TECHNOLOGY MANAGEMENT
WHEELSET AND MATERIALS TECHNOLOGY SPECIFICATION

TRANSNET FREIGHT RAIL SPECIFICATION FOR THE SUPPLY OF AXLES FOR TRACTIVE AND TRAILING STOCK

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Transnet SOC Ltd. and Relevant Third Parties

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1.0 SCOPE

This specification specifies the requirements for the supply of solid or hollow axles for tractive and trailing stock manufactured from ingots or continuous cast blooms.

2.0 SYNOPSIS

BS EN ISO 6892-1: 2016 (latest revision), Tensile testing of metallic materials-Method of test at ambient temperature.

ISO 643(latest revision), Steels – Micrographic determination of ferritic or austenitic grain size.

ASTM E112-13 (latest revision), Standard test method for determining average grain size.

ASTM E1180-08 (latest revision), Standard practice for preparing sulphur prints for macrostructural examination.

ASTM E 340-15: (latest revision), Standard test method for macro-etching metals and alloys.

UIC 811 – 1: (latest revision), Technical specification for the supply of axles for tractive and trailing stock

AARM 101: (Latest revision), AAR Manual standards and Recommended Practices Wheels and Axles

BS EN 13261:2009+A1:2010: (Latest Revision), Railway Application-Wheelsets and bogies axle product requirements.

BS 5892-1:1992+A3:2009: (Latest revision), Railway stock materials, Part 1: Specification for axles for traction and trailing stock.

RSE/TE/PRO/0083: (Latest revision), Evaluation Plan for Suppliers who Wish to Be Listed on Transnet Freight Rail Approved List of Wheel, Axle or Tyre Suppliers

UT95/64: (Latest revision), Ultrasonic testing procedure for railway axles

MT95/03: (Latest revision), Magnetic particle inspection procedure for new machined axles

3.0 DEFINITIONS

The following definitions apply for the purposes of this specification.

3.1 Manufacturer

Any persons, body corporate or body incorporate who have contracted to supply axles to TRANSNET FREIGHT RAIL subject to the requirements of this specification.

3.2 Melt or Heat

The product of a single furnace charge

3.3 Strand

The product of a continuous casting operation, a strand may be the single product of a continuous casting machine or one of several strands produced simultaneously by an individual multi-strand continuous casting machine.

3.4 Bloom

A bloom is a product of an ingot or a continuous cast strand. The length of a bloom may vary.

3.5 Cast

Ingots or blooms that are the product of a single ladle. If a melt or heat is tapped into 2 or more ladles, then the ingots or blooms that are the product of each ladle are to be considered as separate casts.

3.6 Lot

100 axles or less from the same cast that have undergone a similar heat treatment, produced by one manufacturer, and submitted at any one time for approval.

3.7 Solid Axle

An axle of homogeneous steel, produced by forging and/or rolling that has not been bored.

3.8 Hollow Axle

An axle of homogenous steel, produced by forging and/or rolling that has not been bored.

3.9 Transnet Freight Rail Quality Evaluation Committee

The committee will consist of at least the following members.

a) VIT (wheels and axles) member, Transnet, rolling stock.
b) A representative from quality assurance, Transnet, rolling stock.
c) VIT (non-destructive testing) member, Transnet, rolling stock.

4.0 QUALIFICATION AS A MANUFACTURER

4.1 Qualification as a manufacturer of axles that are to be used by TRANSNET FREIGHT RAIL must be approved by the TRANSNET FREIGHT RAIL Quality Evaluation Committee. **The evaluation process will be done in accordance with document number RSE/TE/PRO/0083.** Qualification is effective until revoked by TRANSNET

FREIGHT RAIL. The cause of revocation is the failure of the manufacturer to maintain the requirements of this specification or any contractually agreed exceptions thereto. The manufacturer is unconditionally approved for a period of five year, thereafter Transnet reserves the right to re-audit the manufacture's facility or conduct tests on wheels prior to commencement of the new contract.

4.2 Manufacturers that have been previously approved by Transnet Freight Rail but have not supplied for 5 years or more must be re-qualified. The TRANSNET FREIGHT RAIL Quality Evaluation Committee will conduct a re-audit of the manufacturer facilities **in accordance with document number RSE/TE/PRO/0083** provided that the axle design has not changed.

5.0 MANUFACTURER

5.1 Steel Making Process

The axles must be made from steel produced by the open hearth, electric arc, or basic oxygen process. The steel must be killed in the furnace or ladle. If the ingot route is to be used, then the steel must be poured into hot-topped ingot moulds. Continuous casting is permitted subject to the approval of the steelmaker by the TRANSNET FREIGHT RAIL Quality Evaluation Committee.

5.2 Discard

If the ingot route is used, then a sufficient discard must be made from each ingot to ensure freedom from primary and secondary piping, and undue segregation. If the continuous cast route is used, then a sufficient discard must be made from each end of a continuous cast strand to ensure freedom from primary and secondary piping, and undue segregation.

5.3 Reduction of the Axles

The axles must be manufactured from ingots or blooms that have been reduced to the close-to-form shape. The amount of reduction must be calculated from the original ingot or bloom cross-sectional area and the final reduced cross-sectional area of the rough axle prior to machining.

5.3.1 Forging

The maximum cross-sectional area of the rough forged axles must not be greater than one- third of the minimum cross-sectional area and the final reduced cross-sectional area of the original ingot or bloom unless otherwise agreed by the TRANSNET FREIGHT RAIL Quality Evaluation Committee.

5.3.2 Rolling

The maximum cross-sectional area of the rough rolled axles must not be greater than one- fifth of the minimum cross-sectional area of the original ingot or bloom unless otherwise agreed by the TRANSNET FREIGHT RAIL Quality Evaluation Committee.

5.3.3 Rolling followed by forging

The maximum cross-sectional are of the rough axles produced by rolling followed by forging must not be greater than one-fourth of the minimum cross-sectional area of the original ingot or bloom unless otherwise agreed by the TRANSNET FREIGHT RAIL Quality Evaluation Committee.

The ingots and blooms must be gradually and uniformly heated to the correct rolling or forging temperature. All the temperatures must be recorded on correctly calibrated, continuously recording pyrometers. The pyrometers must be placed so as to reflect the true furnace temperature chart. These charts must be retained for a minimum period of 6 years and must be made available to the TRANSNET FREIGHT RAIL Quality Assurance Inspector on request.

5.4 Hydrogen Cracking (Flakes)

Precautions must be taken by the manufacturer throughout the manufacturing process to avoid the formation of hydrogen cracks.

5.5 Heat Treatment

5.5.1 Slow cooling

The axles must be heat treated after reduction and stamping of the identifying marks. Slow cooling of the axles must be done in closed containers, covered conveyors, or in hoods after reduction. If the axles are heat treated directly from reduction, then they must be slow cooled following the final heat treatment.

Axles that are heat treated directly from reduction must be cooled below the transformation temperature or to approximately 550^{o}C before any re-heating operation. The axles must not be allowed to cool below 280^{o}C without employing slow cooling. A supplemental heat source may be used to assure a slow cooling cycle when the temperature of the axles approaches 280^{o}C. If properly vacuum degassed steel with a hydrogen content of less than 2.5ppm is used, then the slow cooling requirements may be omitted but the axles must then be pile cooled.

5.5.2 Heat treatment requirements

Axles for heat treatment must be re-heated gradually and uniformly to a temperature that will fully austenitize the steel. There are 2 individual heat treatment routes for the axle steel grades, grade A and grade C have the same heat treatment process and grade B and D have the same heat treatment process.

Grade A and Grade C

(a) Double normalising

The procedure will consist of 2 separate normalising treatments. The second will be performed at a lower temperature than the first treatment. Uniform cooling must be employed. Note, a single normalising treatment will be allowed when all the other requirements for the grade A and grade C material can be met.

(b) Tempering

The axles must be re-heated gradually to and maintained at a temperature below the critical range. These axels must then be allowed to cool uniformly.

Grade B and Grade D

(a) Quenching

After heating to and maintaining at a suitable temperature, the axles must be quenched in oil under uniform conditions.

(b) Tempering

The axles must be re-heated gradually to and maintained at a temperature below the critical range. These axels must then be allowed to cool uniformly.

Slow cooling must be done to avoid hydrogen cracking where no vacuum degassing has been done during steelmaking. Heat treatment may be performed in either batch type furnaces or in continuous furnaces.

All temperatures must be recorded on correctly calibrated and continuously recording pyrometers. These pyrometers must be placed so as to reflect the true furnace temperatures. The cast numbers and the quantity of axles in each cast must be identified with the relevant chart. The charts must be retained by the manufacturer for a minimum period of 6 years.

The manufacturer must keep records of the withdrawal and loading rates of the axles for continuous heat treatment process. These records must include the maximum and minimum furnace temperature at the time of withdrawal or loading of axles.

Temperature charts and records must be given to the TRANSNET FREIGHT RAIL Quality Assurance Inspector when the axles are submitted for inspection.

In general the heat treatment process must be managed in such a way as to ensure the uniformity of the steel structure in the same axle and between axles of the same lot and to ensure freedom from distortion.

5.6 Straightening of axles

Straightening of rough forged and/or rolled axles must be performed before any machining, before the samples for testing are taken, and before any other examinations are performed. If straightening is performed at a temperature below 500^{o}C, then the axels must be subjected to a stress relieving heat treatment. At straightening temperatures of 500^{o}C and greater, the conditions chosen must not adversely affect the mechanical properties and structure.

5.7 Branding

The cast number must be stamped on the axle when hot. The axles must be numbered consecutively and this number, together with cast number must be cold stamped or engraved on the axle end after it has been machined.

The following must be cold stamped or engraved in 6mm minimum type on one end only of the axle as shown on the relevant drawings.

- Manufacture's name
- Month and year of manufacture
- Cast number
- Consecutive axle number
- TRANSNET FREIGHT RAIL axle drawing number
- TRANSNET FREIGHT RAIL

No marking must be done on any other part of the axle after it has been machined.

5.8 Machining

The ends of all the axles must be finished machined to the lengths shown in the relevant drawings. The centre hole must be concentric about the axis of the axle.

All the surfaces and dimensions of the axels are to be machined in accordance with the relevant drawings. Unmachined surfaces will not be accepted.

5.9 Dressing-out of longitudinal marks or discontinuities

The localised dressing-out of marks or discontinuities is restricted to the body of the axle and pulley seats only. Localised dressing out is subject to the limits for surface discontinuity length and distribution as described in the Appendix A for the axle body. Localised dressing-out in the axle body region will be allowed for no more than 5 discontinuities with lengths in excess of the maximum limits specified in Appendix A. this localised dressing-out will be further subject to the following:

- The individual discontinuities must not be longer than 30mm
- 2 or more of these discontinuities must not be in line along the axial direction of the axle or in the same cross-sectional plane.

- A maximum depth of 0.5mm must not be exceeded when dressing-out a discontinuity.
- The length of a discontinuity remaining after dressing-out may not exceed 2mm.
- The dressed surfaces must be blended smoothly into the axle body.
- The dressing-out must not extend into the fillet radii of the axle.

5.10 Welding

No welding of any form is allowed on any region of any axle.

6.0 REQUIREMENTS

6.1 Chemical composition

6.1.1 Chemical analysis

The steel must conform to the requirements for the chemical composition shown in table 1.

Table 1: Grade of steel and chemical composition

ELEMENTS	GRADE A	GRADE B	GRADE C	GRADE D
% Carbon	0.45-0.59	0.30-0.45	0.40 maximum	0.30 maximum
% Manganese	0.60-0.90	0.60-1.00	1.20 maximum	0.80 maximum
% Silicon	0.15 minimum	0.15-0.50	0.50 maximum	0.50 maximum
% Sulphur	0.050 maximum	0.050 maximum	0.04 maximum	0.04 maximum
% Phosphorus	0.045 maximum	0.050 maximum	0.04 maximum	0.04 maximum
% Sulphur + % Phosphorus	0.090 maximum	0.090 maximum	-	-
Residual elements				
% Chromium	0.30 maximum	0.30 maximum	0.30 maximum	1.20 maximum
% Nickel	0.40 maximum	0.40 maximum	0.30 maximum	0.30 maximum
% Molybdenum	0.15 maximum	0.15 maximum	0.08 maximum	0.35 maximum
% copper	0.30 maximum	0.30 maximum	0.30 maximum	0.30 maximum

6.1.2 Identification of casts in continuous castings

If more than one cast is continuously cast at one time, then a ladle analysis must be obtained for each cast. If the ladle analysis of one cast does not meet the requirements of this specification, then the bloom or blooms that are a mix of the consecutive casts will be deemed to be outside the requirements of this specification unless analyses of the blooms prove compliance. If the ladle analyses of the sequence casts number assigned to the blooms of the first cast remain unchanged until all the steel in the bloom consists entirely of the next cast.

Alternatively, when all the mixed portion of 2 consecutive casts is contained in one bloom, then that bloom may be given the cast number that comprises the larger volumes of the bloom.

6.1.3 Ladle analysis

An analysis of each cast of the steel must be made by the manufacturer to determine the percentages of the elements specified in tale 1. The chemical composition thus determined must be given to the TRANSNET FREIGHT RAIL Quality Assurance Inspector upon submission for the inspection. The chemical composition must conform to the requirements of table 1.

6.1.4 Check analysis

Specimens for a check analysis may be taken from any or all of the test axles or prolongations submitted for testing at the discretion of the TRANSNET FREIGHT RAIL Quality Assurance Inspector. The chemical composition thus determined must confront to the requirements of Table 1 subject to the allowable deviations in table 2.

Table 2: Permissible deviations between the specified chemical composition of the ladle analysis and the product analysis.

ELEMENTS	GRADE A and GRADE B	GRADE C	GRADE D
% Carbon	0.03 over the maximum/under the minimum limit	0.03 over the maximum limit	0.03 over the maximum limit
% Manganese	0.03 over the maximum/under the minimum limit	0.08 over the maximum limit	0.04 over the maximum
% Silicon	0.02 over the maximum limit	0.03 over the maximum limit	0.03 over the maximum limit
% Sulphur	0.008 over the maximum limit	0.006 over the maximum limit	0.006 over the maximum limit
% Phosphorus	0.008 over the maximum limit	0.006 over the maximum limit	0.006 over the maximum limit

6.1.5 Mechanical properties

The mechanical properties of the axles after heat treatment must be in accordance with the requirements as shown in Table 3. Tension tests from the prolongations shall have minimum tensile strength and yield point values 5% greater than shown in Table 3 below.

Table 3: Grade of steel and mechanical properties

PROPERTY	GRADE (A & B)	PROLONGATION (GRADE A & B)	GRADE C	GRADE D
Ultimate tensile strength (MPa)	600 minimum	630 minimum	520 to 650	650 to 800
Yield strength (MPa)	330 minimum	347 minimum	300 minimum	420 minimum

% Elongation	21 minimum	21 minimum	22 minimum	19 minimum
% Reduction in area	35 minimum	35 minimum	-	-

6.2 Physical properties

6.2.1 Visual appearance

The surface of the axles must not include any marks or discontinuities other than those specified and there must be no marks or discontinuities except at the positions specified. The limits for marks or surface discontinuities are included in Appendix A.

6.2.2 Microstructure

The microstructure of the normalised or quenched and tempered axles must be uniform and typical for the specified heat treatment. The grain size must not be coarser than index 5 as determined in accordance with ISO 643 or ASTM E112-13.

6.2.3 Macrostructure

(a) Sulphur print test

The sulphur print album of UIC 811-1, 1987 (reprint 1-7-91) must be used. A sulphur print of an axle must not show any features that are more pronounced than those in the borderline prints of UIC 811-1, 1987.

(b) Macroetch test

The Macroetch of an axle must not show any features that are more pronounced than those included in Appendix B.

6.2.4 Non-destructive tests

(a) Ultrasonic examination

The purpose of this examination is to verify the following characteristics.

- Absence of internal defects
- Ultrasonic permeability

The examination must be done according to the procedures in document UT 95164(Ultrasonic procedure for railway axles). No axle may show a level of permeability or internal defects that do not meet the requirements as specified in in document UT 95/64(Ultrasonic procedure for railway axles). All axles must be ultrasonically examined.

(b) Magnetic particle examination

The magnetic particle examination must be done according to the procedure in document MT 95/03 (Magnetic particle inspection procedure for new machined axles). The surface discontinuities or marks revealed by this examination may not exceed the limits specified in Appendix A for visual examination. No residual magnetic field capable of attracting magnetic particles may remain in the axle. Magnetic particle examination must be done on all axles.

7.0 INSPECTION

7.1 Inspection of the characteristics of the axles

Axles or prolongations of axles for inspection must be provided by the manufacturer at the expense of the manufacturer. Where prolongations are submitted for inspection, they must be provided at a rate of two per lot. All the required tests must be performed on a sample of an axle or prolongation selected from each axle lot. The sample length taken from the test axle or prolongation must be at least 200mm long.

One axle or prolongation per lot must be selected by the TRANSNET FREIGHT RAIL Quality Assurance Inspector for inspection. This will enable the TRANSNET FREIGHT RAIL Quality Assurance Inspector to randomly select and mark a prolongation for testing.

Every axle lot must be tested in full by the manufacturer. TRANSNET FREIGHT RAIL reserves then right to randomly select an axle or prolongation for testing by TRANSNET FREIGHT RAIL, Materials Engineering. The expense for these axles or prolongations will be covered by TRANSNET FREIGHT RAIL.

Each axle or prolongation selected for testing must comply with the requirements of this specification without any further manipulation. If it is established that the test axle or prolongation has been specially conditioned so that it no longer truly represents the axle lot, then the axle lot will be rejected. The test axles or prolongations that have been tested must be handed over to TRANSNET FREIGHT RAIL without any charge if requested.

7.2 Sampling and preparation of specimens and test pieces

7.2.1 Chemical Analysis

The manufacturer must state the cast analysis of the steel. However, specimens may be taken at the discretion of the TRANSNET FREIGHT RAIL Quality Assurance Inspector from any or all of the test axles or prolongations that have been submitted for testing by manufacturer.

The following specimens will be taken:

A. At least 50g of millings representing the steel from a complete axle cross-section.

B. In the case of a spectrographic analysis, one specimen from the tensile test piece.

7.2.2 Mechanical properties

A tensile test piece must be taken from the sample at the position shown in figure1. The tensile test pieces must be prepared in accordance with the requirements of BS EN 6892- 1: 2016. The diameter of the test piece must not be less than 10mm.

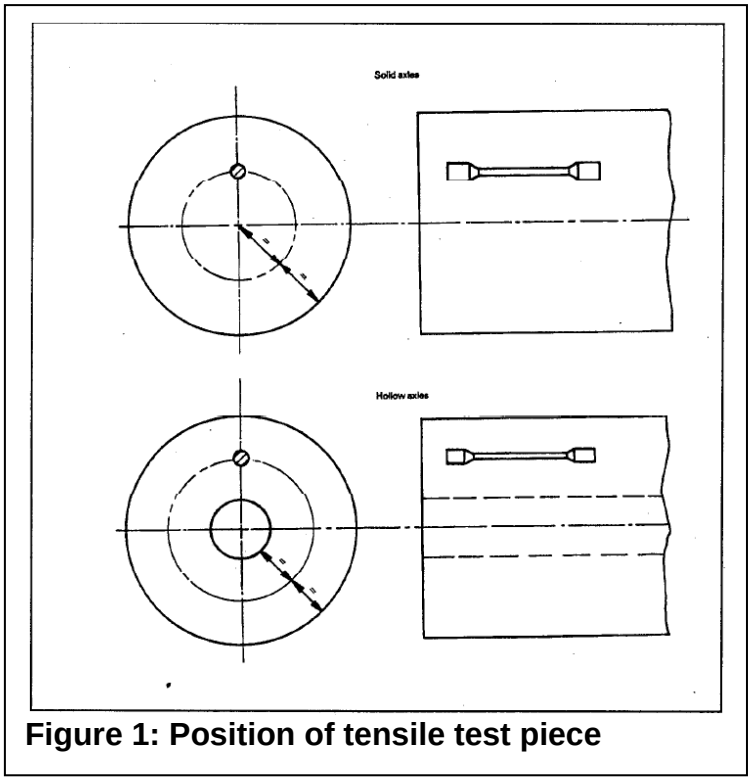


Figure 1: Position of tensile test piece

7.2.3 Microstructure examination

A microstructure specimen must be taken from the head of the tensile test piece that has not been distorted. The specimen must be prepared in such a way as will give a representation of the cross-section of the axle. The face to be prepared must be perpendicular to the axis of the axle. The examination of the microstructure must be done in accordance with the requirements of ISO 643 or ASTM E 112-83.

7.2.4 Macrostructure examination

The sulphur print and Macroetch tests will be performed at a rate of one set per cast.

a) Sulphur print test

The specimen must consist of a radial slice cut from the entire cross-section of the sample of the test axle or prolongation. One of the surfaces must be prepared for examination. The preparation and procedure of the sulphur print

test must be done in accordance with the requirements of ASTM E 1180-08. This specification deals with the Baumann method for sulphur printing.

b) Macroetch test

The specimen must consist of a radial slice cut from the entire cross-section of the sample of the test axle or prolongation. One of the surfaces must be prepared for examination. The preparation and procedure of the Macroetch test must be done in accordance with the requirements of ASTM E 340-15.

7.2.5 Non-destructive testing

(a) Ultrasonic examination

The test piece must be an axle in the delivery condition as shown by the relevant drawings. The examination must be done after the final heat treatment. The surface condition of the axles must make it possible to check the test sensitivity and also to not impair the acoustic coupling. Every axle submitted for approval must be examined.

(b) Magnetic particle examination

The test piece must be an axle in the delivery condition as shown by the relevant drawings. However, the examination must be done before the axle is subjected to a treatment that will protect it from oxidation.

7.3 Test methods

7.3.1 Chemical analysis

The analysis must be done according to the methods defined in the corresponding ISO standards or by any other method that is acceptable to the TRANSNET FREIGHT RAIL Quality Evaluation Committee.

7.3.2 Mechanical properties

The tensile test must be done in accordance with the requirements of BS EN 6892-1: 2016.

7.3.3 Microstructure examination

The examination of the microstructure must be done in accordance with the requirements of ISO 643 or ASTM E 112-13.

7.3.4 Macrostructure examination

(a) Sulphur test

The sulphur print test must be done in accordance with the requirements of ASTM E 1180-08.

(b) Macroetch test

The Macroetch test must be done in accordance with the requirements of ASTM E 340-08.

7.3.5 Visual appearance

The appearance of each axle submitted for inspection must be visually checked before delivery. Evaluation of marks and surface discontinuities must be done in accordance with the requirements of Appendix A.

7.3.6 Dimensions

The dimensions of every axle must be checked by using regularly calibrated measuring instruments that have been approved by the TRANSNET FREIGHT RAIL Quality Evaluation Committee. These dimensions must comply with the dimensions specified in the relevant drawings.

7.3.7 Non-destructive testing

(a) Ultrasonic examination

All the axles must be examined in accordance with the requirements in in document UT 95/64 (Ultrasonic procedure for railway axles).

(b) Magnetic particle examination

All the axles must be examined in accordance with the requirements in document MT 95/03 (Magnetic particle inspection procedure for new machined axles). The limits for marks or surface discontinuities are specified in Appendix A.

7.4 Conclusion of the inspection

7.4.1 Rejection

Any defects in appearance or dimensions will result in the rejection of the axle. The same applies for the magnetic particle inspection that reveals marks or discontinuities that do not comply with the requirements in Appendix A. The axle must be permeable or ultrasonically transparent. The ultrasonic indications must be in accordance with the requirements in in document UT 95/64 (Ultrasonic procedure for railway axles).

If an additional examination reveals that the defects during the ultrasonic examination are hydrogen cracks (flakes), then all the axles from that cast will be rejected. The additional examination will be done by TRANSNET FREIGHT RAIL Materials Engineering.

Any other testing result that does not comply with the requirements of this specification will result in the rejection of the lost subject to the requirements for repeated inspection.

7.4.2 Repeated inspections

Re-testing may be performed at the expense of the manufacturer. The following are the only re-tests that will be allowed.

(a) Chemical analysis

If the chemical analysis does not comply with the requirements of Tables 1 and 2; then two further specimens must be taken from the same test axle or prolongation that was submitted for testing. Both of these specimens must conform to the requirements of Tables 1 and 2 or else the axle will be rejected.

(b) Mechanical properties

If the tests axle or prolongation fails the tensile test, then 2 more test pieces may be taken by the TRANSNET FREIGHT RAIL Quality Assurance Inspector from the same axle or prolongation for repetition of the tensile test. Both of these test pieces must comply with the requirements of the Table 3.

The lot submitted for the testing will be accepted by TRANSNET FREIGHT RAIL if the results of the re-tests and the remainder of the tests comply with the requirements of this specification.

7.4.3 Re-heat treatment

The lot submitted for inspection may be re-heat treated up to a maximum of three re-heat treatment operations if the results of the re-test for checking the mechanical properties do not conform to the requirements of this specification. The TRANSNET FREIGHT RAIL Quality Assurance Inspector will select a further axle for re-testing according to the requirements of clause 6.2, 6.3.3, 7.2.2, 7.2.3, 7.3.2 and 7.33. If these test results do not comply with the requirements of this specification after the final re-heat treatment operations will not be accepted. The re-heat treatment operation may only be done on axles that have not yet been machined.

If the results of the tests comply with the requirements of this specification, then the submitted lot will be accepted provided that all the requirements of this specification are met.

8.0 CERTIFICATION

8.1 The manufacturer must provide a certificate of conformance to this specification. The certificate must certify that the axle lot was manufactured and tested in accordance

with the requirements of this specification. A report of all the test results must accompany the test certificate.

a) The certificate and the report must be submitted to the TRANSNET FEIGHT RAIL Quality Assurance Inspector prior to delivery. The report of the test results must be traceable to the cast and heat treatment lot.
b) A list of the cast numbers, the consecutive axle numbers for each lot of axles, and the destination of the axles must also be handed to the TRANSNET FREIGHT RAIL Quality Assurance Inspection prior to delivery.

9.0 DELIVERY

9.1 Protection against corrosion during transport

After inspection prior to storage or dispatch, the finished machined parts of the axles must be provided with protection against corrosion.

9.2 Protection against mechanical damage during transport

The axles must be provided with effective protection against mechanical damage prior to dispatch.

10.0 GUARANTEE

The manufacture must gust guarantee the axles for a period of n + 6 years against any manufacturing defect that was not revealed during inspection where n is the year of manufacture. This period will be reckoned from the year marked on the axle (n).

Axles that prove to have manufacturing defects that do not conform to the requirements of this specification during the guarantee period will be rejected by TRANSNET FREIGHT RAIL. TRANSNET FREIGHT RAIL, on request, will undertake to supply the manufacture with sample portions of the defective axle for the purpose of a counter examination. The sample portions will be cut from the axle at positions agreed to by TRANSNET FREIGHT RAIL and the manufacturer.

If the axle is rejected, then the axle or axles must be replaced or refunded at their new replacement value. The defective axle will remain as the property of TRANSNET FREIGHT RAIL.

12.0 REVISION HISTORY

Revision	Revision	Details of change	Remarks

Date	number		
March 1996	**Rev 00**	• **-**	**-**
January 2015	**Rev 01**	• Changed the logo from Spoornet to Transnet freight rail. • Appendix B, changed the following pictures: Plate B1, B2 and B3. • Appendix C, added latest revision document UT95/64: Ultrasonic testing procedure for railway axles • Appendix D, added latest revision document MT95/03: Magnetic particle inspection procedure for new machined axles.	
November 2017	**Rev 02**	• Added new material EA1N and EA4T (Grade C and Grade D respectively). • Added heat treatment requirements for grades C and D. (5.5.2) • Added grade C and D material on table 1: Grade of steel and chemical composition. • Added grade C and D material on table 2: Permissible deviations between the specified chemical composition of the ladle analysis and the product analysis. • Added grade C and D material on table 3 for grade of steel and mechanical properties. • Added prolongation values on Table 3 for grade A and B material • Changed the font and template for figure 2 in Appendix B • Tensile testing specification changed from BS EN ISO 10002-1:1990 to BS EN ISO 6892-1: 2016 • Removed documents for Appendix C (UT95/64 Ultrasonic testing procedure for railway axles) and Appendix D (MT95/03 Magnetic particle inspection procedure for new machined axles) • Amended clause 4.0 to add paragraph on the re-qualification of manufactures that have not supplied in 5 years and the evaluation plan according to document number RSE/TE/PRO/0083	The new locomotives from the 1064 project have axles that conform to EA1N and EA4T material Specifications UT95/64 and MT95/03 are available on Project Wise Specification BS EN ISO 10002-1:1990 was replaced by BS EN ISO 6892-1: 2016

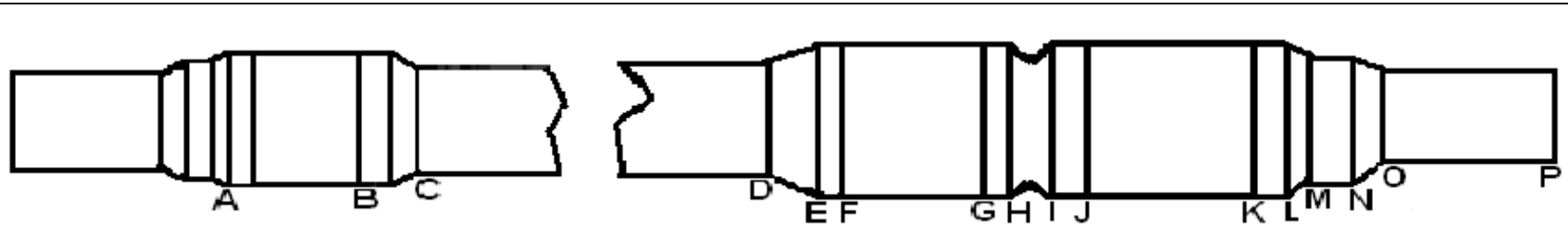
APPENDIX A

A1 LIMITS FOR MARKS OR SURFACE DISCONTINUITIES

A1.1 Circumferential marks or discontinuities will not be allowed on part of the axle.

A1.2 Laps or cracks will be because of the rejection of the axle irrespective of their position on the axle. Dressing-out of these defects is not allowed.

A1.3 Fine longitudinal mark or discontinuities in the machined surfaces of the axles will only be accepted if they meet the conditions as summarized in Figure 2.



POSITION	A TO B	C TO D	D TO E	E TO F	F TO G	G TO H	H TO I	I TO J	J TO K	K TO L	L TO M	M TO N	N TO O	O TO P
	WAGON	**ALL**	**ALL**	**LOCO & MOTOR COACH**				**ALL**	**ALL.EXCEPT WAGON**		**ALL**	**ALL**	**ALL**	**ALL**
MAXIMUM LENGTH OF DISCONTINUITY ALLOWED: (LENGTH IN MM)														
	25	10	5	5	10	5	5	5	10	5	5	10	5	10
MAXIMUM NUMBER OF DISCONTINUITIES ALLOWED														
From 2mm to 5m long	-	-	5	5	-	5	5	5	-	5	5	20	5	20
From 2mm to 10mm long	-	40 per 400mm length	-	-	-	-	-	-	-	-	-	-	-	-
MAXIMUM CUMULATIVE LENGTH IN MM OF DISCONTINUITY ALLOWED														
From 5mm to 10mm cumulative length	-	30 per 400mm length	0	0	50	0	0	0	50	0	0	30	0	30
From 5mm to 25mm cumulative length	50	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMITATION ON NUMBER OF DISCONTINUITIES ALLOWED IN LINE WITH EACH OTHER														
From 2mm to 5mm long	-	-	0	0	-	0	0	0	-	0	0	-	0	-
From 5mm to 10mm long	-	2 per 100mm length	0	0	2 per 100mm length	0	0	0	2 per 100mm length	0	0	2per 100mm length	0	2per 100 mm length
From 5mm to 15mm long	2 or 1	0	0	0	0	0	0	0	0	0	0	0	0	0
From 15mm to 25mm long.	2 or 1	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMITATION OF AREA DENSITY OF CONTINUITIES:														
From 2mm long to 5mm long	-	4 per 400mm^2	1 per 100mm circumference		-	1per 100mm circumference			-	1per 100mm circumference		4 per 400mm^2	1per 100mm circum-ference	4per 400mm^2

Figure 2: Limits for surface mark or discontinuities

APPENDIX B

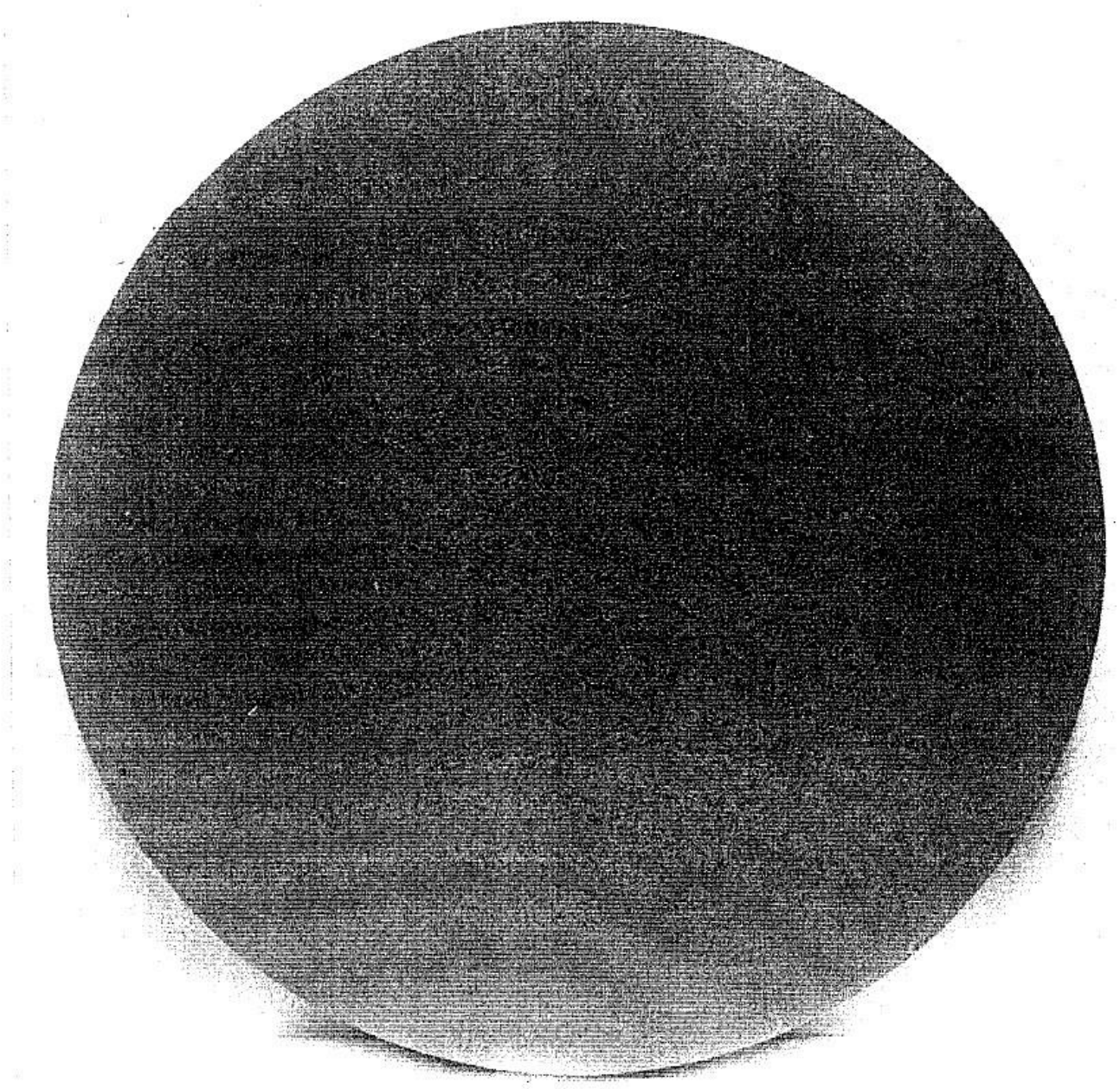


Plate B1

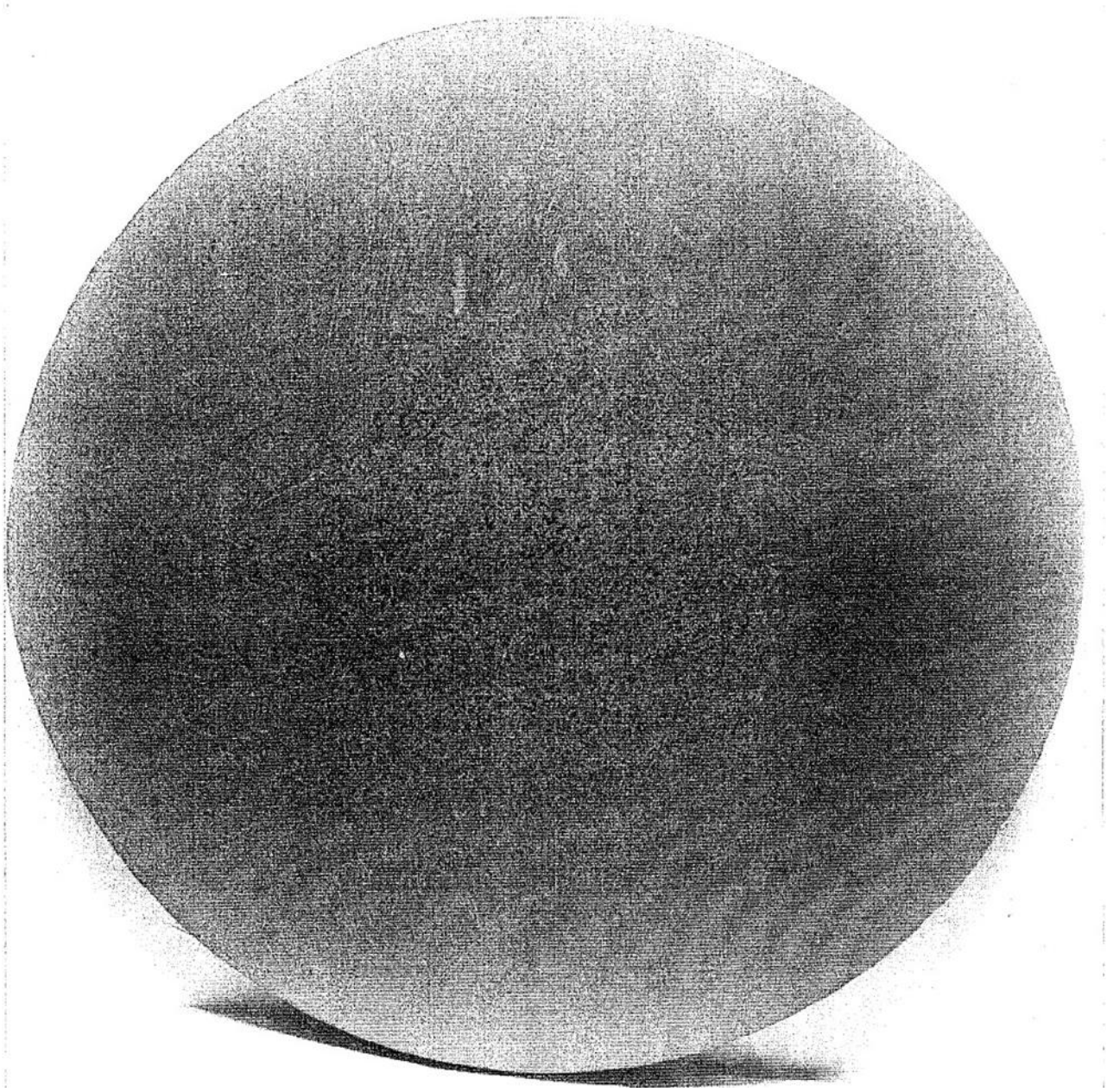


Plate B2

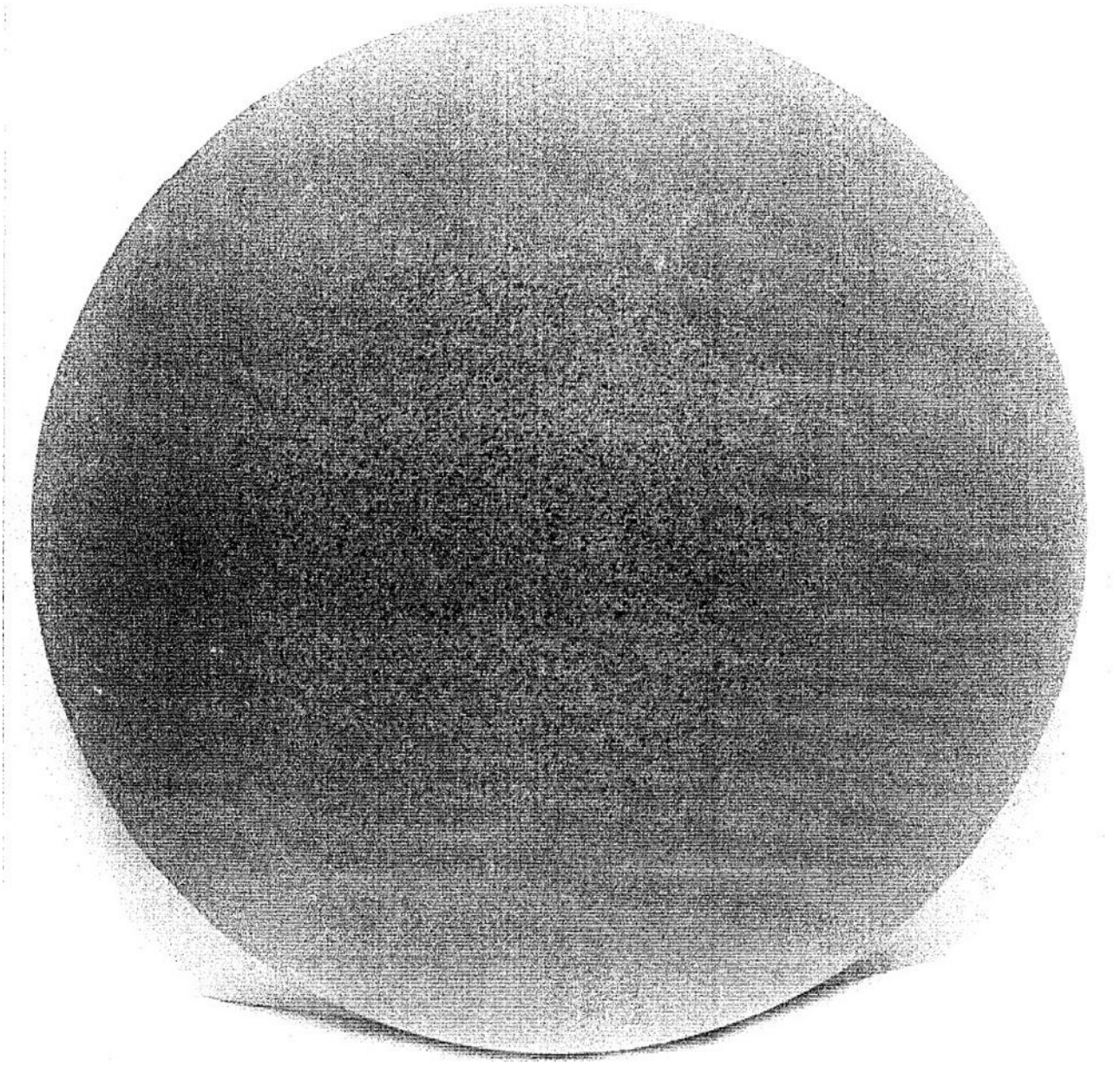


Plate B3