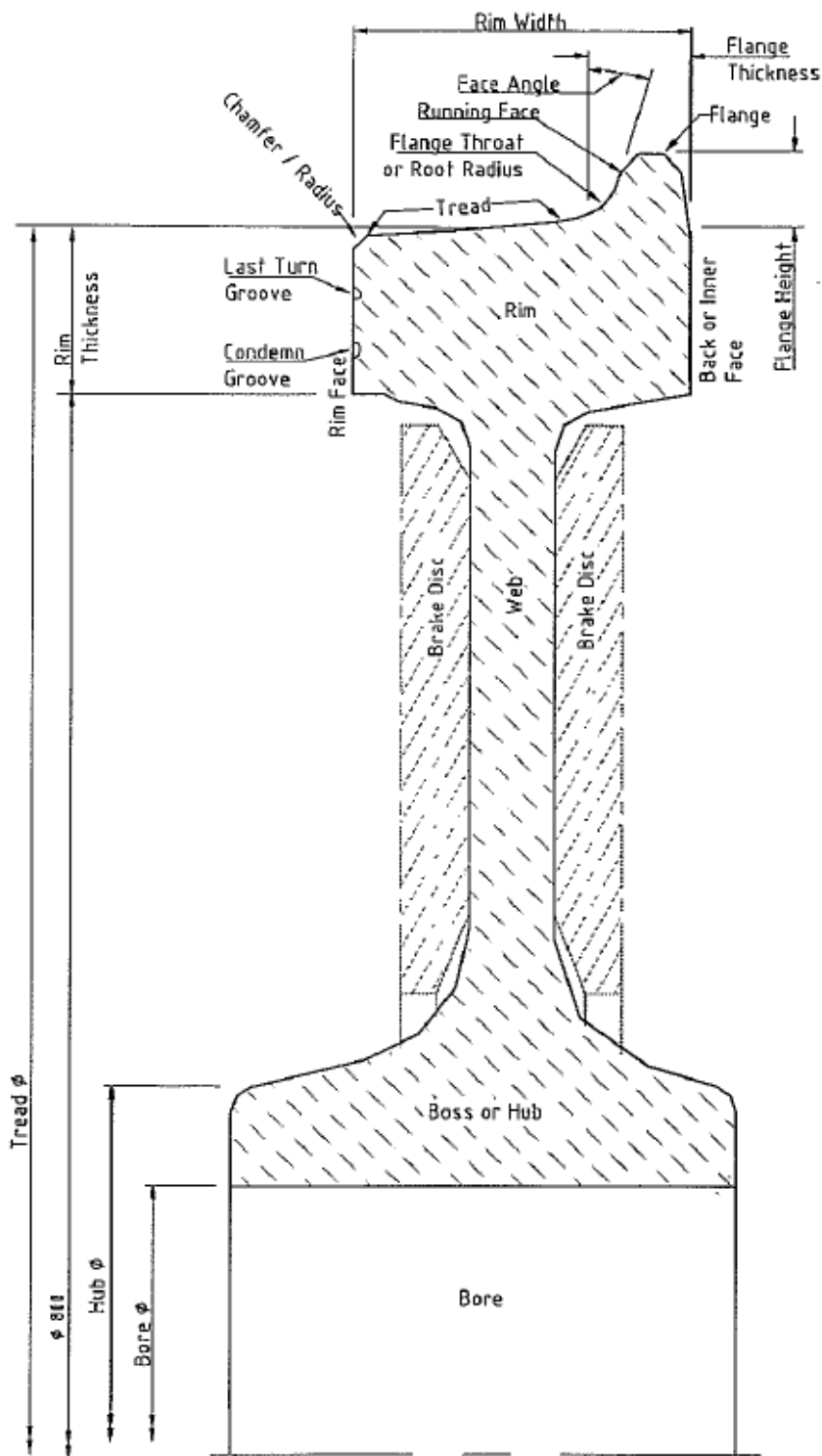
Wheel Assembly Drawings (For information only)

- 243-A0-89-836 (KNet # 8810642) Wheel, Solid – Bogie , 3000-3100 Class Railcars
- 243-A0-95-1796 (KNet # 13221201) Wheel Set – Driven, 3000-3100 Class Railcars
- 243-A0-89-834 (KNet # 10335101) Wheel Set – Trailing , 3000-3100 Class Railcars
- 100159623 (KNet # 13248131) Trailer Wheelset Assembly 4000 Class
- 100159634 (KNet # 13248163) Sheet 1 of 2 Wheelset and Bearing Assembly (Trailer) 1600 Gauge – 4000 Class
- 100159634 (KNet # 13248662) Sheet 2 of 2 Wheelset and Bearing Assembly (Trailer) 1600 Gauge – 4000 Class
- 100159011 (KNet # 13248783) Wheel – 4000 Class

6. Acronyms

ACRONYM	FULL NAME
AMPRN	Adelaide Metropolitan Passenger Rail Network
DMU	Diesel Multiple Unit - diesel powered railcar
DEMU	Diesel Electrical Multiple Unit – diesel powered electric railcar
DPTI	Department of Planning, Transport and Infrastructure
RMA	Railcar Maintenance Agreement
EMU	Electrical Multiple Unit - electric powered railcar

7. Standard Terminology for Rail Wheel Features



HALF SECTION THROUGH WHEEL

8. MP2 Wheel Profile

DPTI applies the MP2 wheel profile to all new and re-profiled wheels.

The MP2 Wheel profile shall be in accordance with drawing 243-A3-96-054(refer Appendix 1)

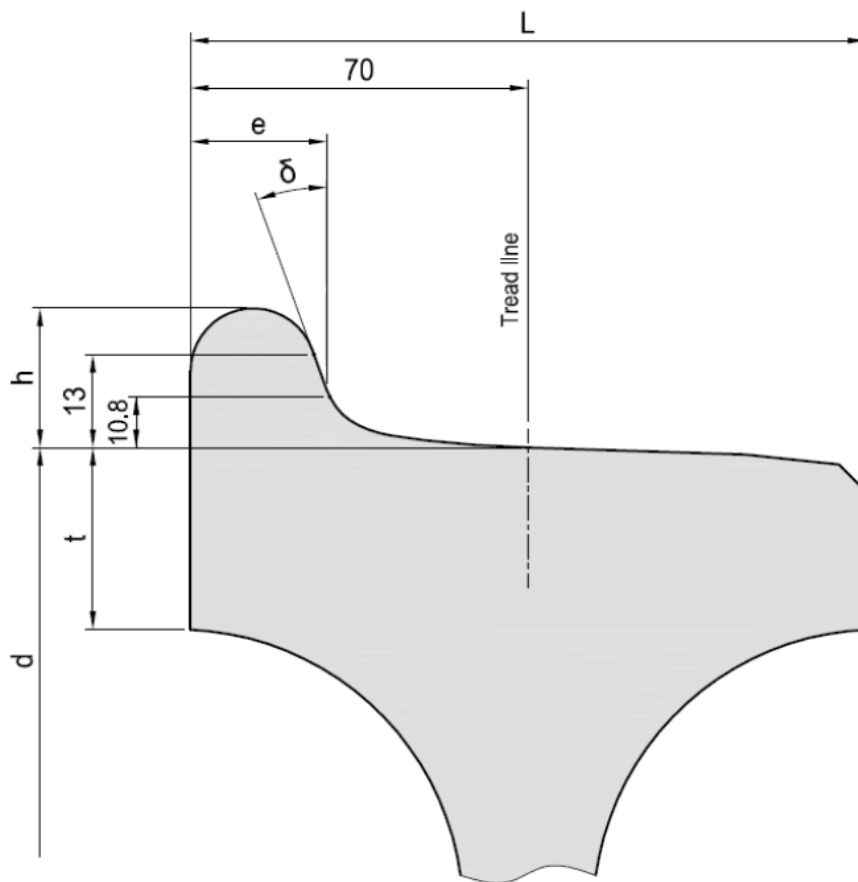
A 7/8th flange width MP2 profile in accordance with RS1-DRG-300005 may be used. The full MP2 profile's intervention limits will apply for these re-profiled wheels.

9. Wheel Inspection

Wheels shall be inspected in accordance with this standard for profile, flange, tread and rim, non-conformances and general physical condition. Inspection shall also be carried out to detect various wheel defects such as thin flange, steep flange, hollow tread, flange defects, thin rim, tread defects, out-of-round wheels, fractured wheels and overheating.

The figure below shows the locations for limiting dimensions. It shows the unworn profile but is also applicable for worn profiles.

Manual wheel profile measurement gauge and condemn gauges are shown in Appendix 2. Alternative approved wheel inspection devices like Calipri, Wheel Mate or Miniprof may also be used. Every inspection device shall be traceable, calibrated annually or as per manufacturer's requirements and must be stamped with device type and serial number.



d: Wheel diameter
L: Rim width

e: Flange thickness
h: Flange height

δ: Flange angle
t: Rim thickness

Figure 9 – Wheel profile critical dimensions

10. Wheel Profile Limits

The railcar wheel profile shall be inspected for the following:

- Thin flange
- Steep flange
- High flange
- Thin rim
- Hollow tread
- Wheel defects

10.1. Inspection Frequency

Railcar wheels shall be inspected in accordance with the schedule shown in table 10.1 and by a qualified person deemed to be competent in wheel inspection.

Table 10.1: Inspection Frequency

RAIL WHEEL CLASS	INSPECTION
3000/3100 Class	In accordance with balanced examination B1 to B16
4000 Class	In accordance with balanced examination A1 to A10, B1, B2, C1, C2

Visual inspection

The wheel profile shall be inspected visually by walking under the railcar at the maintenance facility and using condemn gauge (Appendix 2) where the visual inspection indicates a potential defect.

Detailed inspection

The wheel profile shall be measured using gauge No. 207-661 (see Appendix 2 for details of this gauge) or alternative approved wheel inspection devices like Calipri, Wheel Mate or Miniprof and the measurements shall be recorded at the following frequencies

- For 3000 Class –Major Service in accordance with the RMA which is every 6 weeks \pm 5 days or 12,000 km
- For 4000 Class – Balanced Examination in accordance with the RMA – EMU which is every 60 days

Visual and Detailed inspection of wheels shall also be carried out after the following occurrences:

- Wheel lathe machining
- Wheelset change and
- Derailment (in accordance with section 13)
- Defect report (in accordance with section 12)

10.2. Flange Width / Thickness

Inspection frequency for measurement of flange width / thickness shall be in accordance with table 10.1

10.2.1. Method of Measurement

Flange width/thickness shall be measured with Gauge No 207-661 (see Appendix 2) using the following steps:

- The wheel gauge is to be pressed flush against the side of the rim, the gauge finger resting on the tread surface and the pointer of the rotating arm against the side of the flange as shown;
- The “W” marker on the gauge body indicates the flange thickness as shown on the rotating arm graduations

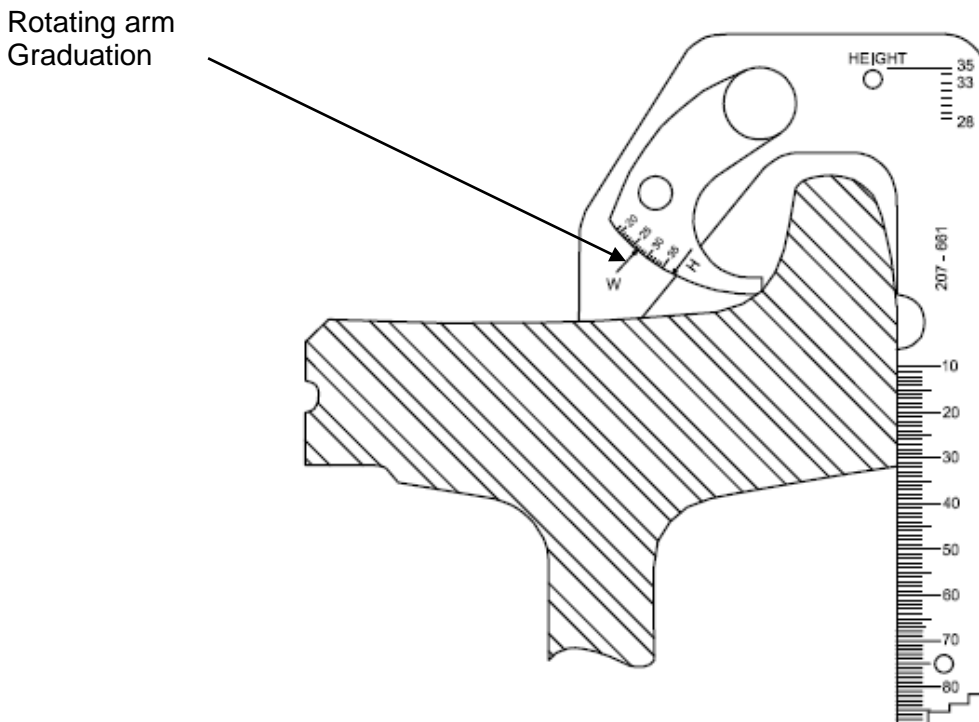


Figure 10.2.1 – Gauge no. 207-661 flange width / thickness measurement

10.2.2. Intervention Limits and Defects Identification

The following table shows the minimum and maximum limits for flange width/thickness dimensions for different railcar wheels, out of limit flange thickness and the relevant response criteria.

Table 10.2: Flange Thickness

RAILCAR WHEEL	MINIMUM (MM)	MAXIMUM (MM)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100	20	30 as new	Less than 20 mm	Re-profile the wheels before further use.	N/A
4000	22	30 as new	Less than 22 mm		

3000/3100	21 or Less	Wheel shall be inspected on a weekly basis to ensure the wheel remains within condemning limits
4000	23 or less	

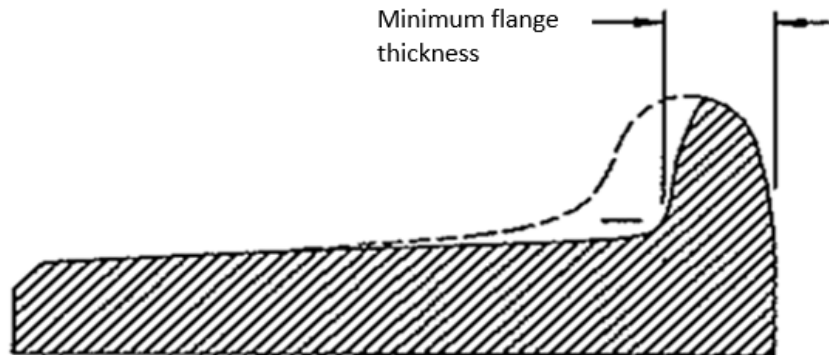


Figure 10.2.2 – Minimum flange thickness

10.2.3. Wheel Condemn Gauge – Thin Flange

Thin flange shall be checked with Gauge No. 300008 (see Appendix 2) as follows:

The gauge is to be held flush against the inner face of the rim as shown in the figure below. If the gauge short arm, is able to fit over the flange and the bottom of the short arm “B” touches the tread area then the flange is thin. If the gauge short arm is not able to fit over the flange and does not touch the tread area, the flange thickness is acceptable.

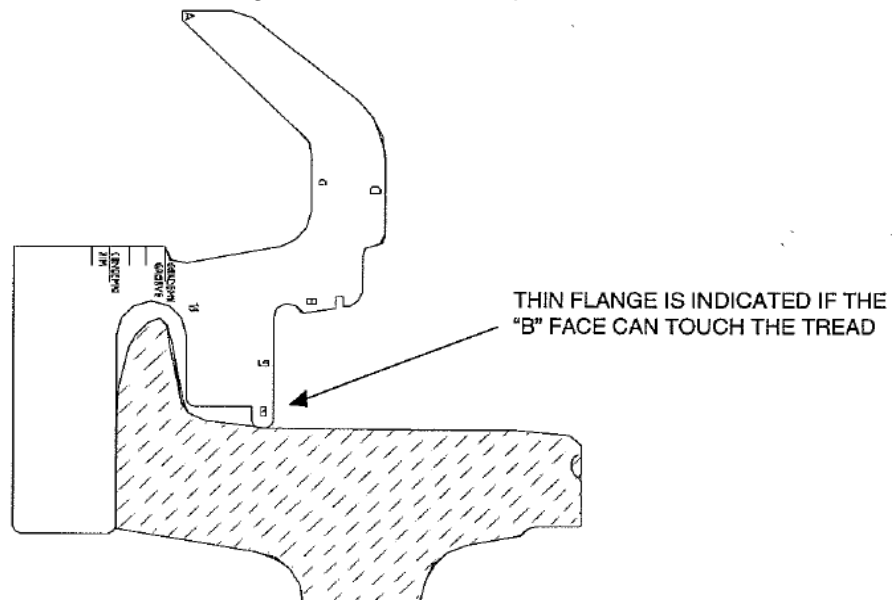


Figure 10.2.3.1 – Wheel Condemn Gauge No. 300008 - thin flange indication

Flange thickness for 4000 class shall be checked with the gauge (Appendix 2.6) as shown below:

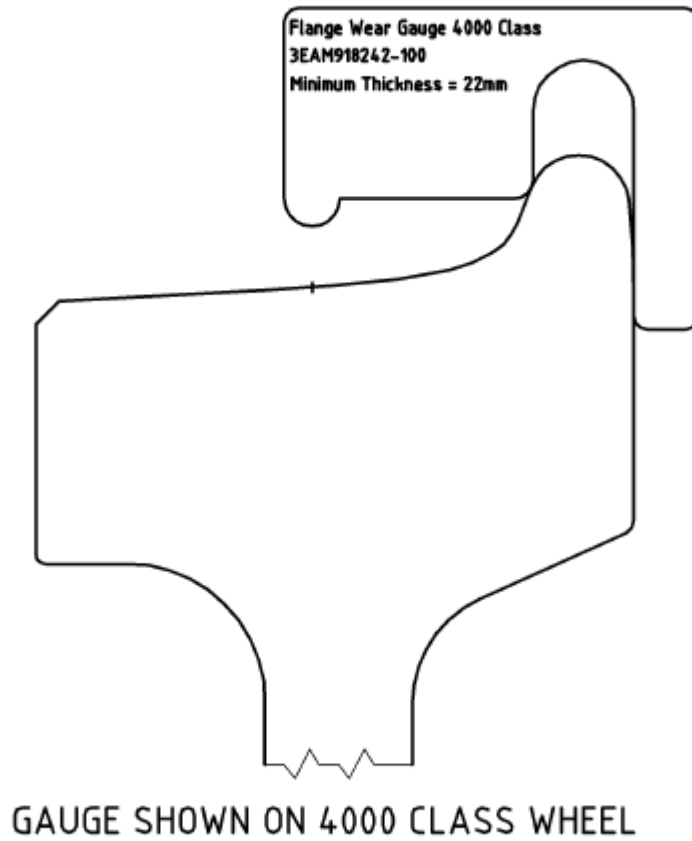


Figure 10.2.3.2 – Wheel Condemn Gauge - thin flange indication (4000 Class only)

10.3. Flange Angle

Inspection frequency for the wheel flange angle shall be in accordance with table 10.1

10.3.1. Intervention Limits and Defects Identification

To determine whether the flange is steep in part or as a whole, the whole wheel shall be visually examined. Flange steepness shall be assessed at the circumferential position of maximum apparent flange steepness. Steep flanges may also be an indication of other problems e.g.:

- One steep flange only may indicate a wheel set that has a variation in wheel diameters.
- Two steep flanges on diagonally opposite corners may cause a crabbing effect due to side frame misalignment.
- Two steep flanges on the same side may indicate mismatched side frame lengths.
- Four steep flanges may indicate a hunting condition caused by worn friction wedges or side- bearers.

Table 10.3: Flange Angle

RAILCAR WHEEL	MINIMUM (DEGREE)	MAXIMUM (DEGREE)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100/4000	10 degrees from vertical	N/A	Less than 10 degrees	Re- profile the wheels within 14 days Examine bogie and check wheel diameters for possible cause of steep flanges	Normal Speed

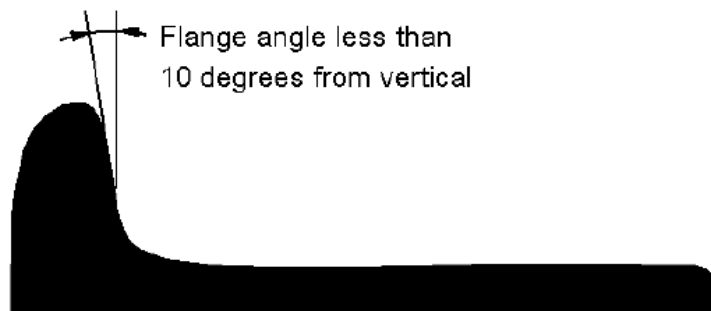


Figure 10.3.1 – Minimum flange angle

10.3.2. Wheel Condemn Gauge – Steep Flange

Steep flange shall be checked with Gauge No.300008 (see Appendix 2) as follows:

The gauge is to be held horizontal, touching the tread and running face as shown. An acceptable flange angle is indicated where no part of the gauge above the slot is touching the flange surface. If any parts of the gauge above

the slot at "E" face of the gauge touches the flange surface, this means the wheel has a steep flange and is not acceptable.

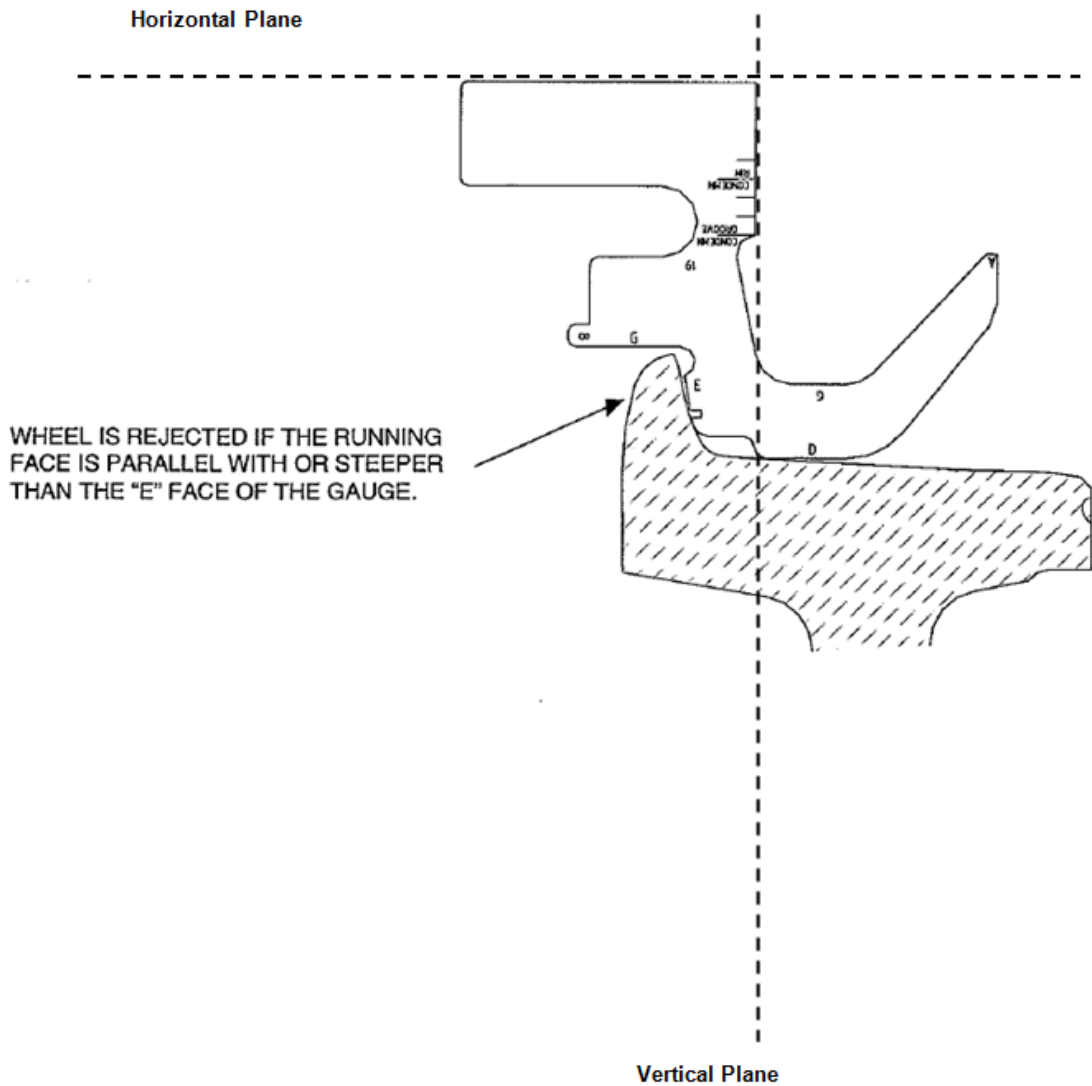


Figure 10.3.2 – Wheel Condemn Gauge No. 300008 - steep flange indication

10.4. Flange Height

Inspection frequency for measurement of flange height shall be in accordance with table 10.1

10.4.1. Method of Measurement

Flange height shall be measured with Gauge No 207-661 (see Appendix 2) using following steps.

- The wheel gauge is to be pressed against the side of the wheel rim, the gauge finger resting on the tread surface and the convex side of the rotating arm against the top of the flange as shown.
- The "H" marker on the rotating arm indicates the total flange height as shown on the gauge body corner graduations.

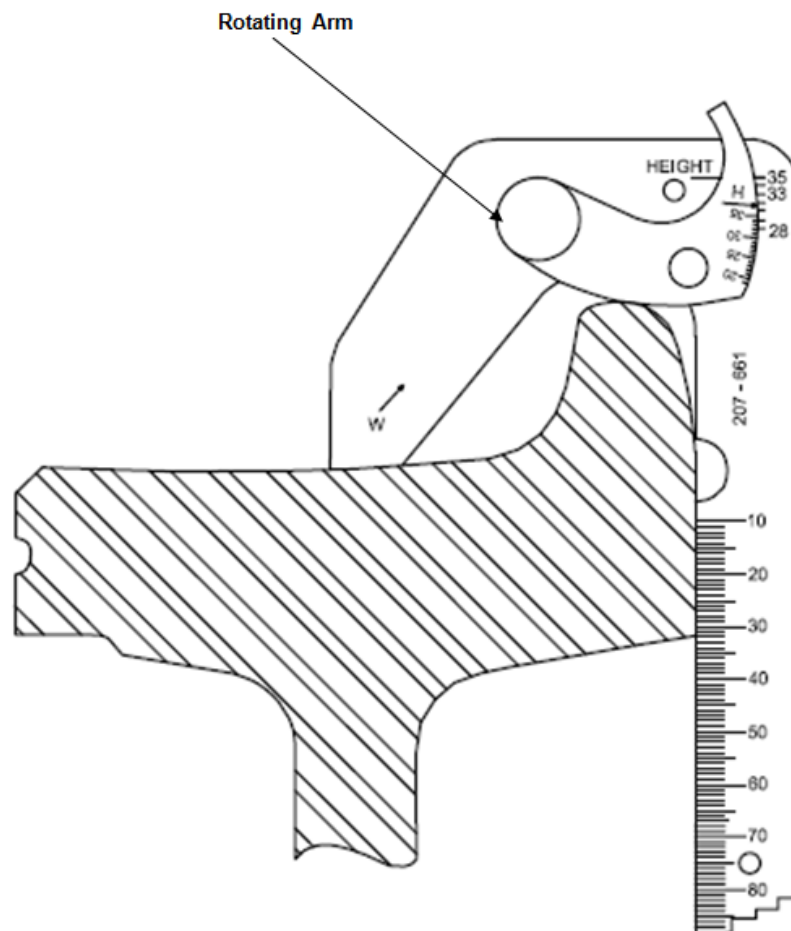


Figure 10.4.1 – Gauge No.207-661 Flange height measurement

10.4.2. Intervention Limits and Defects Identification

The following table shows minimum and maximum limits for flange height for different railcar wheels, out of limit flange height and the relevant response criteria.

High flange can lead to damage to track components and increase the risk of derailment.

Table 10.4: Flange Height

RAILCAR WHEEL	MINIMUM (MM)	MAXIMUM (MM)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100/4000	29 as new	35	Greater than 35 mm	Re-profile the wheels within 14 days	Normal Speed

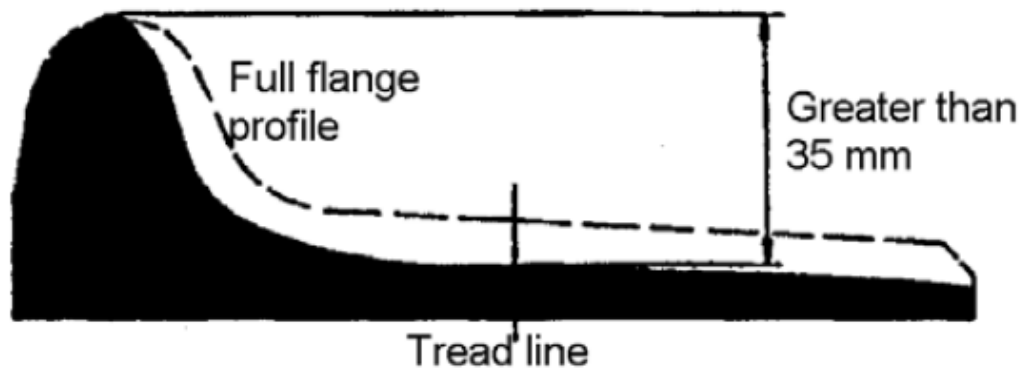


Figure 10.4.2 – Maximum flange height

10.4.3. Wheel Condemn Gauge – High Flange

Flange height shall be checked with Gauge no. 300008 (see Appendix 2) as follows:

The gauge is to be held flush against the inner rim face with the face “A” face on the finger down toward the tread surface. If flange touches “G” section of the gauge, wheel is condemned due to “HIGH FLANGE”

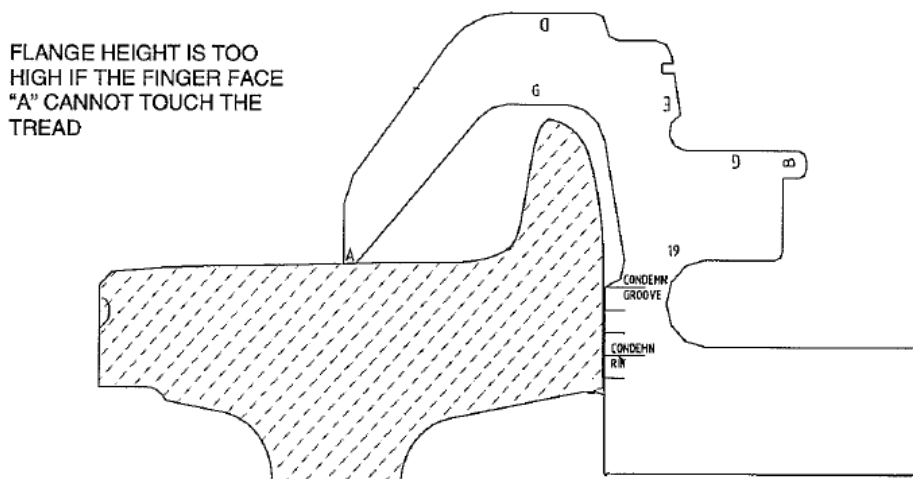


Figure 10.4.3 – Wheel Condemn Gauge No. 300008 - high flange indication

10.5. Tread Diameter

Inspection frequency for measurement of tread diameter shall be in accordance with table 10.1

10.5.1. Method of Measurement

- Tread diameter in traffic can be based on rim thickness as described in section 10.6.
- Tread diameter after machining or new should be measured using accurate apparatus.

10.5.2. Intervention Limits and Defects Identification

Table 10.5.2: Tread Diameter

RAILCAR WHEEL	MINIMUM (MM)	MAXIMUM (MM)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100	840	920	Out of limits	NOT TO RUN on AMPRN until wheel is rectified	N/A
4000	850	920			

Note for Wheel Diameter (Not applicable to 4000 Class railcar):

The wheel diameter may be calculated as follows:

Calculated wheel diameter = (Measured rim thickness X 2) + 800 mm.

10.5.3. Variation in Tread Diameter

Variation in tread diameter shall be allowed as shown in Table 10.5.3:

Table 10.5.3: Variation in Tread Diameter

	MAXIMUM VARIATION - TREAD DIAMETER IN TRAFFIC (MM)		MAXIMUM VARIATION - TREAD DIAMETER AFTER MACHINING / NEW (MM)	
	3000 / 3100	4000	3000 / 3100	4000
Class	3000 / 3100	4000	3000 / 3100	4000
Wheel-Wheel	N/A	1.0	0.25	0.25
W/Set in Bogie	N/A	5	1.0	0.25
Bogie to Bogie	75	N/A	75	N/A
M Bogie to M Bogie on DM Car	N/A	5	N/A	5
T Bogie to T Bogie	N/A	≤25	N/A	≤25
DM Bogie to T Bogie	N/A	≤60	N/A	≤60
DMA Bogie to DMB Bogie	N/A	≤70	N/A	≤70

10.6. Rim Thickness

Inspection frequency for measurement of rim thickness shall be in according with table 10.1

10.6.1. Method of Measurement

The rim thickness shall be measured using Gauge No 207-661 (see Appendix 2), as follows

The wheel gauge shank is to be pressed flush against the inner face of the rim with the gauge diagonal arm resting on the tread surface as shown below.

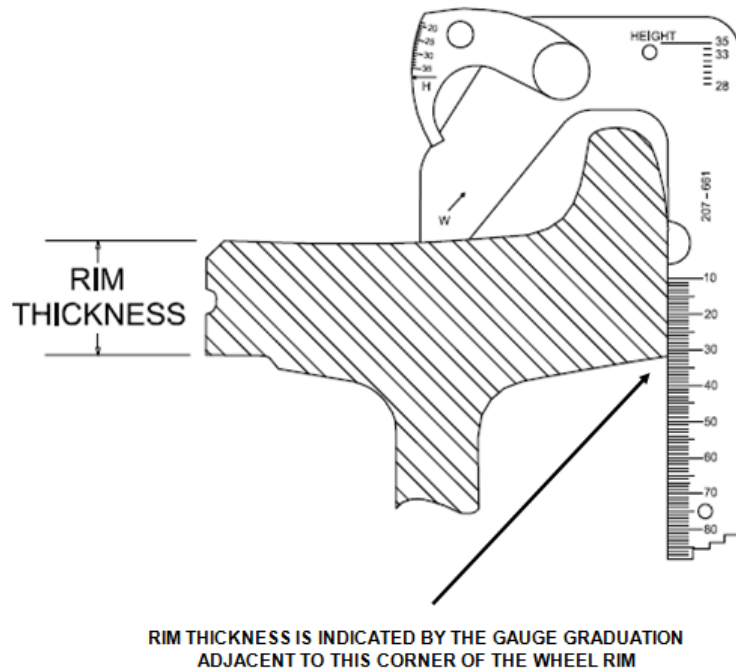


Figure 10.6.1 – Gauge No. 207-661 rim thickness measurement

10.6.2. Intervention Limits and Defects Identification

Following table shows minimum and maximum limits for rim thickness for different railcar wheel, out of limit rim thickness and relevant response criteria

Table 10.6: Rim Thickness

RAILCAR WHEEL	MINIMUM (MM)	MAXIMUM (MM)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100	20	N/A	Out of limits	NOT TO RUN on AMPRN until wheel is rectified	N/A
4000	25				
3000/3100	22 or less			Wheel shall be inspected on a monthly basis to ensure the wheel remains within condemning limits.	
4000	27 or less				

10.6.3. Wheel Condemn Gauge – Thin Rim

Rim thickness shall be checked with Gauge No. 300008 (see Appendix 2) as follows:

Alternative 1 The gauge is to be held flush against the inner rim face with the “A” face on the finger down toward the tread surface.

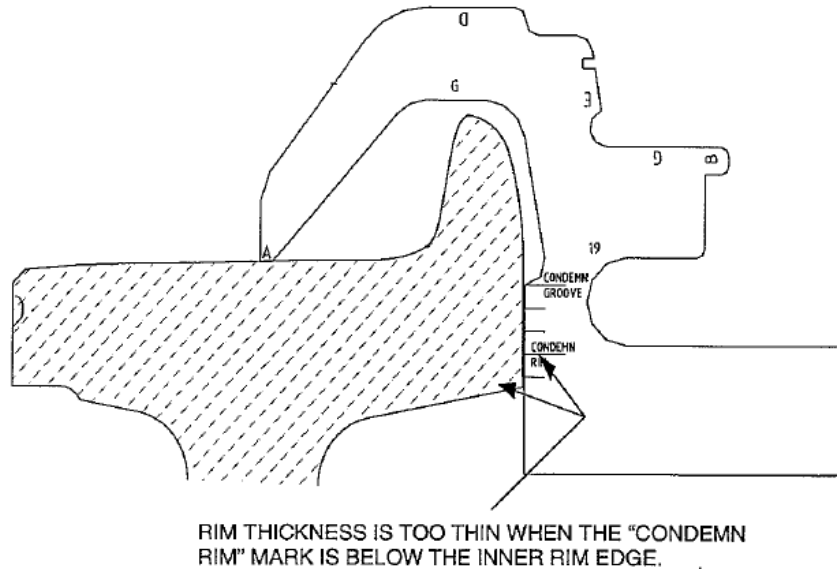


Figure 10.6.3.1 – Wheel Condemn Gauge No. 300008 - thin rim indication

Alternative 2 The gauge is held flush against the outer rim face with the “A” face on the finger down on the tread surface.

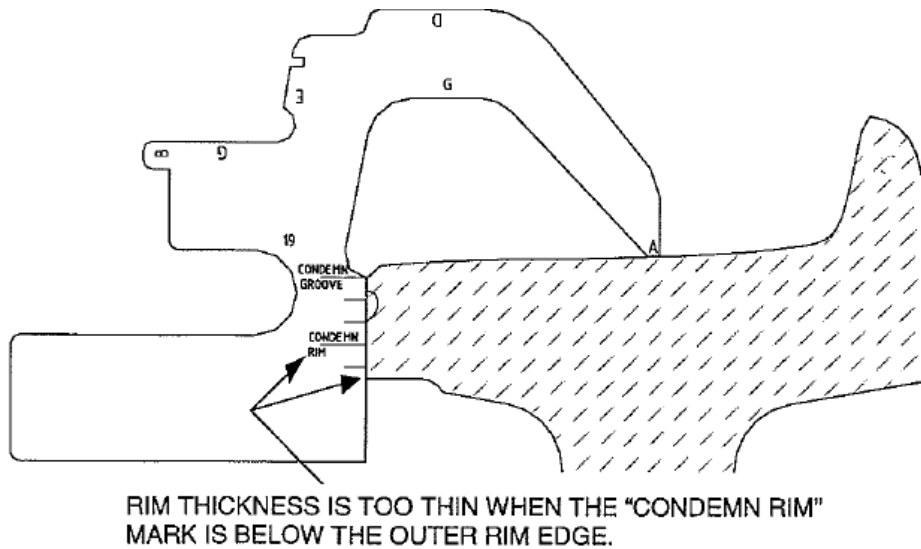


Figure 10.6.3.2 – Wheel Condemn Gauge No. 300008 - thin rim indication

Rim thickness for 4000 class shall be checked with the gauge (Appendix 2.5) as shown below:

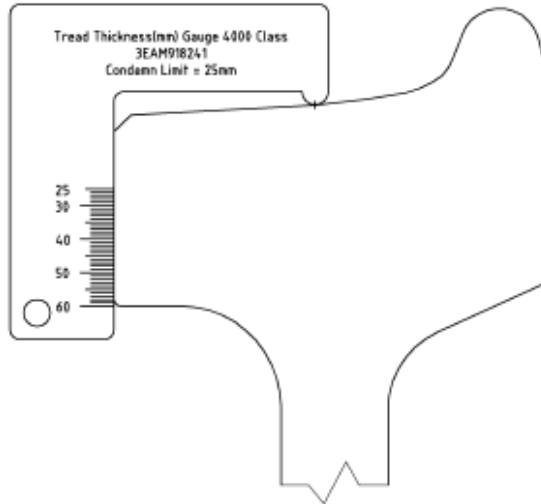


Figure 10.6.3.3 – Wheel Condemn Gauge thin rim indication (4000 class only)

10.7. Tread Hollowing

Inspection of the wheel tread is necessary to determine the presence of hollow tread. The hollow tread limit is set to manage the following issues:

- Rolling contact fatigue and deformation of rail
- Damage at points & crossings
- Worsened steering – resulting susceptibility to hunting and increased fuel consumption

10.7.1. Intervention Limits and Defects Identification

Table 10.7: Hollow Tread

RAILCAR WHEEL	MINIMUM (MM)	MAXIMUM (MM)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100/4000	N/A	3 mm	Greater than 3 mm	Re-profile the wheels within 14 days	Normal Speed

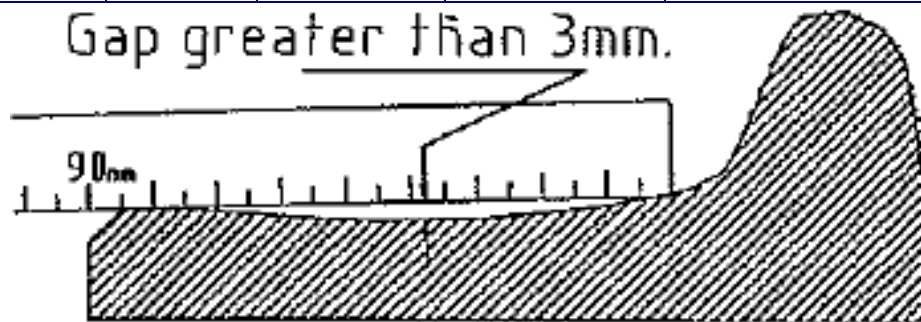


Figure 10.7.1 – Maximum tread hollowing (Diagram – illustrative purpose only)

10.7.2. Wheel Condemn Gauge – Hollow Tread

The gauge PTS-001 (see Appendix 2 for details of this gauge) is to be held flush against the inner rim face as shown below with opposite surface contacting the tread. The feeler gauge is then inserted to determine the extent of wheel hollowing (hw in figure below).

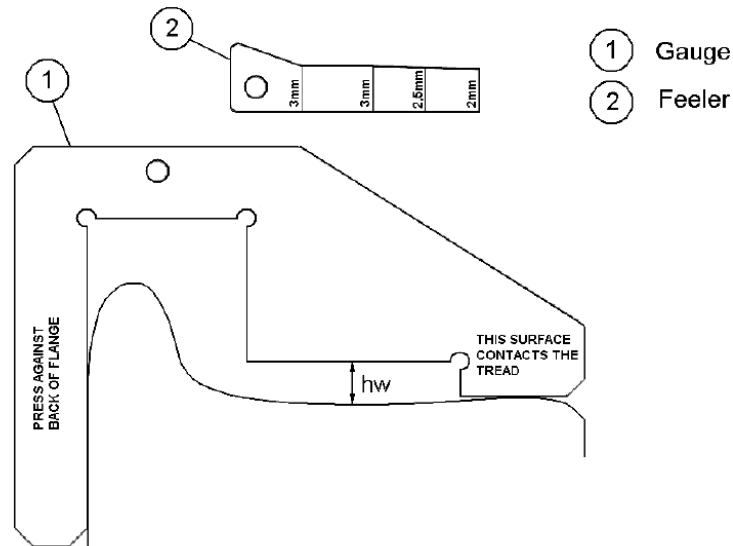


Figure 10.7.2 – Wheel Condemn Gauge hollow tread indication

1. Feeler cannot be inserted; hw is less than 2 mm (record as less than 2 mm)
2. Feeler can be partly inserted; hw is as per graduation on feeler
3. Feeler can be fully inserted hw is more than 3 mm (record as more than 3 mm)

10.8. Back face to back face Dimension of Wheel

- AMPRN’s railway network gauge is 1600 mm.
- Back face to back face dimension shall be measured at all major overhauls and post derailment

10.8.1. Method of Measurement

- Back face to back face dimension of the wheel shall be measured at 120 degree intervals around the wheel disk i.e. at minimum 3 different point on wheel disk.
- Back face to back face wheel dimension is to be measured using a calibrated measuring device.

10.8.2. Intervention Limits and Defects Identification

The following table shows minimum and maximum limits for back face to back face dimension of wheel.

Table 10.8: Back to back face wheel dimension

RAILCAR WHEEL	MINIMUM (MM)	MAXIMUM (MM)	DEFECT CLASSIFICATION	ACTION REQUIRED	SPEED LIMITATION
3000/3100/4000	1522	1525	Out of limits	NOT TO RUN on AMPRN until wheel is rectified	N/A

11. Classification of Railcar Wheel Defects

Following section explains the various railcar wheel defects.

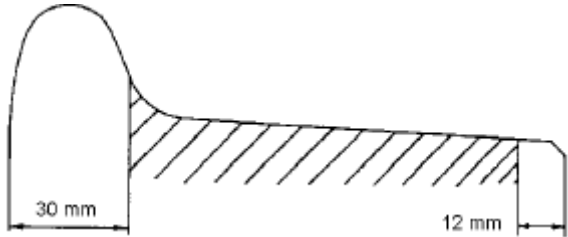
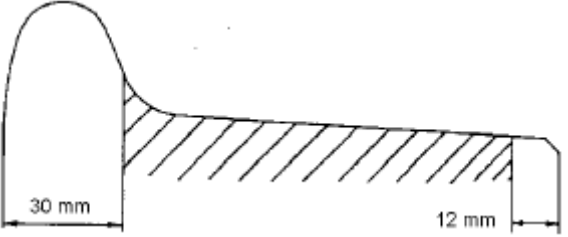
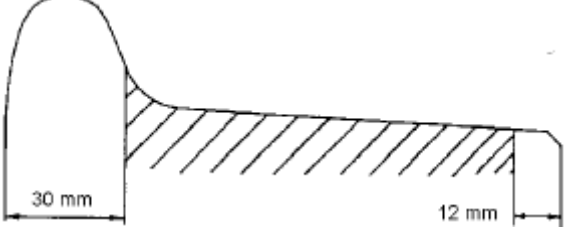
Note:

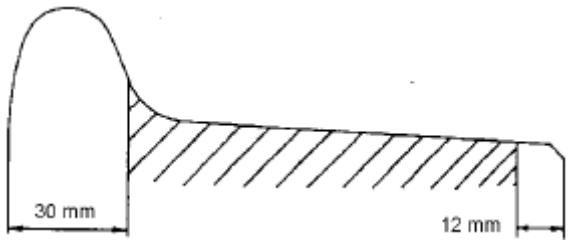
Refer to RISSB Wheel Defects Code for defects photo if required.

11.1. Thermal Cracking

- Thermal cracks are the most severe form of wheel defect. They are detected by close visual inspection of the tread and flange surface. Thermal cracking initially appears as fine lines aligned generally transverse across the tread. The main reason for the thermal crack is the alternate heating and cooling of tread and rim area. Lack of proper inspection and corrective action can develop more severe cracks and ultimately end up with a fractured wheel. Preventive action must be taken at the early stage of development and detection of thermal cracks.
- Various classifications of thermal cracks are shown in Table 11.1

Table 11.1: Thermal Cracking

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1	 <p>Cracks up to 10 mm long in shaded area, but not extending outside of shaded area</p>	No action required	Normal speed
2	 <p>Cracks up to 10mm and 30mm long in shaded area, but not extending outside of shaded area</p>	Closer inspection required to ensure no class 3 defects exist. Report fault on inspection sheet.	Normal speed
3	 <p>Cracks up to 30mm and 40mm long in shaded area or less than 10 mm long in rim area or rim face</p>	Re profile the wheels to remove the cracks within 14 days .If wheel is approaching condemning diameter, treat as class 4 defect	Normal speed

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
4	 <p>Any visible cracks in the flange surface outside the shaded area, or cracks greater than 10mm long on rim surfaces outside shaded area. Any cracks greater than 40 mm long anywhere on the wheel</p>	Remove vehicle from the service until wheel fault remedied.	40 kph MAXIMUM SPEED
5	<p>FRACTURED WHEEL Any crack through rim, web or boss of wheel</p>	Examination by mechanical maintenance officer of the wheel before movement to the nearest repair facility.	NOT TO MOVE Until wheel has been inspected

- Where significant cracks are identified the wheel rim should be marked to allow for inspection to ensure the full extent of the crack has been removed. After machining, a non-destructive crack detection test should be conducted, for example, magnetic particle or dye-penetrant.

11.2. Spalling

- Spalling appears as areas of the tread where base metal has broken out leaving irregular shaped shallow holes normally less than 3 mm deep. This defect is due to thermal damage, over stressing at the rail-wheel contact point or skidding. Spalling is detected by general visual inspection of the tread surface. The signs of spalling are easy to identify as wheel surface becomes rough.
- Various classification of wheel spalling are shown in Table 11.2

Table 11.2: Spalling

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1	Areas less than 12 mm in diameter together covering less than 10% of tread surface.	No action required	Normal Speed
2	Areas less than 25 mm in diameter together covering less than 20% of tread surface	Closer inspection required to ensure no Class 3 spalls exist. Report fault on inspection sheet	Normal Speed
3	Areas greater than 25 mm in diameter, sharp and jagged, together covering less than 50% of tread surface.	Reprofile wheels to remove spalling within 14 days	Normal Speed

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
4	Extensive spalling 3 mm or more deep, sharp and jagged, together covering more than 50% of tread surface.	Remove vehicle from service until wheel fault remedied	40 kph MAXIMUM SPEED

11.3. Skidded Wheels (Flats)

- Skidding appears as areas of the tread where base metal has flowed leaving flat spots. Skidding occurs because the wheel is not moving while vehicle is moving. Skidding is detected by general visual inspection of the tread surface. Skidding leads to more damage to the wheel such as spalling and also reduces the life of other rotating components like bearings.
- Various classification of skidded wheels are shown in Table 11.3

Table 11.3: Skidded Wheels

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1	Single skid of length less than 25 mm.	No action required	Normal speed
2	Single skid of length between 25 mm & 40 mm or multiple Class 1 skids.	Closer inspection required to ensure no Class 3 skids exist. Report fault on inspection sheet. Re-inspection within 14 days and treat as Class 3 if no changes.	Normal Speed
3	Single skid of length between 40 mm & 60 mm or multiple Class 2 skids.	Reprofile wheel to remove flats within 14 days.	40 kph MAXIMUM SPEED
4	Single skid of length between 60 mm & 100 mm or multiple Class 3 skids.	Remove vehicle from service until wheel fault remedied.	25 kph MAXIMUM SPEED
5	Single skid of length greater than 100 mm.	Wheels to be examined by mechanical maintenance officer to determine the method of travel to maintenance depot.	NOT TO MOVE Until assessed

11.4. Scaled Wheels

- Scaling appears as areas of the tread where material has adhered and built up on the tread leaving a lumpy surface. Normally it is due to heating of the wheel tread surface area resulting in material becoming soft, flowing on the tread surface and mixing with foreign particles and then deposited back onto the wheel. Scale build up is detected by general visual inspection of the tread surface.
- Classifications of scaled wheels are shown in Table 11.4

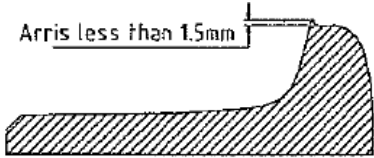
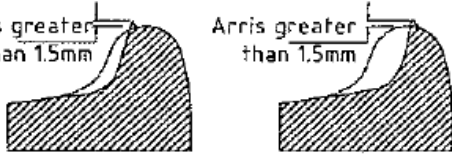
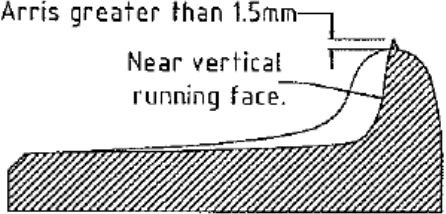
Table 11.4: Scaled Wheels

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1&2	Classification not relevant	No action required	Normal speed
3	Light surface smearing, too small to measure with a standard rule.	Examine brake gear for defects	Normal speed
4(i)	Scale height up to 5 mm.	Reprofile wheels to remove scale	Clear section at: 25 kph MAXIMUM SPEED
4(ii)	Scale height up to 10 mm.		15 kph MAXIMUM SPEED
4(iii)	Scale height up to 15 mm.		5 kph MAXIMUM SPEED
5	Scale height greater than 15 mm.	Wheel is to be examined by mechanical maintenance officer to determine method of travel to maintenance depot.	NOT TO MOVE Until wheel is rectified

11.5. Arris

- Arrises are phenomena where the running face has been extended past the original tread profile by rail abrasion toward or beyond the tip of the flange. Lack of proper rail gauge face lubrication and/or excessive force on the flange due to a rolling stock defect causes arrises on the flange.
- Classification of arrises are shown in Table 11.5

Table 11.5: Arris

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1	Classification not relevant	No action required	Normal speed
2	 Arris less than 1.5 mm above normal flange height.	Re-examine carefully to ensure that no class 3 thermal cracks exist. Defect to be recorded on inspection sheet.	Normal speed
3	 Arris greater than 1.5 mm above normal flange height.	Re-profile wheels to remove arrises within 14 days.	Normal speed
4	 Arris greater than 1.5mm Near vertical running face.	Remove vehicle from the service until wheel fault remedied.	40 kph MAXIMUM SPEED and 25 kph over points, crossings and

	Arris greater than 1.5 mm above normal flange height with near vertical running surface.		turnouts.
--	--	--	-----------

Note: A steep flange with class 2 Arris is a class 4 defect and shall be treated as per class 4 Arris.

11.6. Rolled Edge

- Rolled edge occurs when the rolling of the wheel on the rail causes the tread metal to flow horizontally out past the chamfer on the rim. High lateral contact stresses due to incorrectly tracking of the vehicle are often a contributing factor. If rolled edge extends past the rim face 3mm or more for more than half of the tread circumference it is listed as a class 3 defect. Any crack found on the rolled edge shall be classified as a class 4 thermal crack.
- Classifications of various rolled edge are shown in the Table 11.6

Table 11.6: Rolled edge

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1	Classification not relevant	No action required	Normal speed
2	Rolled edge extends past rim face but less than 3 mm	Defect to be recorded on inspection sheet	Normal speed
3	Rolled edge extends past rim face 3 mm or more for more than half of the tread circumference	Remove the vehicle from the service until wheel fault remedied.	N/A

- The occurrence of a localised area of “Rolled Edge” on a wheel rim is called spread rim. It may be an early sign of a cracked or broken rim and shall be examined by a mechanical maintenance officer to determine further action.



11.7. Damaged / Fractured Wheels

Classifications for various damaged wheels are shown in Table 11.7

Table 11.7: Damaged/Fractured wheels

CLASS	DESCRIPTION OF DEFECT	ACTION REQUIRED	SPEED LIMITATION
1,2&3	Classification not relevant	Not relevant	Normal speed
4	<p>FATIGUE CRACKS IN WHEEL RIM OR FLANGE Solitary cracks with no critical propagation, usually initiated from a manufacturing defect. With no critical propagation means that the cracks are not running through the rim of the wheel.</p>	Remove vehicle from the service until wheel fault remedied.	40 kph MAXIMUM SPEED
	<p>EXTERNAL WHEEL DAMAGE Generally results from heavy impact loads on the wheel which may show up as a chip or gouge in the flange or as a bruise on the tread or a wheel distortion.²</p>		
5	<p>FRACTURED WHEEL Any crack running through the rim, web or boss of the wheel.</p>	Examination by mechanical maintenance officer of the wheel before movement to the nearest repair facility.	NOT TO MOVE until wheel has been inspected
	<p>SHATTERED WHEEL Circumferential crack visible on rim face, often in combination with beak-away of rim material</p>		

11.8. Overheated Wheels

Overheating of wheels due to braking is not high risk for AMPRN railcars as disc brakes are used. However for more information regarding overheated wheels refer to the RISSB Wheel Defects Code.

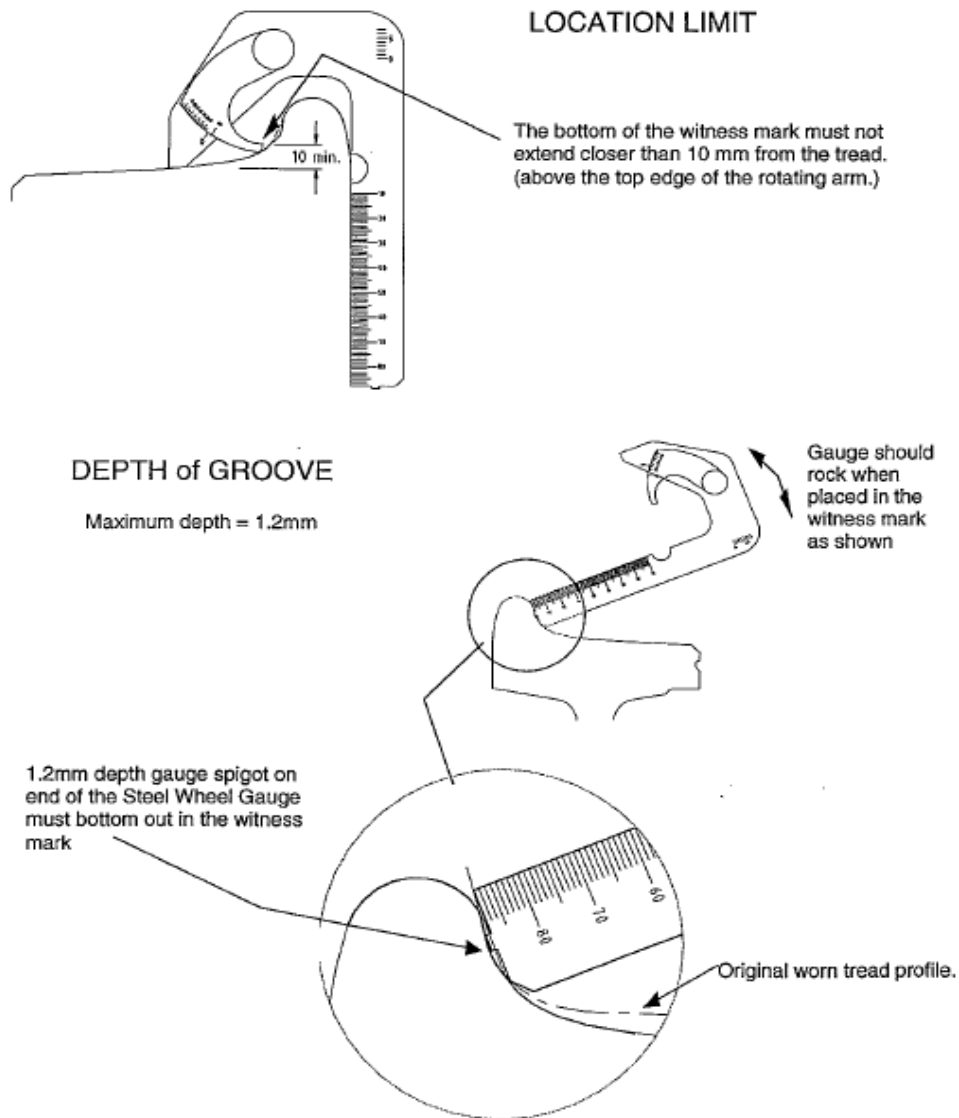
11.9. Out-of-round Wheels

Out of round wheels are not a high risk for AMPRN railcars. However for a fully assembled new or machined wheelset a maximum tolerance for tread radial run out is 0.5 mm. For more information regarding out of round wheels refer to RISSB Wheel Defects Code and *RS1-DOC-000465: Engineering Standard for Train Wheelsets*

11.10. Witness Mark

A witness mark (a circumferential area of original surface) may remain on the running face of the flange after machining of the rim to restore the tread profile. The gauge for checking witness mark is shown in Appendix 2.4. To be acceptable, the witness mark must comply with the following:

² Any chip or gouge in a wheel which is more than 25mm long and/or 12 mm wide shall be classified as a Class 4 – *RISSB Wheel Defects Code of Practice*



12. Shock Vibration and Acoustic Emissions

Wheels that have defects close to the intervention limits identified in Sections 10-11 sometimes cause undesirable shock, vibration and acoustic emissions that are reported by drivers, passengers or maintenance personnel. Defects that contribute to such emissions shall be inspected at intervals no more than 7 days, and may at any time be treated as if they have exceeded the applicable intervention limit.

13. Action Following Derailments

Wheel shall be inspected in detail following any derailments.

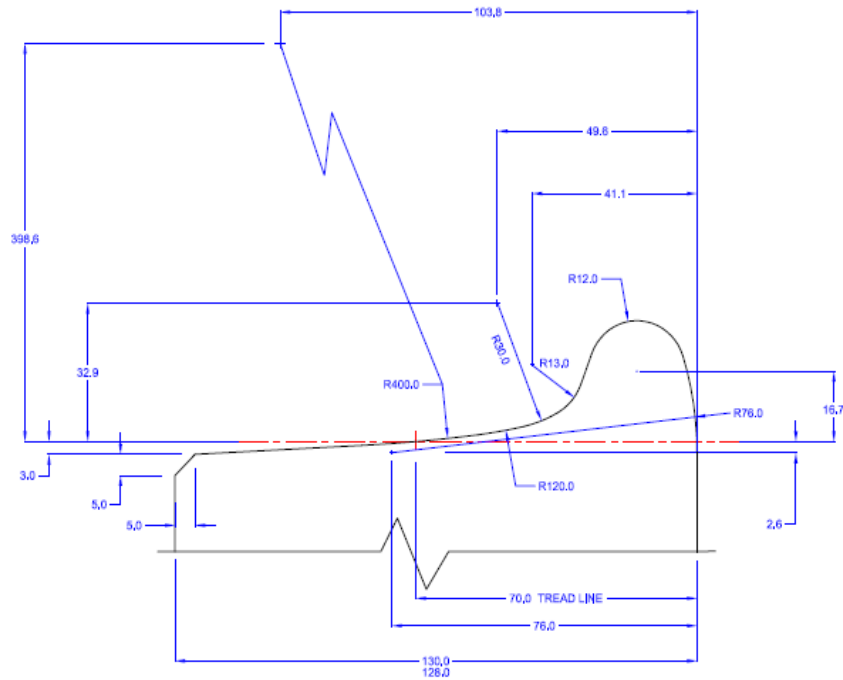
Detailed wheel inspection shall be in accordance with this standard which includes all the criteria listed in Section 9. It shall also include an assessment for bending or distortion.

Back face to back face dimension of wheel shall be measured.

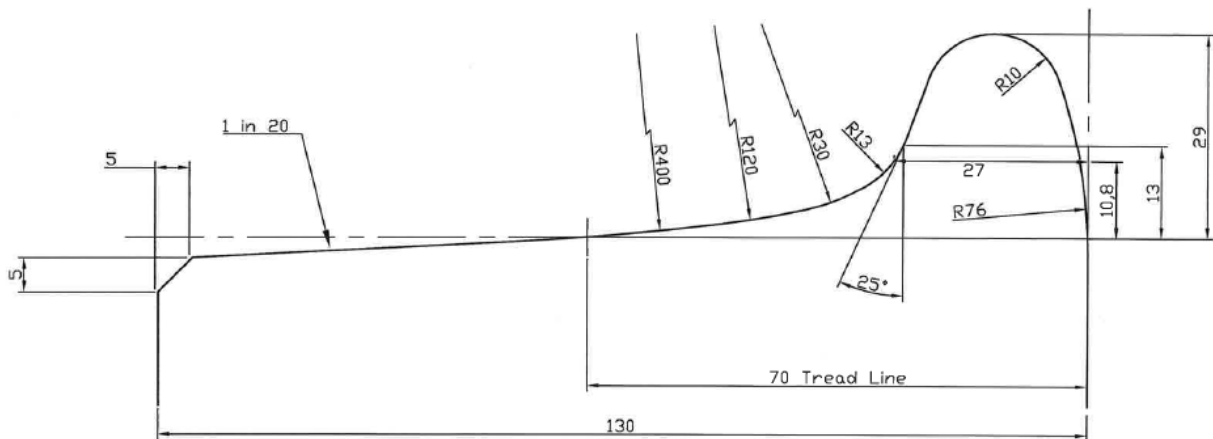
14. Wheel Inspection Records

Wheel inspection records to be held by Rolling Stock Maintainer and shall be available for auditing purposes.

APPENDIX 1 Rail Wheel Profiles – MP2 & 7/8 MP2



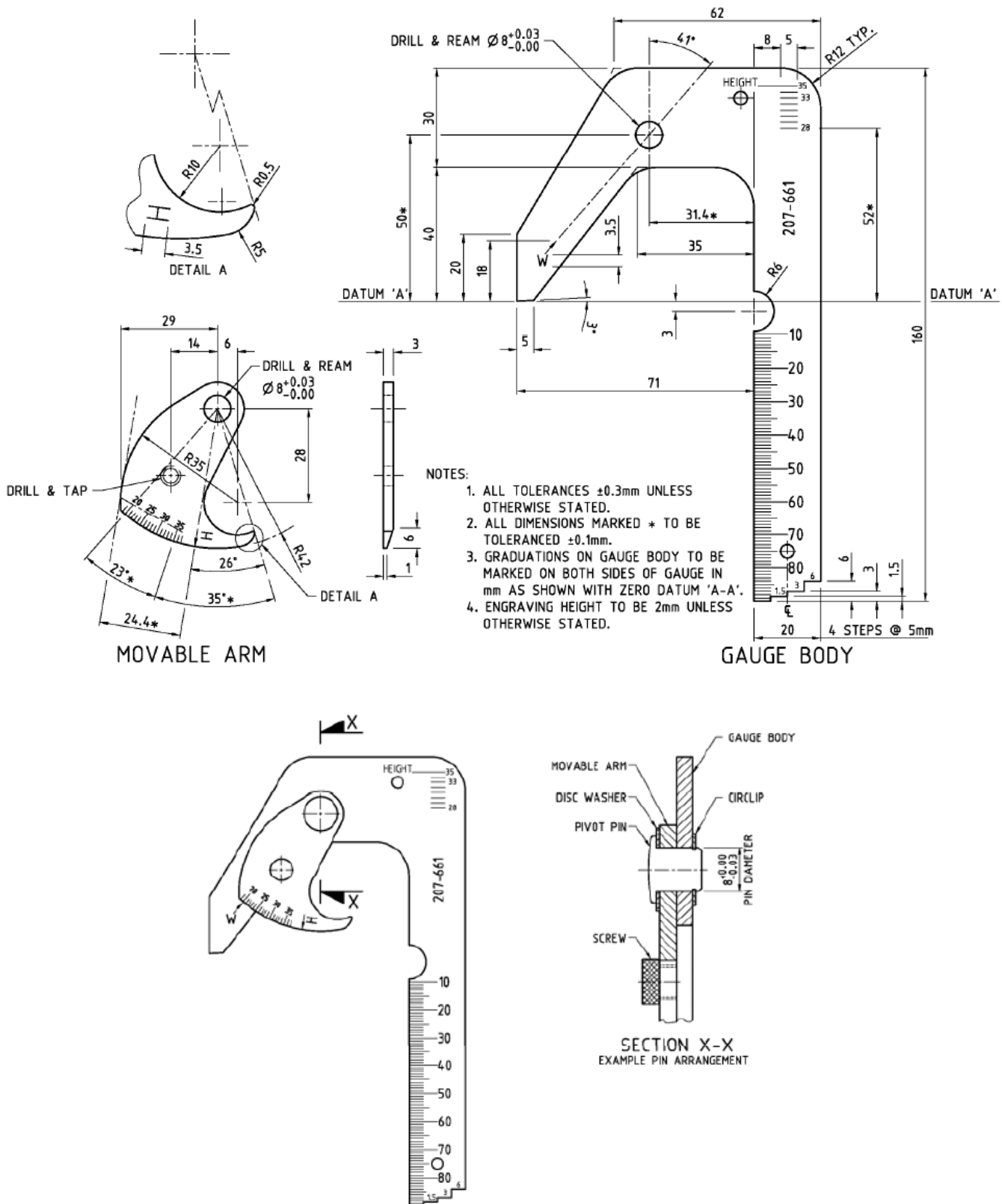
Original drawing number is 243-A3-96-054 - MP2 Tread Profile (KNet # 6914832)



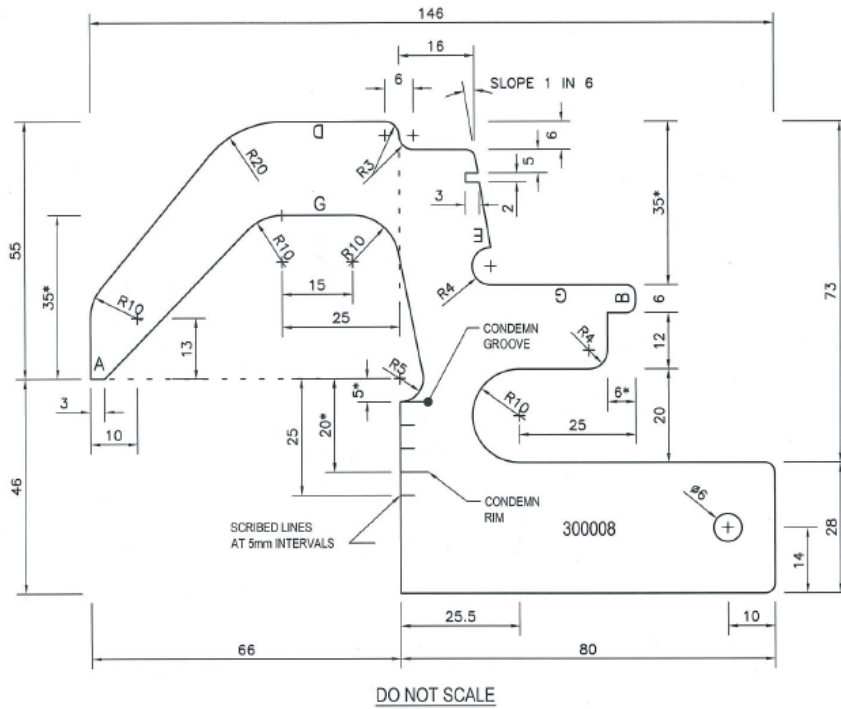
Original drawing number is RS1-DRG-300005 – 7/8 MP2 Tread Profile (KNet # 10482488)

APPENDIX 2 Wheel Profile Gauges

App 2.1 Measurement Gauge (RISSB Gauge No.207-661)



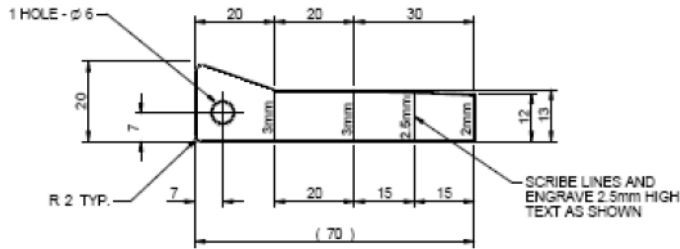
App 2.2 Condemn Gauge (DPTI Gauge No.300008)



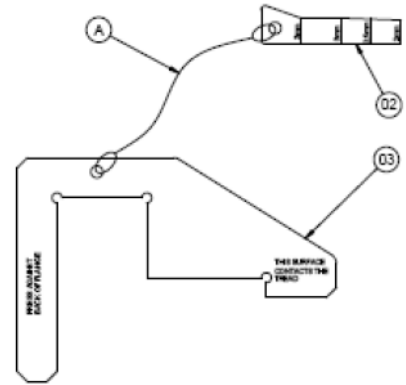
- NOTES:
1. MATERIAL 3mm GAUGE PLATE - NO HEAT TREATMENT.
 2. TEXT TO BE 3mm - STAMPED OR MECHANICALLY ENGRAVED & CENTRED ABOUT THE FACE OF THE GAUGE.
 3. GAUGE MARKED BOTH SIDES AS SHOWN UNLESS OTHERWISE SPECIFIED.
 4. ALL RADII NOT DIMENSIONED TO BE R2.
 5. ALL DIMENSIONS $\pm 0.5\text{mm}$ UNLESS OTHERWISE SPECIFIED.
 6. DIMENSIONS MARKED * $\pm 0.2\text{mm}$.

Note: Please see KNet # 9815786 for more details

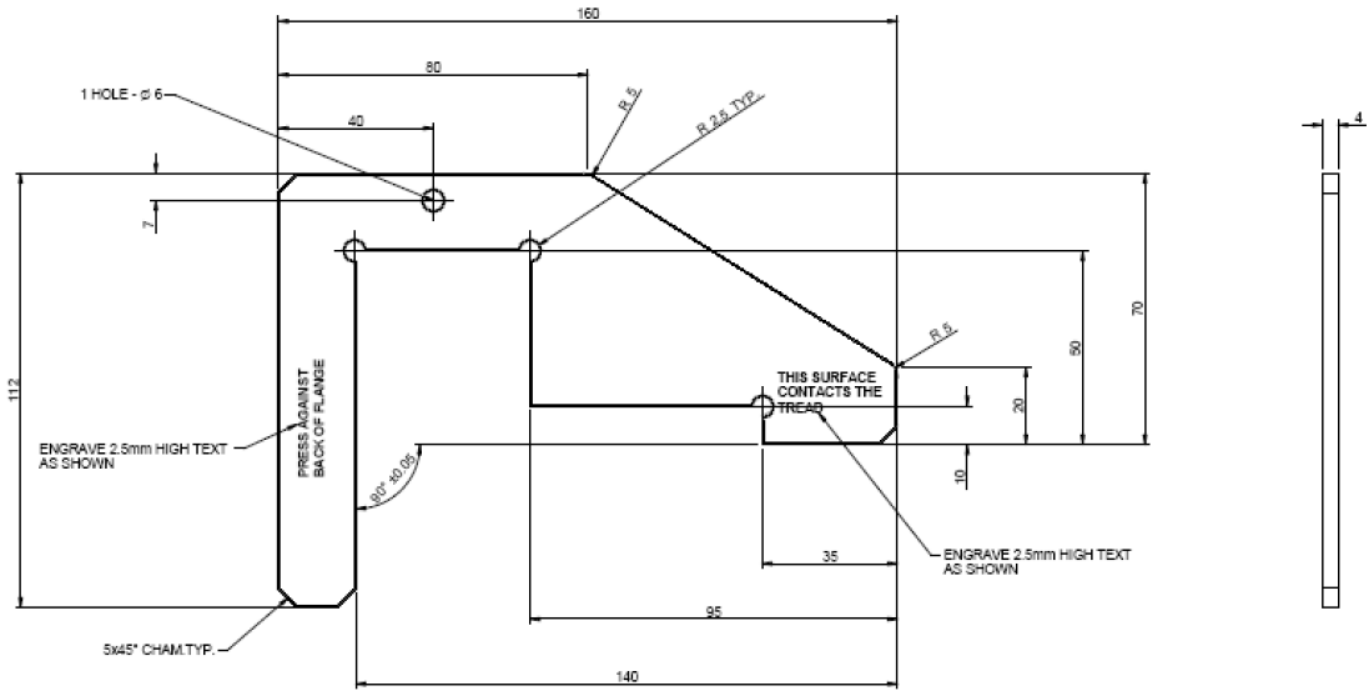
App 2.3 Condemn Wheel Hollow Wear Gauge (RISSB Gauge No. PTS - 001)



(D2) FEELER

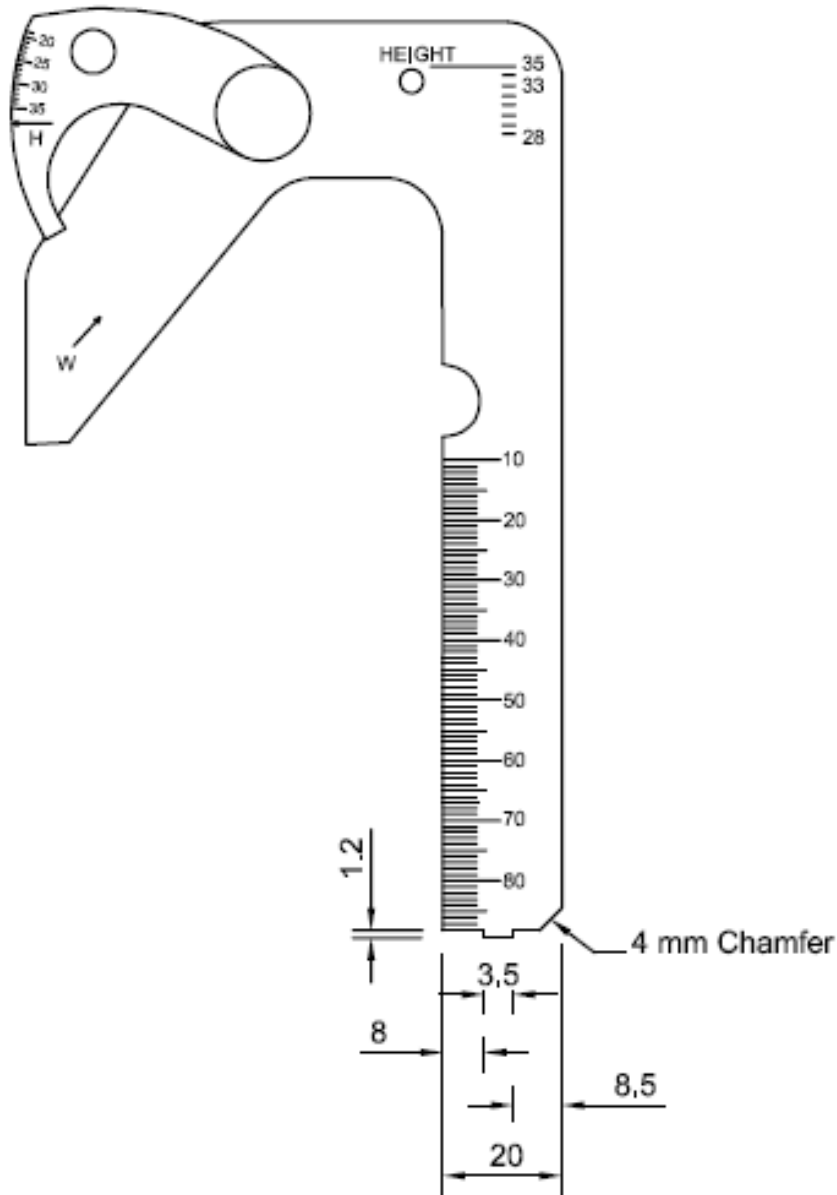


(D1) RISSB WHEEL HOLLOW WEAR GAUGE ASSEMBLY



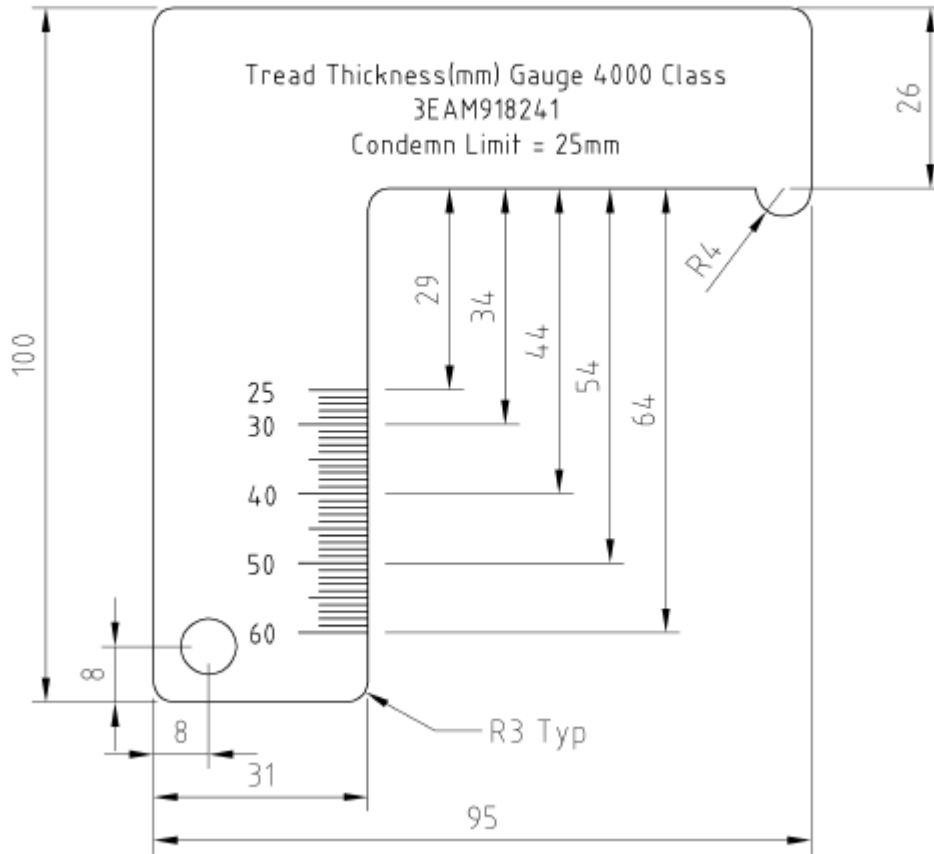
(D3) GAUGE

App 2.4 Condemn Gauge for Witness Mark



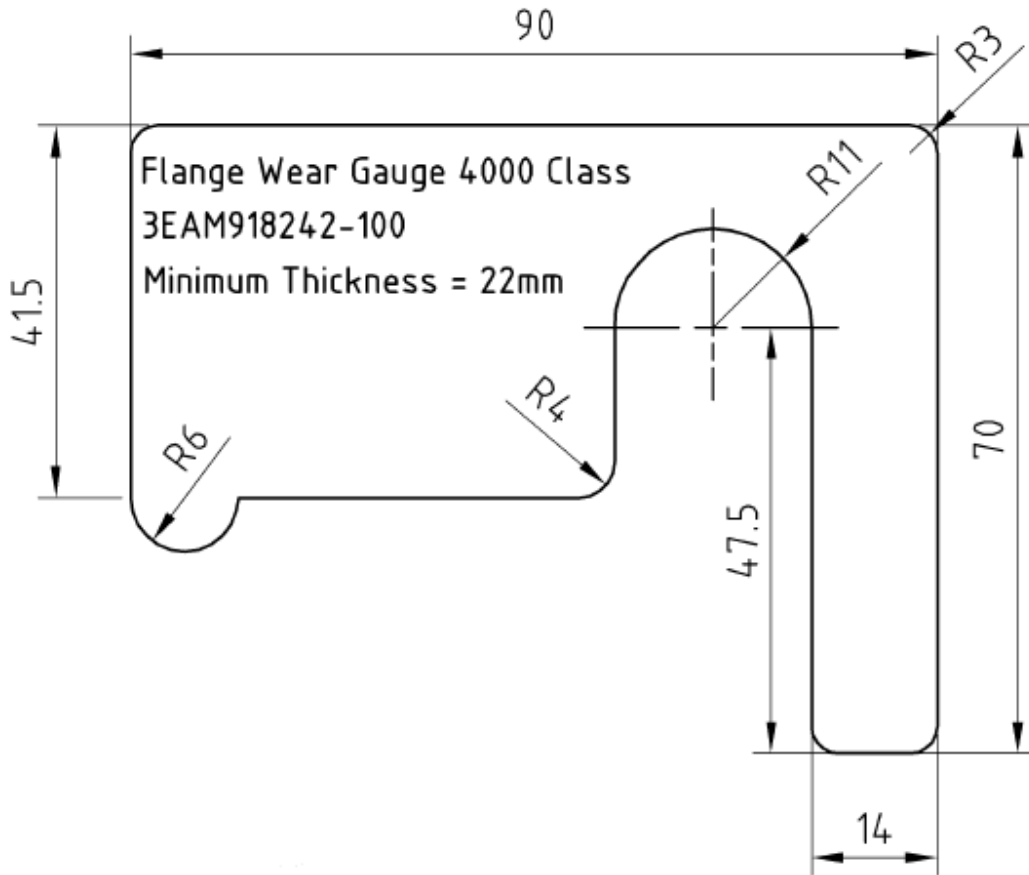
All the other dimensions of this gauge are same as RISSB gauge no. 207-661 as shown in App 2.1

App 2.5 Condemn Gauge for 4000 Class - Rim Thickness



Note: Please see KNet # 8830104 for more details

App 2.6 Condemn Gauge for 4000 class - Flange Thickness



Note: Please see KNet # 11231477 for more details