DOCUMENT TITLE: MAINTENANCE MANUAL FOR TRAIN-44 WHEEL SET

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1. INTRODUCTION

A wheelset is a pair of railroad vehicle wheels mounted rigidly on an axle such that both wheels rotate in unison. Wheelsets are often mounted in a bogie a pivoted frame assembly holding at least two wheelsets – at each end of the vehicle. Most modern freight cars and passenger cars have bogies each with two wheelsets

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THIS MANUAL IS ONLY FOR THE MAINTENANCE AND REPAIRS OF WHEELSETS PRODUCED BY SMH RAIL INDIA PVT LTD

These Instructions define technical parameters of wheelsets, scope of inspections and repairs, criteria of permissibility of defects and replacement or refurbishment of their parts, as well as the conditions and storage times of delivered wheels and axles.
All the above listed operations may be performed only by persons who, based on their education, experience and abilities, have received training (especially NDT tests by ultrasound and magnetic particle methods) in applicable standards, provisions of safety regulations, regulations for rendering first aid and orders of operation of the client railway.

Used for these operations must be only undamaged functional tools, measuring devices and measuring instruments duly calibrated in accordance with the Metrology Rules within the quality management system.
For replacements and assemblies, used may be only those spare parts which meet the requirements of the manufacturer's drawings and the limiting values for refurbishment of functional surface specified therein.

Shop Schedule: a limit which may not be exceeded when performing the last wheel and axle refurbishment in a repair workshop
Running Schedule: a limit which may not be exceeded while the wheel and axle is in use.

These maintenance instructions for trailer and motor wheelsets apply only if they are fitted in vehicles used in the ICF TRAIN 44 - HIGH SPEED EMU. The vehicles may not be used on railway sidings and rail tracks where there is a danger of contact with chemicals and other substances which may have a negative impact on the wheelset's life.
The wheelset axle load must not exceed permissible values specified in the wheelset drawings. For ICF TRAIN 18 - HIGH SPEED EMU: axle load 17t and max. cruising speed 160 kph.

2.Technical Description

2.1 Trailer axle for ICF TRAIN 44 - HIGH SPEED EMU vehicles

Dwg No.MT18Br2 001478-7

Type of transport.....Coaches
Maximum axle load.....17 t Maximum cruising speed.....160 km/h

2.2 Solid wheel for ICF TRAIN 44-HIGH SPEED EMU Vehicles DWG NO. MTBr2 001481-03

Maximum axle load.....17t
Maximum cruising speed.....160 km/h
Wheel diameter.....952 + 0.5 mm
Last reprofiling .....896 + 0.5 mm
Worn out diameter.....877 mm
Tread profile.....PROFIL RDSO/SK-91146 ALT.3

2.3 Motor axle for ICF TRAIN 44 - HIGH SPEED EMU vehicles Dwg. No.MT18Br2 001477-8

Type of transport.....Coaches
Maximum axle load.....17 t Maximum cruising speed.....160 km/h

2.4 Trailor Wheel set For ICF TRAIN 44-High speed EMU Vehicles Dwg No.MT18Br2 001479-4

2.5. Motor Wheel set For ICF TRAIN 44-High speed EMU Vehicles Dwg No.MT18Br2 001480-4

3.Maintenance Schedule

3.1 Maintenance interval

Schedule	Periodicity
Daily	Every Day
Trip	Every 3 days or 5000kms (whichever is earlier)
Monthly	30 Days ± 2 Days
Quarterly	90 Days ± 3 Days
Nine Monthly	270 Days ± 3 Days
Shop Schedule-1 (SS-1)	18 Months ± 5 Days
Shop Schedule-1 (SS-1)	36 Months ± 5 Days
Shop Schedule-1 (SS-1)	72 Months ± 5 Days

! Kilometers per day 1500 km

! The Axle Bearings, Brake discs and Gear Box shall be maintained as per the manufacturer's manual

! Reprofiling to be done depending on actual tread profile and diameter

3.2 Inspection Plan

3.2.1 Inspection plan during wheel set's service

Part	To be checked	Inspection method	Maintenance level					Reference
			1D	1M	3M	1Y	6Y	
Wheelset	Condition of surface and its protection	visual	X	X	X	X	X	4.1.1.1
	Condition of wheel tread and rim face surfaces	visual		X	X	X	X	4.1.1.2
	Electrical resistance (≤ 0.01 Ω)	measurement					X	
	Back-to-back dimension	measurement					X	4.1.3.1
	Diameter difference between wheels on the same axle |d1 - d2|	measurement	After reprofilin		X	X	X	4.1.3.2
	Dimensions of wheelset wheel treads	measurement			X	X	X	4.1.3.3
	Front-to-front dimension	calculation					X	4.1.3.4
	Axial and radial run-out of both wheelset's wheels	measurement					X	4.1.3.5
	NDT test of axle for presence of cracks	measurement				X	X	4.1.6.1
	NDT test of wheel tyre for presence of cracks	measurement					X	4.1.6.2

3.2.2 Inspection plan after refurbishment of wheelset parts

Part	Operation	Reference	Inspection method	Dimensions, shapes and deviations
Axle	Refurbishment of axle seats	4.2.1	measurement	axle drawing
	Refurbishment of axle body	4.2.2	measurement	axle drawing
	Axle replacement	4.2.2	-	spare parts list
	NDT of axle by magnetic particle testing	4.1.6.3	measurement	-
Wheel	Wheel tread reprofiling	4.3.1	measurement	wheel drawing
	Wheel replacement	4.3.2	-	spare parts list
	NDT test of wheel tyre for presence of cracks	4.1.6.2	measurement	no cracks
Wheelset	Wheelset electrical resistance (≤ 0.01 Ω)	4.1.2	measurement	-
	Press-fit diagram, offset, press-fitting forces, wheel integrity	4.3.2.2	-	wheel and axle drawings
	Back-to-back dimension	4.1.3.1	measurement	wheelset drawing
	Diameter difference between wheels on the same axle	4.1.3.2	measurement	wheelset drawing
	Front-to-front dimension	4.1.3.5	measurement	wheelset drawing
	Axial and radial run-out of both wheel set's wheels	4.1.3.5	measurement	wheelset drawing
	Wheel press-fitting alignment "c- c_1"	4.1.3.6	measurement	wheelset drawing

3.3 Limits

3.3.1 Wheels

Part	Damage, wear and tear	Shop Schedule	Running Schedule	Reference
Wheel	Wheel paintwork	not permitted	not permitted	4.4
	Condition of wheel tread and rim face surfaces:	(Data below have been taken from EN 15313:2016)		
	- Shelling and cavities	≤ 60mm	not permitted	4.1.1.2.1, 4.3.1
	- Rolling contact fatigue - RCF		not permitted	4.1.1.2.2, 4.3.1
	- Scaling		not permitted	4.1.1.2.3, 4.3.1
	- Metal build-up		not permitted	4.1.1.2.4, 4.3.1
	- Wheel flats		not permitted	4.1.1.2.5, 4.3.1
	- Circularity defect	≤ 1.0mm	≤ 0.1mm	4.1.1.2.6, 4.3.1
	- Polygonization and local wheel tread collapse		not permitted	4.1.1.2.7, 4.3.1
	- Tread material roll-over in external face	≤ 5mm	not permitted	4.1.1.2.8, 4.3.1
	- Transversal / circumferential crack in tread	not permitted	not permitted	4.1.1.2.9/4.1.1.2.10, 4.3.1
	- Wear groove and chamfer	wear groove must be always fully visible		4.1.1.2.11,4.3.2
	- Tooling marks	not permitted	not permitted	4.1.1.2.12, 4.3.2
	- Signs of damage of various kinds	not permitted	not permitted	4.1.1.2.13, 4.3.2
	- Defects in wheel web holes	not permitted	not permitted	4.1.1.2.14, 4.3.2

	Damage, wear and tear	Shop schedule	Running schedule	Reference
Wheel	- Geometry defects in flange tip and in zone P1-P2	see reference	not permitted	4.1.1.2.15, 4.3.1
	- False flange	≤ 2 mm	not permitted	4.1.1.2.16, 4.3.1
	- Flange thickness	29.4 mm	Min.22mm, Max.	4.1.3.3 4.3.1
	- Flange Height	28.5 mm	Min.27.5mm,	
	- Flange angle dimension		6.5mm	
	- Rim thickness	130-1mm	130-3/+1mm	
	- Wheel axial run-out on wheel set	0.5mm	0.8mm	4.1.3.5 4.3.2
	- Wheel radial run-out on wheel set	0.3mm	0.3mm	4.1.3.5 4.3.1
	- Cracks in rims of tread and rim face in service	Not permitted	Not permitted	4.1.6.2, 4.3.2

3.3.2 Axles

Part	Damage, wear and tear	Shop schedule	Running schedule	Reference
Axle	Axle paintwork	not permitted	not permitted	4.4
	Cracks in refurbished wheel seats & refurbished axle body Cracks in journals, seat of abutment (labyrinth) ring & wheel seats after simple dismantling of relevant parts with no need for their refurbishment	not permitted	not permitted	4.1.6.3 4.2.1 4.2.2 4.2.3
	Cracks (during operation)	not permitted	not permitted	4.1.6.1 4.2.1 4.2.2 4.2.3

3.3.3 Wheel sets

Part	Damage, wear and tear	Shop Schedule	Running Schedule	Reference
Wheelset	Electrical resistance	≤0.01Ω	≤0.01Ω	4.1.2
	Back-to-back dimension	1600+0.8mm	1600+3mm	4.1.3.1 4.3.2.1 4.3.2.2
	Diameter difference between wheels of a wheelset	≤ 0.5 mm	≤ 0.5 mm	4.1.3.2, 4.3.1
	Front-to-front dimension	max.1659 mm	max.1659 mm min.1643 mm	4.1.3.4, 4.3.1
	Degree of wear of brake disc friction surfaces	see product documentation	see product documentation	

4. Maintenance Instructions

By wheelset maintenance we mean ensuring that all functional surfaces and surface protection are kept intact in order to achieve the longest possible life while preserving traffic safety in view of the natural wear or defects developed by usage.
Repairs, disassembly, replacement and re-assembly or discarding the part from further use are done based on periodical inspections and NDT tests.
Maintenance levels and criteria for determining the repair extent are defined further in this document.

! Fitting wheels to an axle by supercooling the axle is prohibited.

! It is prohibited to use any welding works or spraying the wheelsets or their parts (wheels) with heated substances or adding new material to repair non-integrities in the original material.

! Cleaning products used must not damage the wheelset metal surfaces and the wheelset's parts without surface protection and surfaces protected by a coating system specified in clause 4.4.

! Before the actual inspection or a NDT test of the wheelset or its parts, all dirt must be removed to make it possible to carry out the required test and to evaluate the checked parameter.

4.1 Wheelset

The wheelset 's functlon is to carry the railway vehicle and to keep it on the rail track, and to transfer forces between the rail vehicle and the rails. Due to the direct effect of these forces, as well as due to the heat generated in this process, the parts of the assembly lose their utility properties, functional dimensions, surface protection and sealing capabilities.
Due to the direct effect of these moments and forces, external interference and/or dismounting of some of the wheelset's components, the wheel surfaces can get damaged. When this happens, unless specified otherwise, the wheel surfaces can be refurbished.

4.1.1 Checking surface condition and surface protection

4.1.1.1 Regular inspections of surface protection

Inspections are carried out visually, checking all wheelset parts (the entire wheel surface with applied protective coating), with special focus on the surface condition and its protection of

the axle body, transition radiuses from the axle body to the wheel seats and brake disc seats (in the transition zone from the wheel web to the wheel hub and rim).

! If the inspection of the wheel surface reveals a scratch or a crack which penetrates the surface protection down to the base material (bare metal), its depth must be determined immediately, using a suitable NDT test.

If crack is found in wheel the wheel must be replaced unless it can be repaired by reprofiling.

If no crack is found underneath damaged coating specified in clause 4.4., the paintwork must be repaired.

4.1.1.2 Regular inspection of wheel treads and rim faces

! When the wheelset is in use, a system preventing the wheels from spinning when pulling off and when braking must be always set correctly, to avoid frequent development of tread defects (e.g. wheel flats, shelling). Wheelsets must not be overloaded when pulling off and braking.

Inspections of treads and rim faces is done visually or by tests for the presence of the defects specified below. The list of defects presented in this chapter is based on **EN 15313 2016**. Limiting lengths of defects found in wheel treads are specified in Table 1.

Table 1

M		*M* ≤ 18			18 < *M* ≤ 22,5				22,5 < *M*		
V (km/h)		*V* ≤ 160	160 < *V* ≤200	200<*V*	*V* ≤120	120 < *V* ≤160	160 < *V* ≤ 200	200 < *V*	*V* ≤ 100	100 < *V* ≤ 120	120 < *V*
d	1 000 < *d*	80	60	40	80	60	50	35	X	X	X
	840 < *d* ≤ 1 000	60	50	30	60	50	35	25	60	50	30
	630 < *d* ≤ 840	40	30	25	40	30	25	20	40	X	X
	550 < *d* ≤ 630	35	25	X	X	X	X	X	X	X	X
	d < 550	30	X	X	X	X	X	X	X	X	X

M … *axle load in tonnes (t)*
X … *reserved*
D … *actual wheel diameter*

4.1.1.2.1 Shelling, cavities

(see EN 15313:2016, Annex C.2.3, Figure C.4)

This defect is a local material loss in a limited zone of the tread surface, as shown in Figure 1.

In-service limit:

- see clause 4.1.1.2, Table 1

Remedy: Reprofiling the tread until the defect disappears see clause 4.3.1

Figure 1

4.1.1.2.2 Rolling contact fatigue – RCF

(see EN 15313:2016, Annex C .2.9, Figure C.12)

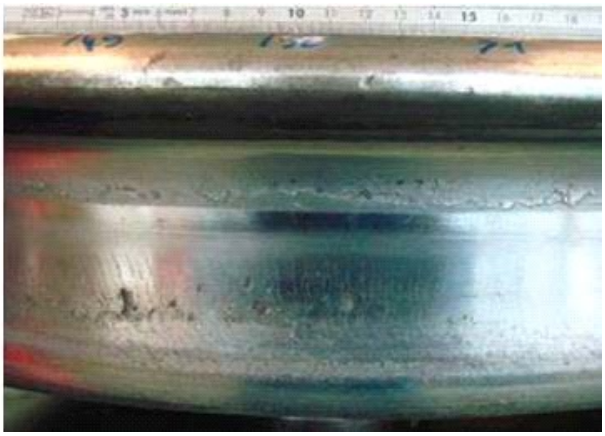
These defects are created due to the repeated fatigue loading in the plane of the tread as it rolls both along tangent track and steers around curves. Initially the damage appears as a network of fine cracks Figure 2a. As the cracks propagate, surface defects are generated as shown in Figure 2b.

Running Schedules:

- see clause 4.1.1.2, Table 1

Remedy: Reprofiling the tread until the defect disappears – see clause 4.3.1

a) Initial stage of RCF



b) Advanced stage of RCF

Figure 2

4.1.1.2.3 Scaling

(see EN 15313 2016, Annex C.2.4, Figure C.5)

The defect shown in Figure 3 is a laminar metal flow over the whole tread circumference. In-service limits

- see clause 4.1.1.2, Table 1

Remedy: Reprofiling the tread until the defect completely disappears, see clause 4.3.1

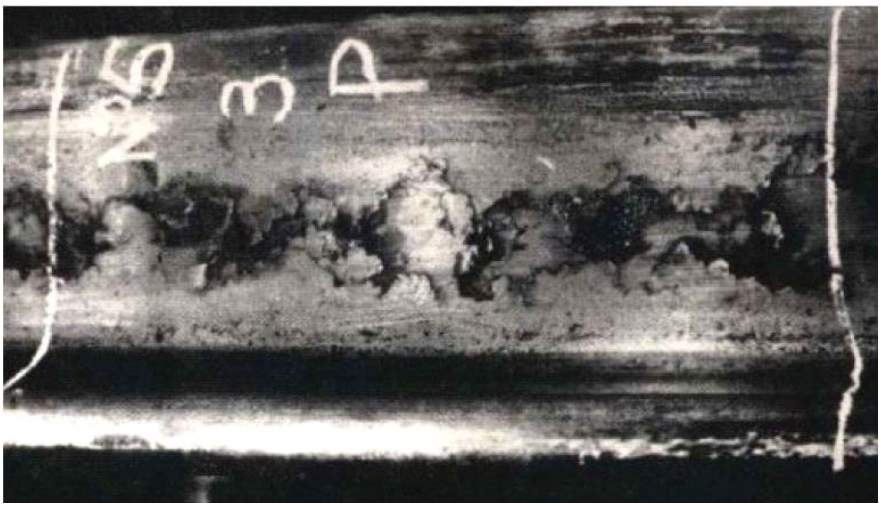


Figure 3

4.1.1.2.4 Metal build-up

(see EN 15313:2016, Annex C.2.2, Figure 3)

Metal build-up is shown in Figure 4.

Running schedules:

- see clause 4.1.1.2, Table 1

Remedy: Reprofiling the tread until the defect completely disappears, see clause 4.3.1

Figure 4

4.1.1.2.5 Wheel flat

(See EN 15313:2016, Annex C 2.1, Figure C.1)

Wheel flats are shown in Figure 5. Flats usually develop on both wheelset's wheel at the same time. Continuing to use the wheelset without reprofiling may result in the development of shelling.

In-service limits:

- see clause 4.1.1.2, Table 1

Remedy: Reprofiling the tread until the defect completely disappears, see clause 4.3.1

Figure 5a

Figure 5b

4.1.1.2.6 Circularity defects (ovality)

(see EN 15313 2016, Annex C.2.7.1, Figure C.8)

The circularity defect includes all in-service permanent changes to the shape of the tread contact zone of the wheel (e.g. polygonization with one or more defects around the circumference of the wheel, local tread collapse, etc.). The reference plane is taken on the running circle and includes point D_0 shown in Figure 11. The general circularity defect is shown in Figure 6.

Running schedules:

- see Table 2 below (informative) and clause 4.1.1.2, Table 1

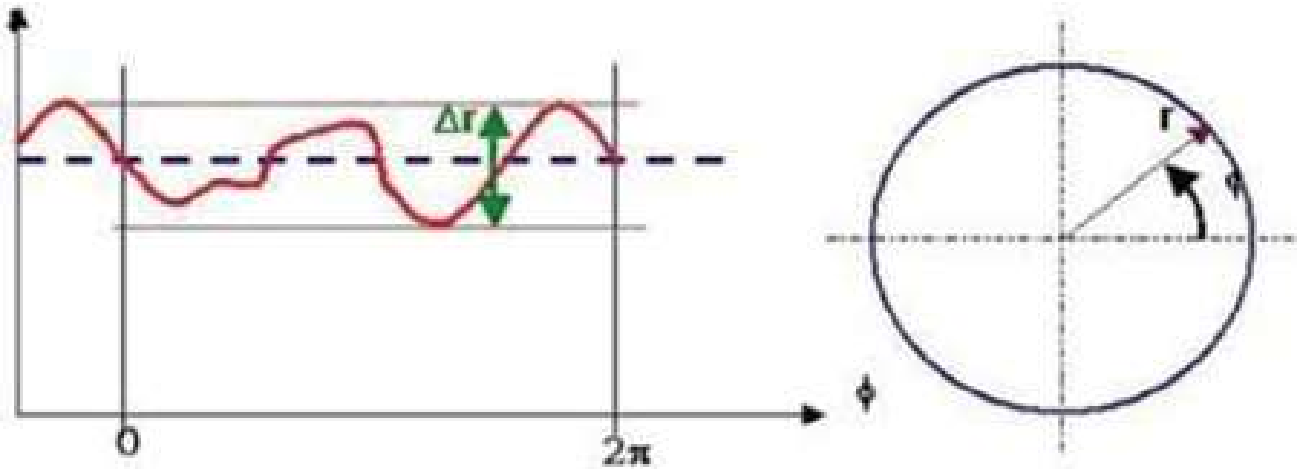
Shop Schedules:

- $\Delta r \leq 0.1$ mm

Table 2

Wheel diameter Speed range	Permissible circularity defects ($\Delta\eta$)
d > 840 mm • v_{max} ≤ 60 km/h • 60 km/h < v_{max} ≤ 160 km/h • 160 km/h < v_{max} v ≤ 200 km/h v_{max} > 200 km/h	1.5 1.0 0.7 0.5
380 < d ≤ 840 mm v_{max} v_{max} > 200 km/h	0.7 0.5
d≤380 mm	0.3

Remedy: Reprofiling the tread until the defect completely disappears, see clause 5.3.1



Key

circularity variation at the wheel tread surface

theoretical circle at wheel tread surface definition

of circularity defects

Figure 6

4.1.1.2.7 Polygonization and local tread collapse

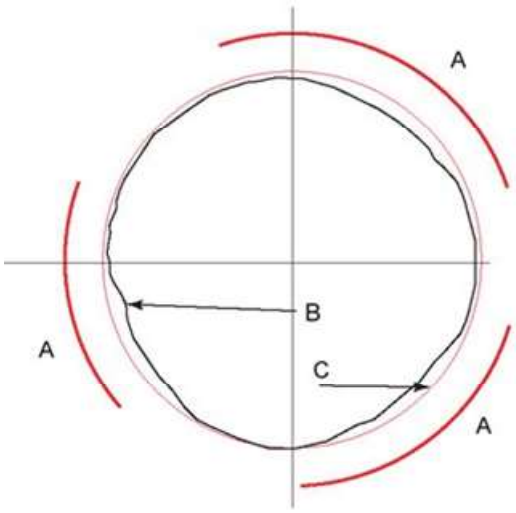
(See EN 15313 2016, Annex C.2.7.3, Figure 10)

Polygonization is shown in Figure 7a.
A local tread collapse is shown in Figure 7b.
Shelling in the Centre of a local tread collapse is shown in Figure 7c.

Running schedules:

- see clause 4.1.1.2.6, Table 2

Remedy: Reprofiling the tread until the defect completely disappears, see clause 4.3.1



Key

A designates the circularity defect zone

B designates the actual tread shape

C designates the reference wheel tread

Figure 7a

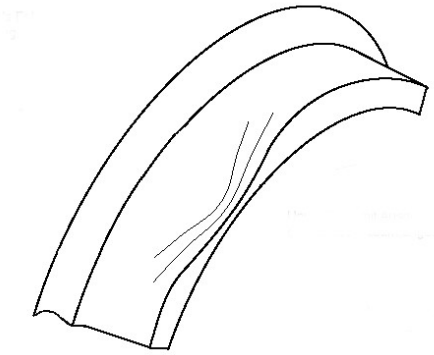


Figure 7b

Figure 7c

4.1.1.2.8 Wheel tread corner roll-over

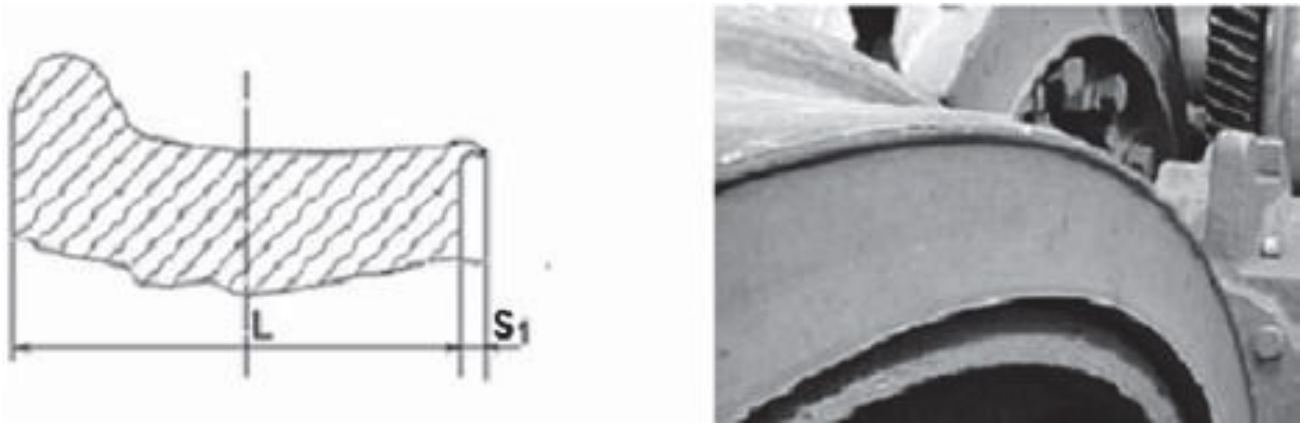
(See EN 15313 2016, Annex C. 2.11, Figure C15)

The wheel tread roll-over of dimension S1 is a continuous defect around the wheel tread corner circumference. This defect is shown in Figure 8.

Running schedules:

- $S_1 \leq 5$ mm

Remedy: Reprofiling the wheel tread until the defect completely disappears, see clause 4.3.1



Key

L rim width

S_1 dimension of wheel tread corner roll-over

Figure 8

4.1.1.2.9 Transversal cracks in wheel tread surface

These are cracks orientated under an angle of about 90° relative to the wheel's circumference. They usually appear individually on the wheel tread surface, but can be also spread in larger numbers along the wheel's circumference. They usually start developing from flats or spots of shelled material from the wheel tread. They might also appear after reprofiling done to remove shelling and scaling, or as heat cracks developed as a result or using block brakes.

In-service limits **not permitted**

Remedy: Reprofiling the wheel tread until the defect completely disappears, see clause 4.3.1

4.1.1.2.10 Circumferential cracks in wheel tread surface

These are cracks orientated in the direction of the wheel tread. Can be straight or curved. Transversal cracks might initiate from circumferential crack ends.

In-service limits **not permitted**

Remedy: Reprofiling the wheel tread until the defect completely disappears, see clause 4.3.1

4.1.1.2.11 Wear groove and chamfer

(See EN 15313 2016, clause 6.2.1.7, 6.2.1.8, 6.2.1.9)

The main dimensional and installation characteristics of the groove are as follows

- dimensions

The dimensional characteristics of the groove are shown in Figure 9.

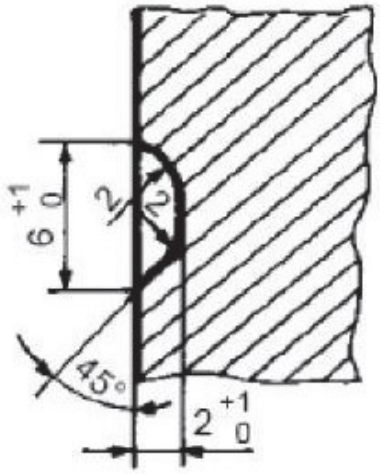
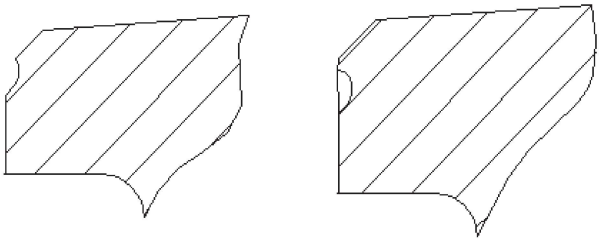


Figure 9

- groove location

The groove location must take into consideration the location of point I which is specified in EN 13715.
A section of the tread profile is given in EN 15313 2016, Ch.6.2.1.7 in Figure 10;
The wear groove, when mandatory, shall always be fully visible after reprofiling or in service. The decision criteria are shown in Figure 10.



1 **2**

Figure 10

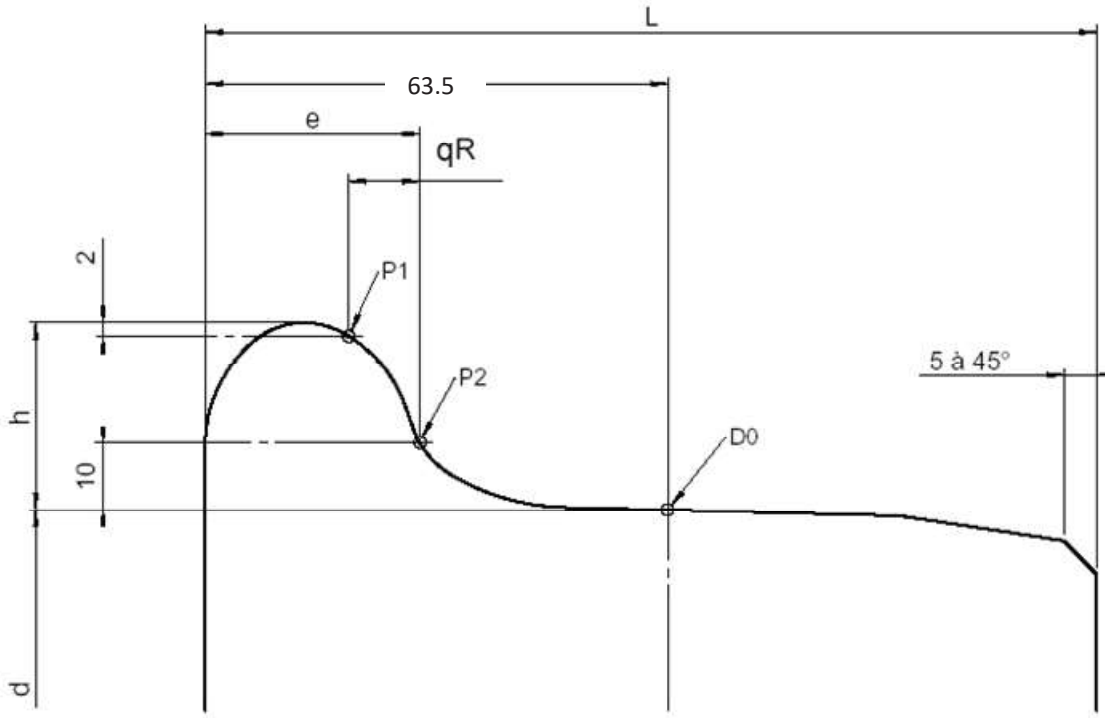
Key

1 not permitted

2 permitted

The chamfer is defined in Figure 11. The nominal dimensions are 5 mmx5 mm.

Dimensions in millimetres



Key

d	wheel diameter
D_O	position of wheel tread
h	flange height
L	rim width
qR	flange angle dimension between P1 and P2

Figure 11

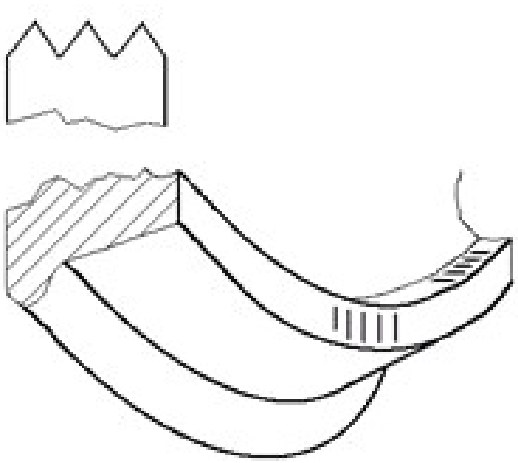
4.1.1.2.12 Tooling marks

(See EN 15313 2016, Annex C.2.18, Figure C.25)

The various types of dangerous tooling marks are shown in Figure 12.

Running schedules: **not permitted**

Remedy: Replacing the wheel or, provided the drawing tolerances allow it, machining until the defect is completely gone.



a) Tooling mark

b) Marks left by lathe chuck jaws

Figure 12

4.1.1.2.13 Damage marks of all types

(see EN 15313 2016, Annex C.2.19, Figure C.26 and C.27) The main

types of damage marks are as follows

- sharp-edged circumferential defects on the web or wheel center as shown in Figure 13.

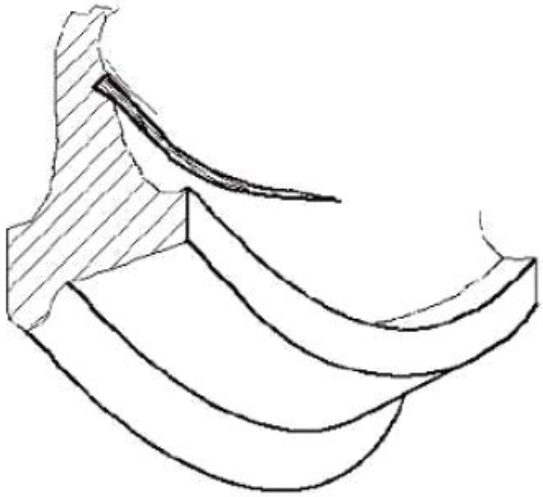


Figure 13

- sharp-edged radial marks on the internal face of the wheel. This type of defect is shown in Figure 14.

Figure 14

- sharp-edged radial defect on the web. This type of defect is shown in Figure 15

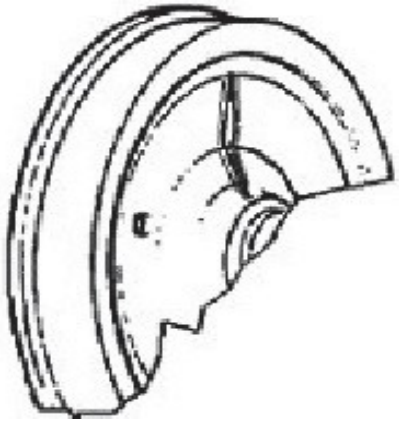


Figure 15

Running schedules: **not permitted**

Remedy: Replacing the wheel or, provided the drawing tolerances allow it, machining until the defect is completely gone.

4.1.1.2.14 Wheel web hole defects

(see EN 15313 2016, Annex C. 2.21, Figure C. 28) Wheel web

hole defects are shown in Figure16.

Running schedules: **Not permitted**

Remedy: Wheel replacement

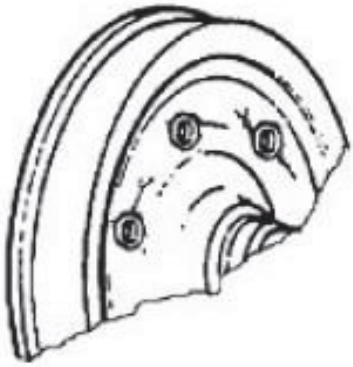


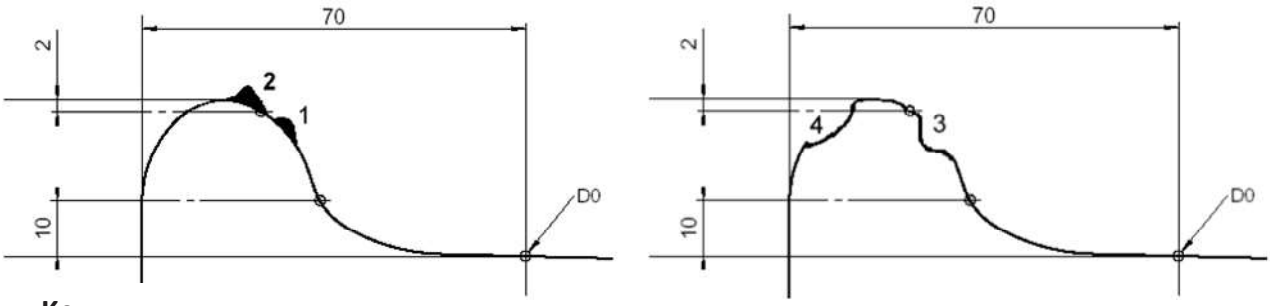
Figure 16

4.1.1.2.15 Geometric defects at the flange tip in zone P1-P2

(See EN 15313 2016, Annex C.2.15, Figure C.22)

Zone P1 – P2 (active face of the flange) is shown in Figure 11.
Defects of this type, continuous or not, are shown in Figure 17.

Dimensions in millimeters



Key

1,2 defects after metal flow

3,4 material loss

Figure 17

Running Schedule

- Material flow in the P1 zone – the flange tip, defined in Figure 11, is permissible provided the representative dimension qR is greater than 6.5 mm.
- Defects, sharp edges or burrs, number 1, 3 or 4, defined in Figure 19, are not permitted.

Remedy: Reprofiling the wheel tread until the defect completely disappears, see clause 4.3.1

4.1.2.16 False flange

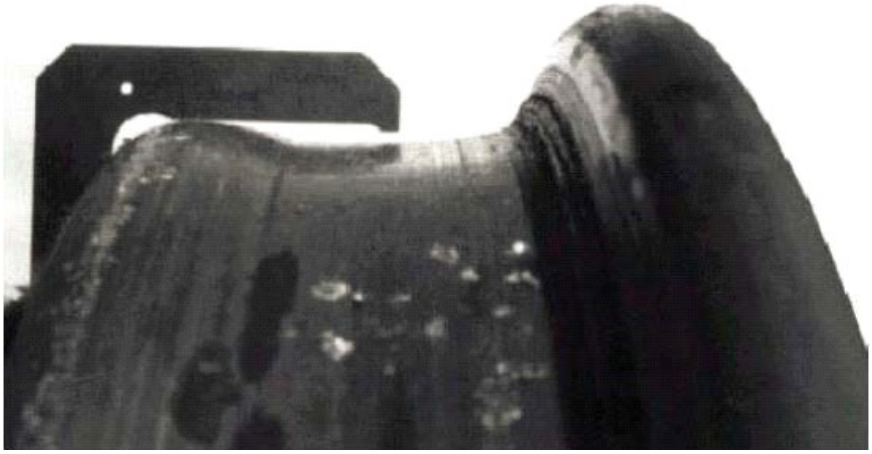
(see EN 15313 2016, Annex C.2.14, Figure C.19 and C. 20)

False flange is formed when the rim-face side of the tread is raised above the nominal tread running band. A false flange can be formed when significant tread wear is concentrated at the running band (se Figure 18).

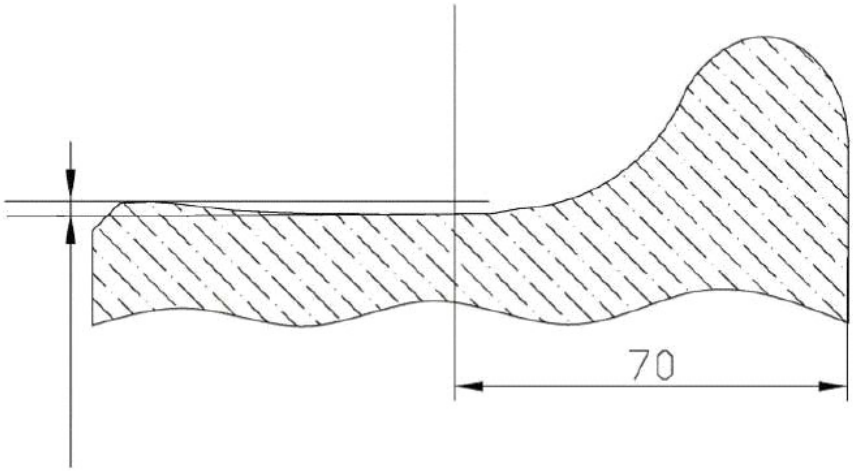
Running schedule

- ≤ 2 mm

Remedy: Reprofiling the wheel tread until the defect completely disappears see clause 4.3.1



a) **Picture of false flange**



b) **Definition of false flange**

Figure 18

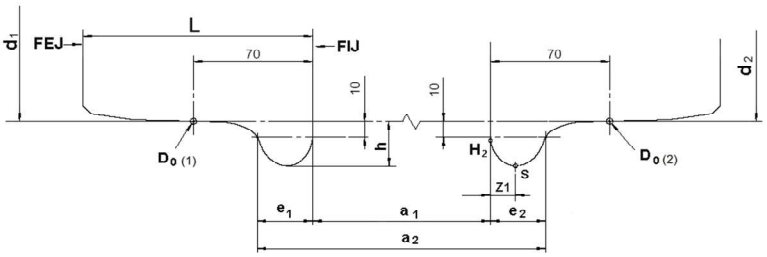
4.1.2 Verification of wheelset electrical resistance

Electrical resistance is verified after wheelset refurbishment, with a measuring device (ohmmeter). Voltage must be between 1.8 V and 2.0 V DC. The ohmmeter electrodes must be attached to the rim of both wheels. The wheelset must be either removed from the bogie or electrically isolated from it, as well as from the rail, at least one wheel. Electrical resistance of the wheelset after a wheel replacement and refurbishment of the contact surfaces of the press-fitted joint must not be greater than 0.01 Ω

4.1.3 Checking wheelset dimensions

The essential dimensional references of the interface are defined in Figure 19.

Dimensions in millimetres



Key

a_1 back-to-back dimension

a_2 front-to-front dimension ($a_1 + e_1 + e_2$)

D_O position of wheel tread (1) wheel 1, (2) wheel 2

e_1, e_2 flange thickness

h flange height

H_2 transition point between internal face of the rim and the flange

L rim width

z_1 internal zone of flange (H_2 s)

FEJ internal face of the rim *FIJ*

external face of the rim *S*

flange tip

d_1, d_2 wheel diameters

Figure 19

4.1.3.1 Checking back-to-back dimension of a wheelset

The distance if checked by direct measurement of the distance between internal faces of the rims of both wheels with a measuring device of a minimum measurement accuracy (scale resolution) 0.1 mm.

The back-to-back dimension of a wheelset are measured at three points at 120° intervals (a_{11},a_{12}, a_{13}), between internal faces of the rims of both wheels, at 60±5mm flange tip.

$$a_1 = (a_{11} + a_{12} + a_{13}) / 3$$

Running schedule: (S_R)

- $a_1$min = 1597 mm, a_{1max} = 1603 mm (under load)

Shop schedule: (S_R)

- $a_1$min = 1599.2 mm, $a_1$max = 1600.8 mm (without load)

4.1.3.2 Checking diameter difference between wheels of a wheelset

The check is carried out by direct measurement at the point of running circles of both wheels, i.e. 70 mm from the internal face of rim, with a measuring device of a minimum measurement accuracy (scale resolution) 0.01 mm, in planes I and II which are perpendicular to each other, with the diameter of the two wheels:

$$d_1 = d_{1I} + d_{1II} / 2 \qquad \text{and} \qquad d_2 = d_{2I} + d_{2II} / 2$$

Running schedule:

- $|d_1 - d_2| \leq 0.5$ mm (see EN 15313:2016, clause 6.4.2, Table 8)

Shop schedules:

- $|d_1 - d_2| \leq 0.3$ mm (see EN 13260:2020(E) table:3)

Remedy (if the limit has been exceeded): reprofiling the wheel tread, see clause 4.3.1

4.1.3.3 Checking wheel tread sizes and rim width of both wheels

The check is carried out by direct measurement made on the wheel treads and rims of both wheels with a special measuring device of accuracy 0.01 mm which allows the following parameters to be measured simultaneously (see EN 15313:2016):

Running schedules:

- Flange thickness (S_d): $e_{min.}$ = 22 mm, $e_{max.}$ = 33 mm (see EN 15313:2016, clause 6.2.1.3, Table 2)
- Flange height (S_h): $h_{min.}$ = 27.5 mm, $h_{max.}$ = 36 mm (see EN 15313:2016, clause 6.2.1.2, Table 1)
- Flange angle dimension: qR ≥ 6.5 mm (see EN 15313:2016, clause 6.2.1.4)
- Rim width: $L_{min.}$ = 127 mm, $L_{max.}$ = 131 mm with no tread material roll-over in the external face plus tolerance

Wheel treads after reprofiling are usually checked with the wheel still on the reprofiling lathe. If not, then the check is carried out using a special profile measuring device or profile shape gauge. When the latter is used, assessed is the difference between the reprofiled profile and the new profile.

Shop schedule (after reprofiling):

- Shape deviation from the gauge: ≤ 0.2 mm

Remedy (if the limit has been exceeded): reprofiling the wheel tread, see clause 4.3.1

4.1.3.4 Checking front-to-front dimension

The check is carried out by calculating (adding) measurement readings of the flange thickness of both wheels and an average value of the back-to-back dimension $a_1 = (a_{11} + a_{12} + a_{13})/3$

The calculated front-to-front value (a_2) or (S_R) is obtained from the formula: $a_2 = e_1 + a_1 + e_2$, measured as described in clause 5.1.3.1 and 5.1.3.3.

Running schedule:

- $a_2$min = 1643 mm, $a_2$max = 1659 mm (loaded)

Measurements of wheelset 's front-to-front dimension are usually done straight in the press-fitting press after new wheels have been press-fitted, or straight after reprofiling of wheel treads on the reprofiling lathe. If not, the check of front-to-front dimension is carried out by direct measurement using a special measuring device with a dial indicator of a minimum accuracy 0.1 mm.

Wheelset's front-to-front dimension is measured at three points at 120° intervals (a_{21}, a_{22}, a_{23}) around the wheel's circumference.

Shop schedule:

- a_2 = max.1659 mm (unloaded)

4.1.3.5 Checking axial and radial run-out of wheelset's wheels

The check is usually carried out straight in the press-fitting press after new wheels have been press-fitted, or straight after reprofiling of the wheel treads on the reprofiling lathe. If not, axial and radial run-out is checked using a suitable measuring device or directly by using a dial indicator of a minimum accuracy 0.01mm, mounted on a stable stand. The stand must not transfer vibrations from the surroundings to the measuring device. The reference basis for the run-out measurements are the axle bearing journals.

The check is always carried out with the wheels rotating, unloaded, or on a wheelset removed from the bogie.

Axial run-out is measured on the internal face of rim at a point 60 ± 5 mm. Radial run-out is measured on the wheel tread at the point of wheel running circle, i.e.
63.5 mm from the internal face of rim.

Running Schedule:

- axial run-out: → ≤ 0.8 mm (see EN 15313:2016, clause 6.4.4, Table 10)
- radial run-out: ↑ ≤ 0.3 mm (see EN 15313:2016, clause 6.4.3, Table 9)

Shop Schedule:

- axial run-out: → ≤ 0.5 mm (see EN 13260:2009+A1:2010)
- radial run-out: ↑ ≤ 0.3 mm (see EN 13260:2009+A1:2010)

Remedy (if the limit has been e x c e e d e d): dismantle the wheelset, see clause 4.3.2.1

4.1.3.6Checking alignment of wheelset's press-fitted wheels dimension "c - c_1"

The check is carried out by direct measurement using a dial indicator of minimum accuracy 0.01 mm, mounted on a stable (magnetic) stand, which must not transfer vibrations from the surroundings to the measuring device.

Dlmenslon "c - c_1 "is the difference in distances between the reference plane of the axle and

the rim internal face of the press-fitted wheel, applicable always to the same side of the wheelset. The measurement is carried out on the internal faces of the rims, 60 + 5 mm below the flange tip.

The check must be carried out every time new wheels have been press-fitted to an axle, without axle bearings and their components.

Off-vehicle limits (after reprofiling):

- $c - c_1 \leq 1$ mm (see EN 13260:2009+A1:2010)

Remedy (if the limit has been exceeded): dismantle the wheelset, see clause

4.1.4 Wheel axial and rotational displacement

(See EN 15313:2016, Annex C. 6.3.1, Figure C. 43)

Axial displacement is the axial movement of a component relative to its bearing surface. This type of defect is shown in Figure 20, that illustrates the example of a wheel.

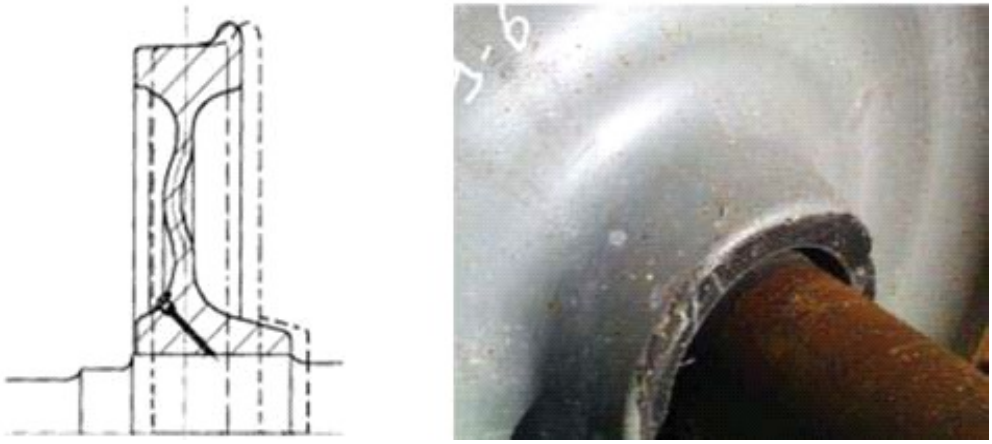


Figure 20

Rotational displacement results from a rotation of a component relative to its bearing surface. This type of defect is shown in Figure 21 that illustrates the example of a wheel.

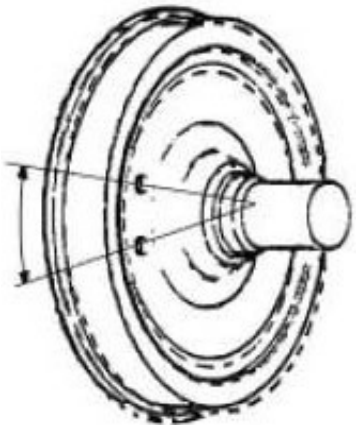


Figure 21

Running schedule

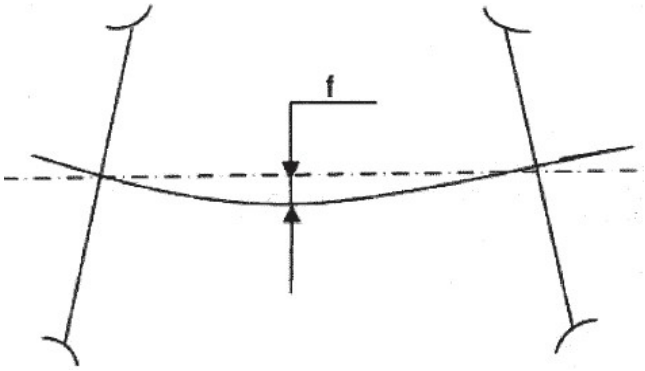
- Neither type of a defect is permissible

Remedy: Wheel replacement, see clause (alternatively refurbishment or axle replacement, see clause 4.2.1.

4.1.5 Bent axle

(see EN 15313 2016, Annex C. 6.4, Figure C. 45)

The deformation of an axle is indicated by its non-linearity as shown in Figure 22, with the sag "f" relative to the position of the original symmetrical axle.



Key

f sag relative to the position of the original symmetrical axle

Figure 22

In-service limits

- not permitted

Remedy: Axle replacement

4.1.6 Wheelset NDT testing

NDT testing of worn or defective spots on any part of the wheelset must be always carried out in dangerous cases (see clause 5.1.1.1) in accordance with the client railway's regulations.

Before the actual testing can commence, the surface to be tested must be cleaned from any sediments of dirt and dust.

4.1.6.1 Ultrasonic testing of axles for presence of cracks

Ultrasound testing of solid axles is carried out from the axle's end faces, using angle probes. Unless the testing method is stipulated by the test regulation of the client railway to which the wheelset is intended, followed must be the procedure and used must be equipment specified by the axle manufacturer's standard.

4.1.6.2 Ultrasonic testing of wheel rims for presence of cracks

Wheel rims are tested for the presence of cracks by the ultrasound method in accordance with the regulation of the client railway for which the wheelset is intended. As a rule, the test is carried out after the first trimming cut before the wheel reprofiling. After the reprofiling, the wheel tread surface must be checked by magnetoscopy (MPT) for the presence of cracks which might have originated in an inadequately remedied defect.

4.1.6.3 Magnetic particle testing of axles

The test must be carried out in accordance with the regulation of the client railway for which the wheelset is intende d. The test is carried out on the axle's wheel seats and on the seats of abutment (labyrinth) rings after the appropriate parts have been dismounted, making the actual surface (of the wheel, the inside bearing rings, etc.) accessible.

The testing must be carried out after refurbishment of the contact surface of wheel's or axle body's seat

4.2 Axle

Axle is a rotating part with seats for fitting wheels, axle bearings, labyrinth rings, axle brake discs and, in case of a power wheelset, axle gearbox.

Axle provides mechanical and electrical bond between the two wheels; imposed upon the axle are bending and braking moments.

Direct effects of these moments, external interferences or dismounting of one of the parts fitted to the axle may damage the axles seats. If this happens and unless stipulated otherwise, the axle seats detailed below can be refurbished (renovated).

4.2.1 Refurbishing axle wheel seats

Axle wheel seats are refurbished by reducing the nominal diameter of the cylindrical surface of the axle seat, including the tapered transition of this seat, with the aim of achieving

dimensional, shape and positional deviations and surface roughness which are within the tolerances specified in the manufacturer's drawing

By axle wheel seat are understood the below cylindrical surfaces (including tapered transition)

Wheel seat diameter[mm]^	
Manufacturing tolerance Motor axle	Ø 212 v6
Minimum (Motor axle)	Ø 209 v6
Manufacturing tolerance Trailer axle	Ø 190 v6
Minimum (Trailor axle)	Ø 187 v6

^ Motor axle, drawing number MT 18Br2 001477-8

Trailor axle, drawing number MT 18Br2 001478-7

! Refurbishment must be done to an identical nominal diameter of both axle seats, even if one of them shows no signs of damage or defect.

4.2.2 Refurbishing axle body

Axle bodies is refurbished by reducing the nominal diameter of the cylindrical surface including tapered transitions, with the aim to achieve dimensional, shape and positional deviations and surface roughness which are within the tolerances specified in the manufacturer's drawing

Axle body diameter[mm]^	
Manufacturing tolerance	Motor axle Ø179+2 Trailer axle Ø160+2
Minimum	Ø179, Ø160

^ Motor axle, drawing number MT 18Br2 001477-8

Trailor axle, drawing number MT 18Br2 001478-7

Local axle body repairs are permitted. The place of such repair must be at least 50 mm away from the seat edge. The repair must be carried out by grinding off the defect to a maximum depth 0.6 mm, with a transition radius from the repaired area being at least R75. The length of the repaired section in the axial direction must not exceed 50 mm. Transition to cylindrical sections must be gradual and free of any edges. Maximum permissible surface roughness must be Ra = 1.6 µm.

After the refurbishment, the axle body surface protection must be restored in accordance with instructions of the manufacturer of the coating material used on the axle.

4.2.3 Replacing the axle

Axles are replaced when the degree of wear or the extent of a defect exceeds the running schedule set forth by these Instructions or the regulations of the client railway for which the axle is intended.

Axle replacement requires all components to be dismounted. Wheels are dismounted as described in clause 4.3.2.1 herein.

Axle bearings are dismounted In accordance with the axle bearing manufacturer's product documentation.
Axle brake discs are dismounted In accordance with the brake disc manufacturer's product documentation.

4.3 Wheel

Wheel is a body of a rotational shape, shape-wise divided into a hub with a machined hole for fitting onto an axle, a wheel web and a wheel rim with a tread and flange.

Wheels are cold press-fitted to an axle as part of a wheelset whose function is to keep the railway vehicle on the rail track, to transfer traction and braking moment as well as axial forces, imposing loads mainly on the wheel flange (driving in curves and through rails crossings). Direct imposition of these forces and moments, external interferences or dismounting of one of the parts fitted to the axle can lead to some of these parts (functional surfaces of the wheel) getting damaged. If this happens and unless stated otherwise, the below defined wheel surfaces can be refurbished (renovated).

4.3.1 Reprofiling wheel tread

Wheel tread is reprofiled by machining the tread surface around the entire surface of the rim including flange, by reducing its nominal outside diameter measured at the point of the wheel running circle.

Reprofiling must achieve dimensional, shape and positional deviations, including surface roughness, to be within the tolerances specified in the wheel manufacturer's drawings.

Running circle diameter [mm] ^	
New wheel	Ø 952+0.5
Last reprofiling	Ø896+0.5
Shop schedule	**Ø877**

^ monobloc wheel, drawing number MT18Br2 001481-03

! Refurbishment must be carried out to an identical nominal diameter of both wheel treads, even if one of them shows no signs of damage of defect.

! Nominal diameter of the wheel tread after reprofiling must not be smaller than the limiting nominal diameter specified in the wheel drawing. If the drawing does not specify a last reprofiling diameter, a rule applies that the last reprofiling diameter is determined by the diameter of the wear groove. After the operation, a full section of the wear groove must be visible.

After the wheel has been reprofiled, a series of measurements specified in clauses 4.1.3.2 to 4.1.3.5. must be repeated.

4.3.2 Wheel replacement

Wheel replacement is carried out when the degree of wear or the extent of a defect has exceeded the in-service limit set forth by these Instructions or by the regulation of the client railway for which the wheel is intended.

4.3.2.1 Dismounting wheel from axle

! It is prohibited to heat the wheel hub with a welding torch or with any other source of heat to dismount the wheel from the axle.

Wheels are pulled off the axle on a hydraulic press equipped at least with a pressure gauge to register the pulling force. To avoid damaging the axle seat and the wheel hub hole, before pulling force is applied, it is necessary to release the bond between the press-fitted joint's contact surfaces by injecting pressure fluid through the G1/4 injection hole in the wheel hub leading to a distribution groove in the wheel hub's hole.

The pressure fluid is generated in a high-pressure injector capable of developing at least 250 MPa pressure.

! When using the high-pressure injector, the equipment manufacturer's user instructions must be followed.

An indicator to stop increasing the injector pressure is when the pressure fluid starts flowing out of the press-fitted joint on both sides, ideally around the entire hub circumference. When this happens, continue injecting the fluid for about 30 seconds to ensure that it penetrates the

entire circumference of the press-fitted joint. Then you can start applying the dismounting force upon the inner face of the wheel hub.

Unless the wheel is during the dismounting operation centered, hung or propped up under the wheel tread, a dismounting case attached to the journal must be used to place the wheel in.

The outside diameter of this case must match the diameter of the hub hole less a 0.5 mm insertion allowance.

4.3.2.2 Press-fitting wheel to axle

Wheels are press-fitted on a hydraulic press equipped with a pressure gauge and a registration device for graphical recording of the pressing force curve as a function of the press-fitting track (a press-fit force displacement diagrams).

The pressure sensors on the press must be sufficiently accurate to allow the press-fitting force to be determined with a minimum accuracy of 10 kN.

The pressure gauge, the registration device and the conformity of the pressure gauge values with those in the press-fit diagram must be checked on a regular basis according to a Metrology Rules as part of the quality management system. Maximum deviation must not exceed 5 kN.

The press-fitting force recording in the diagram must allow the press-fitting forces to be read off the diagram with a 25 kN accuracy.

The length ratio between the “diagram length” to “press-fitting” must be at least 1:2.

The magnitude of the press-fitting force reached at the end of the press-fitting operation and the lubricant used must meet the requirements specified in the wheelset manufacturer’s drawing.

The press-fitting speed and the shape of the press-fit diagram must meet the requirements specified in technical conditions and values specified in the wheelsets manufactures drawing.

For each press-fitting joint must be available a corresponding press-fit diagram with the following information added

a) Logo of the organization who did the press-fitting.
b) The press-fit diagram sequence number.
c) Unique identification of the press-fitted wheel and axle.
d) Dimensions of the wheels and axles relevant contact surfaces
e) An offset determined from measured dimensions of the contact surfaces.
f) Type of the lubricant used to lubricate the contract surfaces during the press-fitting operation.
g) The press/fitting force reached at the end of the press-fitting operation in kN.
h) The press-fitting date.
i) Signature of the press operator.

If the press-fit diagram fails to meet the criteria specified in technical conditions and values specified In the wheelset manufacturers drawlng, it is possible (provided the technical conditions allow it) to perform an integrity test of the press-fitted joint.

The test is carried out 48 hours after the wheel was press-fitted to the axle by applying a force equal to 1.2-times the minimum pressing force specified in the wheelset manufacturer's drawing.

The imposed test force must be of an opposite direction to the press-fitting force, and be applied for at least 30 seconds. The press-fitted joint must not fail during the test. This can be verified by checking the press-fit diagram (provided the press when working in the opposite direction allows it), or by attaching a measuring device (of a minimum accuracy 0.01 mm) to the wheel rim before the test.

After the wheel has been press-fitted to the axle, the wheelset dimensions must be checked and the measurement readings recorded in the wheelset's measurement sheet.

Checked are the dimensions defined in the following clauses:

- 4.1.3.1 Checking back-to-back dimension
- 4.1.3.2 Checking diameter difference between wheels on the same axle
- 4.1.3.3 Checking dimensions of wheel treads and rim width of both wheels
- 4.1.3.5 Checking axial and radial run- out of wheelset's wheels
- 4.1.3.6 Checking press-fitting alignment of wheelset's wheels (dlmenslon "c - c1 .")

4.4 Repairing wheelset (wheel and/or axle) paintwork

Wheelset parts whose surface protection is defective must be first degreased with a degreasing product and any dirt stuck to the surface from use must be removed.

! Any degreasing, cleaning and lubrication products used, including for degreasing flanges, must not damage metal surfaces without protection, surfaces with a protective coating system or sealing mastics. These products must meet the clint's technical specification.

The degreasing product is applied with a brush with plastic bristle and let for about 5 minutes to take effect. After rinsing and drying, any non-adhering paint surrounding the damaged spot is removed with a steel scraper.

4.4.1 Removing old paint

4.4.1.1 Local repairs

Marked spots of local damage are smoothened with a sand paper of minimum granularity P80. For fine smoothening of transition zones is used sand paper of granularity up to P400. The transition between the steel surface of the wheel set part and the original paintwork must be smooth and continuous.

4.4.1.2 Complete removal of old paint

If when removing non-adhering paint from around a defect, more than 50% of the paint has been removed or peeled off, the paint must be removed from the part completely. This is done using a paint removal. The entire surface is roughened with sand paper of minimum granularity P80.

4.4.2 Degreasing wheel set (wheel) parts before applying new coating

Final degreasing is don e wlth a degreasing product approved by the coatlng system's manufacturer. The degreasing product is applied by brush with plastic bristle and let for approx. 10 minutes to take effect. After rinsing, the surface is dried with compressed air or a dry cloth which does not release fluff.

! Application of the coating system must commence within 4 hours after the part or the damaged spot to be repaired has been degreased (applies in ideal conditions for applying the coating system).

4.4.3 Selecting coating system

For paintwork repairs is used a two- layer MÄDER coating system.

Coating system specification for wheel and axle	
Primer	ARKOTE 31 NDFT 75-90 µm
Top coat	Arkote 31, RAL 7016, BR 40-70 NDFT 110µm

For painting repairs, the same coating system must be used as the one used on the new wheel set

Painting works can be performed only when the axle (wheel) temperature is at least 3 C above the dew point. Relative humidity must be between 30 and 70%. These values must be checked before the actual application of the coating system, using a suitable measuring instrument.

4.4.3.1 Paint preparation

Base	ARKOTE 31 PRIMER		ARKOTE 31 TOPCOAT	
Hardener	Durcisseur ARKOTE 31		Durcisseur ARKOTE 31	
Thinner	DILUANT T2506		DILUANT T2506	
%	Volume (ml)	Weight (g)	Volume	Weight
Base	3	100	3	100
Hardener	1	23	1	23
Thinner	0 - 1	0 - 20	0 - 1	0 - 20
Viscosity B4 Ford cup	30 ± 4 Sec @ 30°C		30 ± 4 Sec @ 30°C	

Preparing the paint for application:

- check whether the paint is not past the expiration date shown on the label; allow the
- components to reach ambient temperature;
- stir the paint thoroughly,
- adjust the viscosity to match the application technology to be used; if
- there is any dirt in the paint, filter them off through a sieve.

! ***All works must be performed in accordance with the paint manufacturer's instruction and paint technical sheets***

4.4.4 Paint application and drying

The ARKOTE 31 PRIMER can be applied on the in-advance prepared surface with a brush or by air or airless spraying in a single layer or, if the specified minimum thickness has not been achieved, in two layers, with a 90-minute time break between the two coats.

The ARKOTE 31 TOP COAT top coat can be applied with a brush or roller, or by air or airless spraying, if necessary, in multiple layers. Allow at least 12 hours between coats.

Weather conditions when applying the coating system must meet the recommendations of the paint system's technical sheet

An exact consistency and workability time must be adhered to as specified in the coating system's technical sheet. With an increasing temperature the paint workability time decreases. The mixture's viscosity can be as required by adding solvent in the ratio specified in the coating system's technical sheet.

Current thickness of a wet layer can be measured at random using a comb. Current thickness of a dry layer can be measured only if the layer is sufficiently dry (non-sticky), using a special magnetic flow-based instrument in accordance with EN ISO 2808.

Base	ARKOTE 31 PRIMER	ARKOTE 31 TOPCOAT
Application	1 - 2 layers (5 mins b/w each coating)	2 - 3 layers (5 mins b/w each coating)
WFT Spec	110-130 µ	130 - 170 µ
DFT Spec	45 - 55 µ	60 - 80 µ
Over coating - Air Dry	10 hrs	10 hrs
Force Dry	30 mins Flash off - > 60 mins @ 60° C EMT	30 mins Flash off - > 60 mins @ 60° C EMT
Nozzle Size	1.2 to 1.4 mm	1.2 to 1.4 mm
Appl. Temperature	15° - 35° C	15° - 35° C
Humidity	< 70%	< 70%
Pressure	2 to 4 bar (Preferable 2-3 bar)	

4.4.5 Checks and records

The worker who has done the repair must record the following information

a) Place of repair, worker's name,
b) Bogie number,
c) Date of old paint removal, degreasing and new coat application,
d) Air temperature inside the hall, air humidity, axle temperature and dew point.

Checked must be also an overall appearance of the applied coating system (no wrinkles, runs, blisters, etc.) and, provided the paint is sufficiently dry, a random check of the paint layer thickness is made with an ultrasound thickness meter.

5. Transportation and Storage

5.1 Transportation and handling

The wheelsets are transported either on road trucks or in enclosed railway wagons or in closed containers. A manipulation unit is a single wheelset placed on a special transportation palette designed for handling by a forklift. The wheel treads, rim faces and hubs including the wheel hole, must be protected by temporary conservation.
Handling must be done exclusively by crane, with the wheelset suspended on ropes which must not damage the wheelset surfaces or its paintwork. It is prohibited to handle the wheelsets by painted surfaces, especially by the axle body.
If the wheelsets are transported without axle bearings, then journals and seats of abutment rings must be protected by at least temporary conservation and protected against mechanical damage.

! It is prohibited to handle wheelsets and their parts with electromagnetic equipment and steel cables.

Wheelsets and/or their parts must be stowed in the transportation vehicle or container in such a way that they cannot move relative to the vehicle or container or relative to each other. The wheelsets must be secured on the stowage surface against movement with wooden blocks or frames.

Secure the wheelsets against moving on the stowage floor of the transportation vehicle or container with wooden blocks or frames. Transportation palettes containing wheels must be adequately secured against moving on the stowage floor of the transportation vehicle or container with fastening belts.

5.2 Storage

Wheelsets and their parts must be stored in covered, dry, clean and ventilated premises, protected against the effects of atmospheric conditions and chemicals. Immediately after delivery, a check must be made whether their protection against corrosion and mechanical damage is intact.

Wheelsets protected by a conservation product can be stored in clean and covered premises for not longer than one year, provided their original packaging is intact, and for not more than six months if the packaging has been removed but the integrity of the protective conservation product film has not been disturbed.

In order to guarantee long term protection by conservation, the client must check the conservation condition on a regular basis and, if it is necessary, renew the protection. A written record must be made of the renewed conservation. A safe distance between axle ends of stored wheelsets is 50 mm.

If the conservation product film has been disturbed, or if the conserved parts are to be stored for a protracted period of time, the conservation film must be checked and renewed. We recommend to carry out these checks at least once a month.

Complete wheelsets with axle bearings fitted must be protected against inclement weather conditions and other harmful factors. The bearings containing contact seals must be placed preferably in covered premises.

Bearings with labyrinth seals must be stored in covered premises, always with a final arrangement of the bearing casing, or with provisional protection provided by the axle bearing's manufacturer.

Putting axle bearings into hermetically closed plastic bags is prohibited, as condensation may develop inside the bag.

Bearings fitted to wheelsets with bearing chambers must be stored in covered premises (if possibly enclosed), protected against the effects of unfavorable weather. Complete axle bearings stored for longer than 24 months without being fitted to a bogie must be checked by taking samples before they are used. If you need further details, please contact your local technician of the axle bearing manufacturer.

Axle bearings fitted to wheelsets in bogies or under vehicles must be rotated at least once every six months to prevent their oxidation on the orbital contact due to inaction. If the bearing cannot be turned or if the fitted wheelsets have been stored for more than 18 months, the bearing condition must be checked by disassembling a selected bearing sample. For more information, please contact your local technician of the axle bearing manufacturer.

The same applies reasonably also when a whole locomotive is stored (or taken out of use for a protracted period of time), or its bogies, etc.

5.3 Cleaning

When cleaning a vehicle/bogie/wheelset, care must be always taken that the water nozzle is not aimed at gearbox and bearing system seals. Moisture inside the bearing/gearbox reduces the effectiveness of the lubrication grease and causes the bearing steel oxidation which in turn will lead to bearing defects. Watch this especially if you use for washing high pressure water nozzles.

Unless specified otherwise, the maximum permitted water pressure is 30 bar. With higher pressure, the water might penetrate through the seal or disturb the anticorrosion protection (coating system, sealing and other kind of conservation) of the wheelset parts.

It is prohibited to use abrasive and/or corrosive substances and solvents which might disturb or damage the anticorrosion protection or the coating system.

6. Special Tools and Measuring Instruments

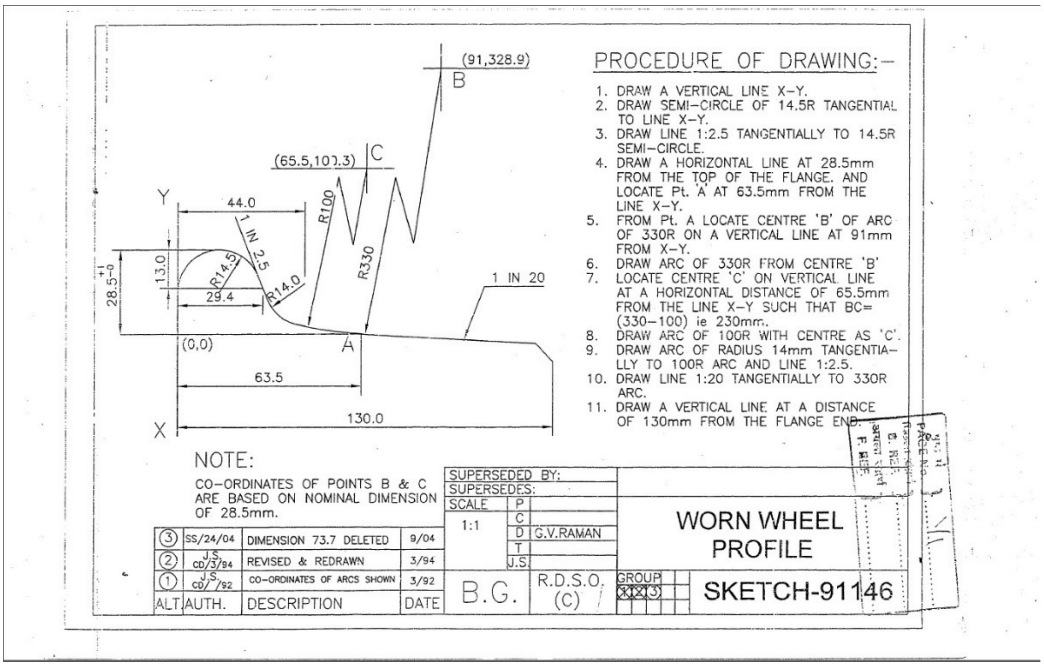
6.1 Workshop measurements

6.1.1 Wheel tread shape gauge

If it is necessary to check a wheel tread (e.g. if it is not possible to check the wheel tread after reprofiling on the reprofiling lathe, or when the wheelset is to be checked after press-fitting), the tread is checked with a special shape gauge.

Measurements can be carried out either on a wheelset removed from the bogie or on a wheelset installed underneath a vehicle. An output is a visual check of the refurbished wheel fit against a shape gauge placed perpendicularly to the wheel thread.

Wheel tread shape gauge should be as per RDSO "SKETCH-91146"



6.1.2 Wheel diameter

The gauge is used to check the diameter of the wheels running circle, and to identify any difference in these diameters between the wheels press-fitted to the same axle

Measurements can be carried out on a wheelset removed from the bogie. An output are measurement readings of diameters d_1, d_2 (by adding the value of the wheel diameter set on the gauge with caliper's or an etalon, and maximum indicator deviation) and the calculated value of their difference $|d_1 - d_2|$.

Wheel diameter gauge Paragon Instruments Engineers model "PIE WD-1(M)"

6.1.3 Device for measuring back-to-back dimension

The measuring device is used to check whether the distance between the wheel's internal faces of rims is correct and also, if used as an in-service check, to measure the back-to-back dimension of a wheelset.

Measured with Mitutoyo make Stick Micrometer (137-204)

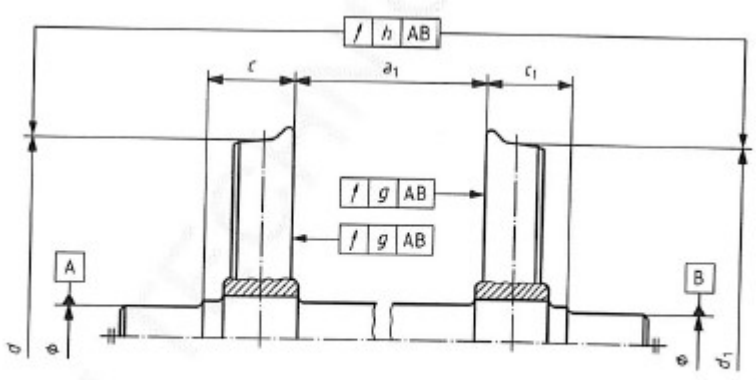
Measurements can be carried out on a wheelset removed from the bogie. An output is a measurement reading of the back-to-back dimension a_{12}, a''_{12}, a_{13}, and from them calculated value "a_1".

This measuring device is not required if the wheel fitting press has a device for measuring the back-to-back dimension.

6.1.4 Measuring device for checking alignment of press-fitted wheels (dimension "c - c_1")

The measuring device is used to check if the wheels press-fitted to an axle are in the correct position.

Measurements can be carried out on a wheelset removed from the bogie and without a bearing system. An output is the difference in maximum values "c-c1" read off the indicator



Measuring Internal face of the wheel and plane of the journal side defining the corresponding collar bearing surface

6.1.5 Device for checking axial and radial run-out of wheelset wheels

The device comprises of a magnetic stand and a dial indicator.

Measurements can be carried out either on a wheelset removed from the bogie, or on a rotating wheelset installed underneath a vehicle. An output is a measurement reading of an axial and radial run-out (maximum deviation read off the indicator).

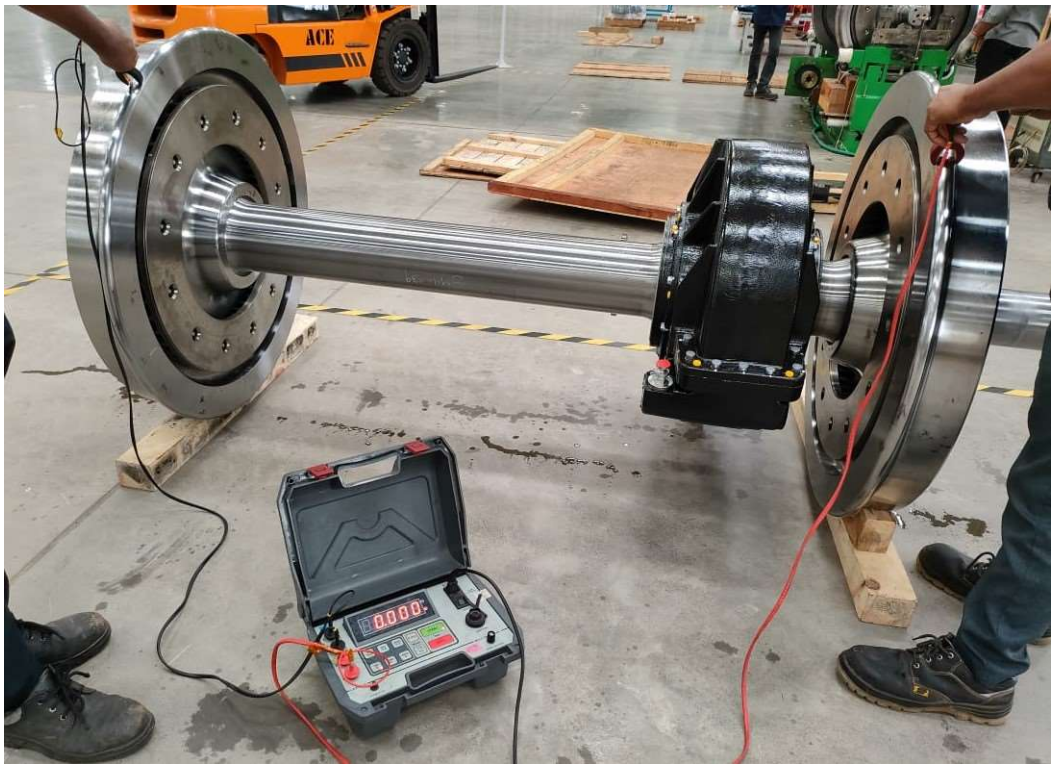
This instrument is not required if the wheel fitting press includes a run-out measuring device.

The Dial gauge range Mitutyo

Measured with Mitutoyo Plunger Type Dial Gauge L.c-0.01mm range 0-10mm (2046A) with magnetic stand

6.1.6 Verification of wheelset electrical resistance

Electrical resistance is verified after wheelset refurbishment, with a measuring device (ohmmeter). Voltage must be between 1.8 V and 2.0 V DC. The ohmmeter electrodes must be attached to the rim of both wheels. The wheelset must be either removed from the bogie or electrically isolated from it, as well as from the rail, at least one wheel. Electrical resistance of the wheelset after a wheel replacement and refurbishment of the contact surfaces of the press-fitted joint must not be greater than 0.01Ω



7. Spare Parts

7.1 Spare parts list

- Trailer axle (**Dwg No.MT18Br2 001478-7**)
- Motor axle (**Dwg. No.MT18Br2 001477-8**)
- Monobloc wheel (**DWG NO. MTBr2 001481-03**)