AXLE

Presented by-

Rajendra Kushwaha

Instructor/C&W

MSTC/GKP

An axle is a component of a wheel set to hold the wheel discs in position. The axle box is also mounted on the journal of the axle (**See figure 10.3** for Axle)

The axles are forged from the pre-cast steel blooms of desired specification and length, machined to accuracy after checking for both internal and external flaw detection systems. Blooms are checked for chemical composition and micro/macro properties before they are taken up for forging.

Axles are manufactured to various sizes and specification. Blooms to the desired specification are procured from leading integrated steel plants in sizes specified to obtain the desired reduction ratios. The blooms are thoroughly inspected for their chemical composition and micro/macro properties before they are taken up for forging.

Billets are cut to required unit lengths and heated in a rotary hearth furnace to forging temperatures. The heated billets are then transferred to a CNC controlled precision Long Forging Machine procured from M/s. GFM, Austria. The advantage of the precision forging process is minimised machining allowance, leading to reduced wastage. The fish tail ends of the forged axles are gas cut and the axles hot stamped with a unique number. The forged axles are

then normalised in a walking beam furnace, followed by air-cooling and tempering. For axles meant for traction applications, where higher tensile strength and hardness is required, the axles are quenched after normalising using polymer quenchant.

Samples are drawn from each batch and checked for physical and metallurgical properties tested before being taken up for machining.

The machining line is again a completely automated system with integrated engineering for material transfer from one station to another. The various machining stages include end milling, cup turning and cantering; rough, semi-finish and finish turning, burnishing of wheel drilling and tapping of axle end holes, grinding of axle journal and dust guards. During the course of machining cycle, all axles are ultrasonically checked for internal flaws and Magnetic Particle Testing is done to detect any surface flaws. RWF is procuring a radial scanning equipment to undertake radial probing of the axles required as per UIC standards.

Stage Inspection of Axles

- Chemical Composition and visual/ultrasonic tests on blooms before forging
- Macro and micro properties of forged axles
- 100% ultrasonic including radial scanning and magnetic particle testing
- Measurement of pitch circle diameter, journal diameters, tapped holes and ovality
- Measuring the surface finish.

Axles

A) Loco Application:

Gauge	Description
BG	WDM-2C
	WDM-2
	WAG-7
	WDP-2
	TAO-659
	WDP-1 & WDG-2
	WDG2 & WDG3
	WAP-1, WAP-4
	WAG-9
	WAP-5
	WDP-4
	WDG-4
	X Class
MG	VDM-4

B) Freight Application:

Gauge	Description
BG	BOX N - 22.9T
	25T axle suitable for k class CTRB
	25T axle load axle

C) Passenger Applications:

Gauge	Description
BG	BG EMU axle (MC)
	BG EMU axle (MC) MEMU
	BG EMU TC axle
	EMU axle for Milk Tank Wagon
	16T BG Coaching
	LHB axle
	Kolkata Metro axle (TC)
	Kolkata Metro axle (MC)

Wheelsets

A) Freight Application:

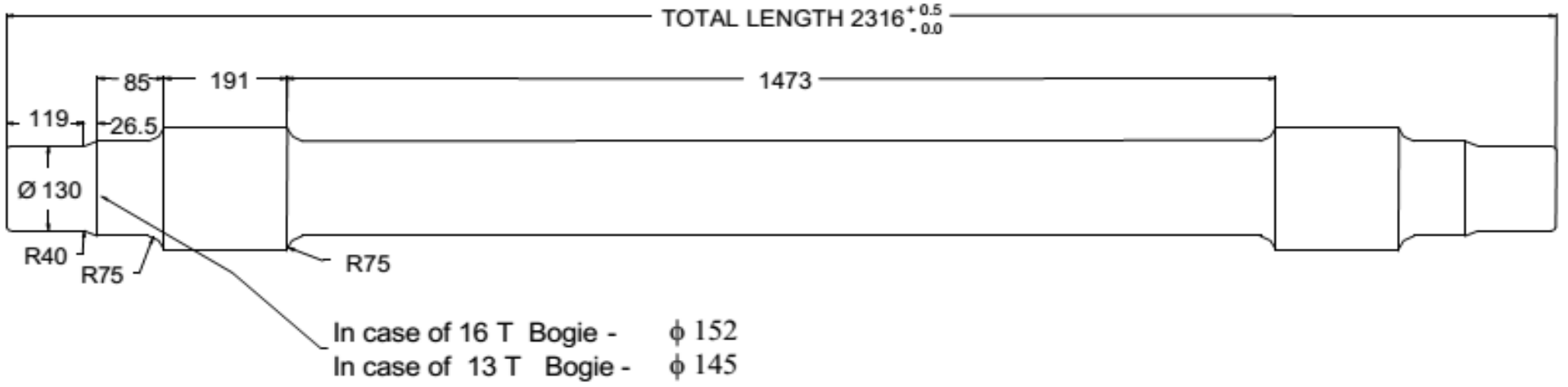
Gauge	Description
BG	Box_N
	840 mm dia container flat wagon wheelset
	840 mm dia for 25T axle load wheelsets

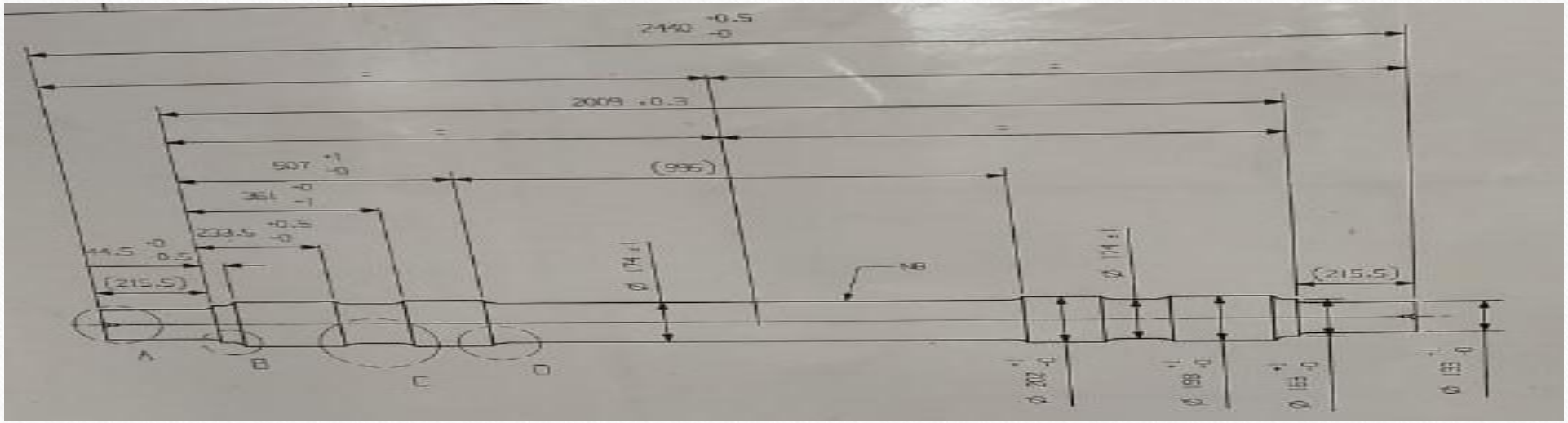
B) Passenger Applications:

Gauge	Description
BG	BG Coaching
	958 mm dia EMU wheelset for Milk Tank Wagon

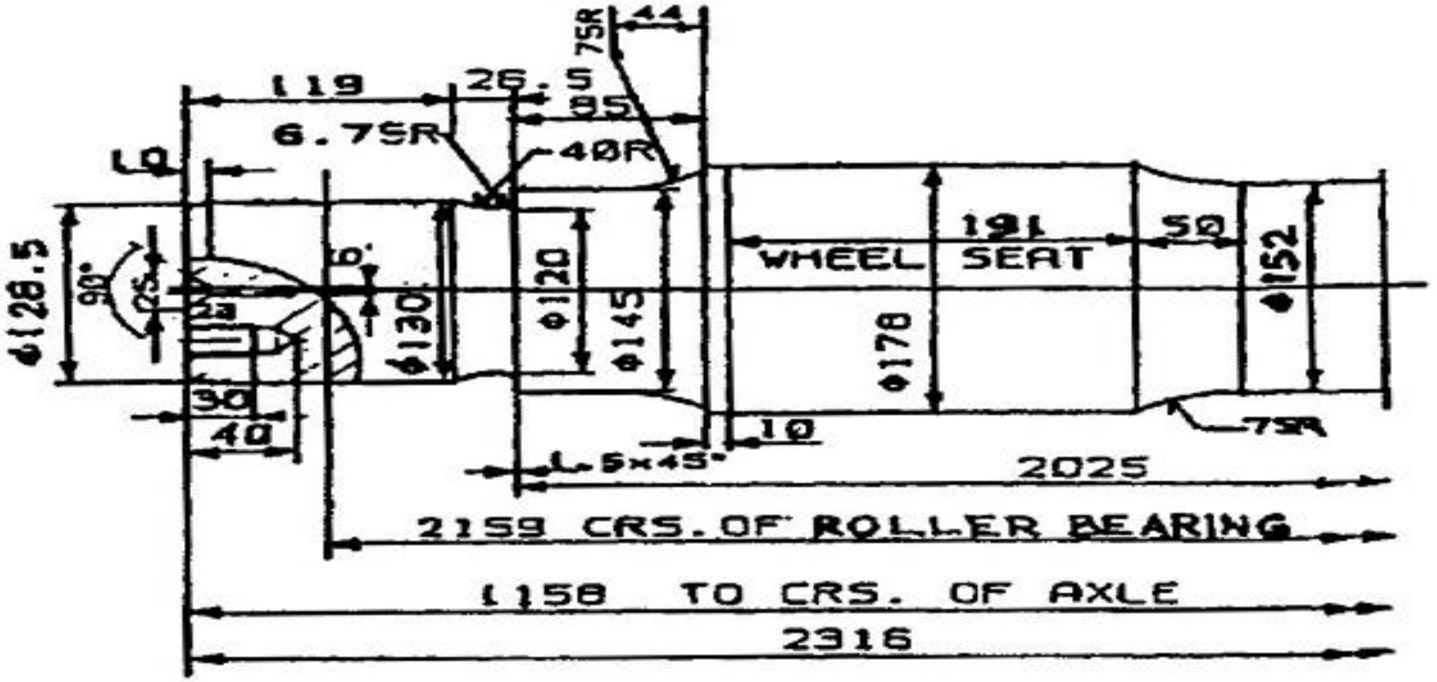
Axle Specifications

Specification	Application	C	Mn	Si	P	S	Hydrogen in Liquid Steel	Ultimate Tensile Strength N/mm2	Yield Strength N/mm2 Min	Elongation Min	Impact U-notch J Min	Grain Size
IRS R-16-95	Passenger & Freight Car Axles	0.37 max	1.12 max	0.15 - 0.46	0.04 max	0.04 max	< 3 ppm	550 - 650	320	22%	25	5 - 8
IRS R-43-92	Traction Axles	0.40 - 0.55	0.60 - 0.90	0.15 min	0.045 max	0.045 max	< 2 ppm	570 - 685	Not less than 50% of UTS	17 - 21%	25	6 - 8


TOTAL LENGTH 2316 +0.5 -0.0
85
191
1473
119
26.5
Ø 130
R40
R75
R75
In case of 16 T Bogie - ϕ 152
In case of 13 T Bogie - ϕ 145


2440 +0.5 -0
2009 ±0.3
(996)
507 +1 -0
361 +0 -1
233.5 +0.5 -0
14.5 +0 -0.5
(215.5)
NB
(215.5)
A
B
C
D

16.25 t Axle for ICF coach



ICF DRG. NO. WTAC3-0-2-301

Press fit of wheel on axles

- Wheel disc is pressed to axle with interference fit (the bore of the wheel should be 0.304 mm to 0.355 mm less than the outer dia of the wheel seat on the Axle)
- Wheel Gauge should be in between 1599 and 1602 mm
- Axial off centre should be within 1.0 mm (wagon) & 0.8 mm (coach)
- Radial off centre should be within 0.5 mm (wagon) & 0.25 mm (coach)
- The Journals should be protected with bituminous black to IS:9862
- All Axles fitted by workshop during POH or despatched to depot should be Ultrasonically tested

Press fit of wheel on axles

Hydraulic press is used for assembly of the wheel with a force of 400 to 500 Kgs per mm dia of wheel seat (approximate force used for different wheels are given below)

Description	Tonnage
13 tonne axle	68.8 to 103.2 t
16.25 tonne axle	71.2 to 106.8 t
BOXN & BLC	85 to 127 t

Stamping of particulars

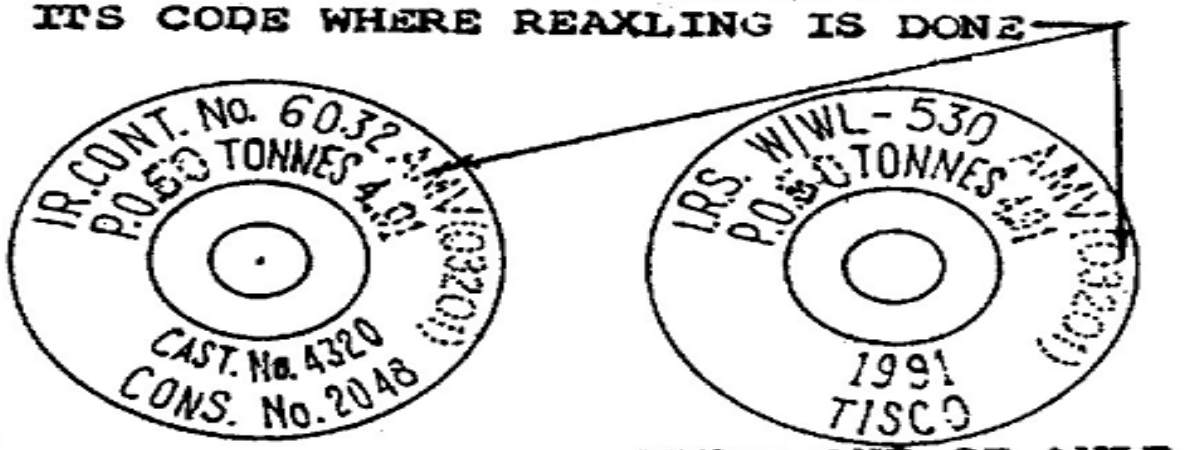
Whenever axles are renewed the workshop shall punch in 5 mm letters the following particulars on the journal face

- Place of pressing
- Date of pressing
- Pressure of pressing

Whenever UT is done the details shall be stamped cold on the inner hub fillet with 6 mm punch not more than 1.5 mm depth

Stamping of particulars

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



ONE END OF AXLE

OTHER END OF AXLE

NOTE:
ALL STAMPING TO BE DONE WITHIN 63 DIA.
ON BOTH JOURNAL FACES.

DEFECT OBSERVED ON THE AXLES AND THEIR ORIGIN

The defects arising on the axle are therefore primarily due to short comings during manufacture and also during manufacture and also due to a variety of service conditions to which they are subjected.

The sources of various defects are –

a) steelmaking and shaping operation

b) machining operation

c) heat-treatment operation

d) assembly operation

e) Repair Practice

f) maintenance practice and g) corrosion.

Loose Axle

- While assembling wheel with axle proper interference should be maintained between wheel and axle. Due to improper selection of interference the wheel may shift outwards or it may come out completely. Loose axle is a rejectable defect.
- Axles involved in Accidents should be magnaflux tested in addition to Ultrasonic test.
- Axle having notch should be withdrawn from service

ULTRASONIC TESTING OF AXLES

All incoming wheel sets are tested for flaw detection test of axles in the shop before sending them to service. Following techniques are adopted to test the axles.

i. Far end scanning
ii. Trace delay
iii. Near end low angle scanning
iv. High angle scanning

HOT AXLE-

An axle, which has run hot, should be distinguished by stamping 5-mm size star on the face of the affected journal as shown in Plate 25; wheel sets with such axles must not be used in passenger carrying vehicles. If journal or end of axle has any discolouration due to over heating or if circumferential cracks determined by magnetic crack detection are found in the journal, the axle may be scrapped and mutilated to prevent re-use.

Note: - Wheels with discoloured journals due to overheating should be sent to workshops for checking cracks in the journal.


WHEEL & AXLE COMPLETE
AXLE FINISH MACHINED
SEMI FINISHED AXLE
5S
FINISHED AXLE
Modern Coach Factory
SEMI FINISHED AXLE
(PL NO-33509037)
(QPC-04)
(DRAWING NO-LW02149 ALT-C)

Material of Wheel

The chemical composition of the steel for Cast Wheel	
C	0.47% to 0.57% for type A used for carriage stock 0.57% to 0.67% for type B used for wagon stock
Mn	0.60 to 0.80%
P	0.03% max
S	0.03% max
Cr	0.15% max
Ni	0.25% max
Mo	0.06% max
Combined % for Cr, Ni & Mo must be 0.40% max	

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

Any Question?

THANK YOU