

## REVISION OF SPECIFICATION / STR

**Ref: IRS R-19/93 Part- III with Corrigendum no. 1-6**

### **Item Name: Cast Steel Wheels for Carriages and Wagons (Applicable to all Gauges)**

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.
2. It is requested that your comments / suggestions with regard to improvements / modifications in specification / STR of this item may be submitted in the following format alongwith the justification for the changes required.

#### **Part A: Basic Information**

SN	Particulars	Information
1	Name	
2	Designation	
3	Professional Qualification	
4	Organization / Firm's Name	
5	Address for Correspondence	
6	Contact No.	
7	Email ID	
8	<b>In case of Firm / Individual:</b> Manufacturing experience of item (or similar Item) on which comments are offered	
9	<b>Where relevant:</b> Whether any technical document to support suggested changes is available / enclosed for better appreciation	

#### **Part B: Comments / suggestions on the specification**

SN	Clause No. of RDSO STR / Spec	Clause, as exists in RDSO STR / Spec	Clause , as it should read after incorporation of comments / suggestions in the RDSO Spec / STR	Justification for changes

#### **Comments may be sent to:**

Joint Director/VDG/Carriage  
Research Designs and Standards Organization  
Manak Nagar, Lucknow – 226011

Email: [dirvdg1@rdsso.railnet.gov.in](mailto:dirvdg1@rdsso.railnet.gov.in) OR [dirvdg1@gmail.com](mailto:dirvdg1@gmail.com)

SN. 6355.

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS  
(RAILWAY BOARD)

विश्लेषण अनुभाग  
Specification Section  
अ.स.मा.सं., मानक नगर, लखनऊ-11  
R.D.S.O., Manak Nagar, Lko-11

INDIAN RAILWAY  
STANDARD SPECIFICATION  
FOR  
CAST STEEL WHEELS  
FOR  
CARRIAGES AND WAGONS

027228

(APPLICABLE TO ALL GAUGES)

SERIAL NO. R-19/93 (PART-III)

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Issued by

RESEARCH DESIGNS & STANDARDS ORGANISATION

LUCKNOW - 226011.

Price Rs. 1700/-  
2250/-

Government of India

Ministry of Railways

Railway Board

Corrigendum No. 6 of November 2008

to

Indian Railway

Standard specification

for

Cast steel wheels for

Carriages and Wagons

(Applicable to all gauges)

Serial No. IRS R-19/93 (Part III)

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Replace the clause 1.1 by the following:

This specification covers the requirements for multiwear cast steel wheels for Carriages & Wagons stock. For carriage stock, this specification is applicable upto 110 kmph speed only.

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Government of India

Ministry of Railways

Railway Board

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Corrigendum No. 5 of January 2008

to

Indian Railway

Standards specification

for

Cast steel wheels for

Carriages and Wagons

Serial No. IRS R-19/93 Part-III

(Applicable to all gauges)

Clause 2.2

Read silicon percentage as '0.15 to 0.70' against '0.15 to 0.40'

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027229

Government of India

Ministry of Railways

Railway Board

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Corrigendum No. 4 of June 2003

To

Indian Railway

Standards specification

for

Cast Steel wheels for

Carriages and Wagons

Serial No. IRS R-19/93 (Part III)

(Applicable to all gauges)

Replace Clause No. 5.1 by the following.

"Marking should be done as per RDSO drawing No. Sk-92114 with latest alteration."

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Government of India  
Ministry of Railways  
(Railway Board)

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Corrigendum No.3 of September 1999

To

Indian Railway  
Standard Specification

For

Cast Steel Wheel For  
Carriages and Wagons

(Applicable to All Gauges)

Serial No. R-19/93 (Part-III)

In Lieu of Sketch 92114 Alt.1 Substitute to Sketch-  
92114 Alt.2.

027231

Government of India  
Ministry of Railways  
(Railway Board)

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Corrigendum No. 2 of October 1997

to

Indian Railway

Standard Specification

For

Cast Steel Wheels for Carriages & Wagons

Serial No. R-19/93 (Part-III)

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In lieu of Sketch-92114 Alt. Nil substitute Sketch-

92114 Alt.1.

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Government of India  
Ministry of Railways  
(Railway Board)

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Corrigendum No.1 of June 1997  
to  
Indian Railway  
Standard Specification  
for  
Cast Steel Wheels for Carriages and Wagons  
S.No.R 19/93(Part-III).

- (1) Add the following in second line of Clause 2.1.2 after  
3 ppm:

" As per standard procedure"

- (2) Add the following Clause as Clause 2.1.3

"Nitrogen content in the steel shall not exceed 0.007

- (3) Add the following Clause as Clause 16:

"16. Guarantee

- 16.1 The wheel shall be guaranteed by the supplier for five years against any defect attributable to the manufacture and not revealed during acceptance inspection.
- 16.2 This period shall be calculated from the end of the month stamped on the wheel.
- 16.3 In case of wheels for new vehicles, the delivery date of the vehicles to which they are fitted shall be regarded as the date of delivery of wheels.
- 16.4 Wheels, which during guarantee period show defects making them either unfit for service or reducing their period of service, will be rejected.
- 16.5 When two wheels from the same cast have failed in service, or when more than 5% of the wheels from the same cast reveal defects within the above conditions, the purchaser shall have the right to reject the whole of the cast.
- 16.6 Rejected wheels shall be made available to the supplier with a view to arrange their replacement or reimbursement.

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SPECIFICATIONS REFERRED

This specification refers to the latest amendments of following specifications:

1. IRS-R-19/93 - Wheel and axle assembly for carriages and wagons.  
(Part-I)
2. IS - 77 - Linseed Oil, boiled for paints.
3. IS - 228 - Method for analysis of steel.
4. IS - 1499 - Method of Charpy Impact Test (U-notch) for metal.
5. IS - 1500 - Method for Brinell Hardness Test for Steel.
6. IS - 1608 - Method for Tensile Testing of steel products other than sheet, strip, wire and tube.
7. IS - 7001 - Method for shot peening and test for shot peened ferrous metal parts.
8. IS - 9139 - Malleable Iron shots and grits for use in Foundries.

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विशेषज्ञ विभाग  
Specification Section  
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R.D.S.O., Manak Nagar, Lko-11

INDIAN RAILWAY STANDARDS SPECIFICATION  
OF CAST STEEL SOLID WHEELS FOR CARRIAGE & WAGON

(Applicable to All Gauges)

No. IRS R-19/93 (Part-III)

1. SCOPE

1.1 This specification covers the requirements for multiwear cast steel wheels for Carriage & Wagon stock. For Carriage stock this is applicable upto 110 Kmph speed with vacuum brakes only.

1.2 Wheels shall be of following classes according to the service intended.

- Class 'A' - for Carriage Stock
- Class 'B' - For Wagon Stock

MANUFACTURE

2.1 Process of Steel Making

- 1. The wheels shall be manufactured from steel made by electric process and refined by any secondary refining process.
- 2. The hydrogen content of the liquid steel shall not exceed 3 ppm. If it exceeds, then proper antifracking treatment shall be carried out after which the hydrogen content shall be measured which shall not exceed 3 ppm.

2.2 Ladle Analysis

The Ladle analysis of steel, when carried out by the method specified in the relevant part of IS:228 or any other established instrumented/chemical method, shall be as per Table 1. In case of any dispute, the procedure given in the relevant part of IS:228 shall be the referee method. However, if the method is not given in any part of IS:228, the referee method shall be as agreed to between the purchaser & the manufacturer.

Chemical Composition

Ladle Analysis (Percentage)

C - Class A - 0.47 to 0.57  
Class B - 0.57 to 0.67

Mn	-	0.60 to 0.80	Si	-	0.15 to 0.40	
Cr	-	0.15 max.	} combined	S	-	0.03 max.
Mo	-	0.06 max.		P	-	0.03 max.
Ni	-	0.25 max.				

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## 2.3 Product Analysis

The product analysis shall be carried out on the finished product. Permissible variation in case of such product analysis from the limit specified under clause 2.2 shall be as follows:-

<u>Element</u>		<u>Variation Percent</u>
Carbon	-	+ 0.03 - 0.02
Manganese & Silicon	-	+ 0.03 - 0.03
Phosphorus & Sulphur	-	+ 0.005 - 0.000
Chromium & Nickel	-	+ 0.05 - 0.00
Molybdenum	-	+ 0.02 - 0.00

## 2.4 Manufacturing Process

The cast steel wheels shall be manufactured by the process of pressure pouring in graphite moulds. However any other proven process can also be followed if agreed to by the Purchaser and the manufacturer. During the process of manufacture, necessary care in regulation of temperature gradients shall be exercised to prevent the development of internal defects or injurious stresses.

## 2.5 Heat Treatment

The heat treatment shall consist of treatment of the rim only. The wheels shall be uniformly reheated to the proper temperature to refine the grain and then the rim shall be quenched. Following quenching, the wheels shall be charged into a furnace for tempering to meet the hardness requirements of clause 6.5 and subsequently cooled under controlled conditions.

## 2.6 Shot Peening

### 2.6.1 Peening intensity, arc height measurement & coverage

Shot peening to improve the plate fatigue strength shall be carried out on all wheels, after heat treatment and corrective surface preparation, if any, in the plate area extending approximately one-half of the way into the hub and rim fillet radii on the front and on the back of the wheel. The peening intensity and time shall be sufficient to produce an average arc

height of not less than 0.2 mm and full coverage on all Almen "C" strip as measured in accordance with IS:7001 Method for Shot Peening and test for Shot peened ferrous metal parts. The degree of peening shall be as specified in the drawings.

2.6.2 Shot & shot size control  
 The shot shall be S-M 1400 (SAE-550) or larger hardened steel as specified in IS-9139 (SAE-J827). The peening machine should be equipped with a separator for continuously removing broken shots. Sufficient new shots shall be added to ensure that a minimum of 85% of S-M 1400 (SAE-550) or larger shot is maintained in the machine at all times.

3. QUALITY OF WHEEL

The wheels shall be sound throughout and show no cracks, blow holes, inclusions, shrinkage cavities or any other harmful defects.

4. DIMENSIONS, TOLERANCES AND FINISH

4.1 The wheels shall conform to the dimensions and tolerances shown in the drawings.

4.2 Wheels shall be rough bored and shall not have black spots in the rough bore. Front hub face of wheels shall be parallel to the plane of the vertical reference line and may be as cast or machined. The back face of the hub may be cast or machined.

4.3 The contour of tread and flange as well as surface finish shall be as shown in drawings. Wheels may have the contour as cast or machined at the option of the purchaser.

4.4 Machining and elimination of imbalance (In case applicable)

Machining operation shall be chosen so that the wheels comply with the requirements for both surface finish and dimensional tolerance specified by the purchaser. Elimination of imbalance shall be achieved by eccentric machining of the fillet between the web and the rim on the flange side as shown in FIG.4. The thickness of the metal removed shall not exceed 4 mm and the resultant surface shall be carefully blended into adjacent material. In no case shall it be permitted to add additional mass. Drilling of holes for correction of imbalance is prohibited.

4.5 Wheels shall be given a thorough surface examination and gauging at the place of manufacture before being offered for inspection. They shall have a workmanlike finish and must be free from defects liable to develop in or cause removal from service.

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- 4.6 No defects shall be corrected by welding. Spot grinding or machining before the removal of surface defects shall not exceed a depth of 3 mm nor shall it reduce any section below the minimum dimensional requirements. The depression produced by grinding shall be uniformly blended into the surrounding contour. Where corrective machining or grinding has been done such surfaces shall not exceed a roughness of 12.5 microns and a uniform transition from the machined or ground surface into the plane of the "as cast" surface must be provided.
- 4.7 As cast surfaces shall be free of abrupt change in section or grooves and in a clean condition free of scale prior to final inspection.

4.8 Wheels shall not be covered with any substances to such an extent as to hide defects.

**5. BRANDING**

- 5.1 Following particulars shall be stamped or marked by electric etching on the outer face of the rim of each wheel. In addition other particulars as specified by the purchaser shall also be stamped/etched. Stamp with sharp edges shall not be used. The branding on wheel rim shall be in at least 10 mm high letters.
  - 1. Manufacturer's code name (in 3 digits, with purchaser's prior approval)
  - 2. Year of manufacture (in 2 digit i.e. the year 1993 shall be indicated as 93)
  - 3. Individual serial number (in 5 digits)
  - 4. Contract Number (in brief form as approved by the purchaser).
  - 5. 'IR' for Railway initial
  - 6. Drawing Number
  - 7. Letter 'A' or 'B' to indicate the class of wheel
  - 8. Inspector's stamp
  - 9. 'UT' for Ultrasonic testing

5.2 The position of residual imbalance, if desired by the purchaser, shall be indicated by a paint mark consisting of a radial stripe about 15 mm wide on the inner face of the wheel. The values of the imbalance shall be indicated below the end of the stripe according to the following code:

- E1 for a residual imbalance of  $\leq 50$  gm-m.
- E2 for a residual imbalance of  $\leq 75$  gm-m.
- E3 for a residual imbalance of  $\leq 125$  gm-m.

Manufacturer shall maintain and preserve the record correlating every individual wheel with the cast number and heat treatment given and produce the same on demand by the Purchaser/Inspecting Officer.

5.3 Wheel dia. shall be measured and marked with white paint on the web/plate portion on all the wheels being supplied in loose condition.

6. SELECTION OF TEST PIECES

The number of wheels per batch to be subjected to the checks and tests shall be in accordance with Table-3. Test pieces shall be selected at random by the inspector and shall be stamped for identification. For this purpose, each batch shall comprise wheels from the same cast and having undergone the same heat treatment. However, for chemical analysis and macroscopic examination, the batch shall comprise wheels from the same cast.

6.1 Chemical Analysis

6.1.1 An analysis of each heat shall be made by the manufacturer to determine the percentage of elements specified in para 2.2. This analysis shall be made from a test specimen taken during pouring. The chemical composition thus determined, together with such identifying records as may be necessary, shall be made available to the purchaser or his representative and shall conform to the requirements specified in para 2.2.

6.1.2 An analysis may be made by the Purchaser from sample furnished by the manufacturer representing the day's heats, or from finished wheels selected from the heats in question by the purchaser's representative. The chemical composition thus determined shall conform to the requirements specified in para 2.3. Samples from a finished wheel shall be obtained at a location in the hub in such a manner as not to impair the usefulness of the wheels. Each sample shall be thoroughly mixed together and shall be clean and free from scale, oil and other foreign substances.

6.2 Verification of Residual Stress

This test is required to be done for rim quenched wheels only.

6.3 Tensile Test

One test piece each shall be taken from the test wheel from position 1 and position 2 shown in FIG.1.

6.4 Impact Test

Three test pieces shall be taken from the position a, b and c of the sample wheel as shown in FIG.1. The impact test pieces shall be marked to identify their longitudinal surfaces which are parallel to section AA (see FIG.1). The axis of the cylindrical bottom of the notch shall be parallel to radius AA in FIG.1.

6.5

**Macroscopy**

The test piece shall consist of a radial slice through the whole cross section of the wheel, with one surface ground or polished sufficiently to eliminate machining marks and to obtain a clear macrographic image.

6.6

**Brinell Hardness**

6.6.1

The hardness of the rim of heat treated wheels when measured in accordance with the requirements of para 6.6.2 shall be within the range given in Table 2.

6.6.2

Each wheel to be tested shall be subjected to a Brinell Hardness test on the plane face of the rim on the side opposite the flange. The position selected for indentation shall be on a circumference with a radius approximately 25 mm less than that of a running circle (see FIG.2). Before making impression any decarburised metal shall be removed from the front face of the rim at the point chosen for measurement. The surface of the wheel rim shall be properly prepared to permit accurate determination of hardness.

6.6.3

**Hardness Survey of Rim**

This test shall be carried out on the same test wheel which has passed the tensile test. A cut section of the wheel shall be prepared as shown in Fig.2 for conducting hardness survey. One of its faces shall be prepared in accordance with IS:1500 (Method for Brinell Hardness test for steel). The hardness indentations three each at a distance of 5 mm and 35 mm from the tread and one at point A shall be situated on the three lines, shown in FIG.2. If the limit of wear is less than 35 mm from the tread, the indentations shall be made at this limit instead of 35 mm. The hardness values obtained should be within the range mentioned in Table.2 The hardness survey test shall indicate a smooth transition from the tread to the interior of the wheel vertically downwards.

**Note:** The test piece should be preferably saw-cut. Should flame cutting be employed, sufficient discard should be made during shaping to eliminate the heat affected zone. Flame cutting to be resorted to only in exceptional cases.

6.6.4

If any tested wheel fails to meet the requirements of para 6.6.1 it shall be checked by making two additional hardness measurements, one on each side, approximately 25 mm away of the point first measured. If both of these check measurements meet the requirement of para 6.6.1, the wheel shall be considered to have met the requirements of para 6.6.1.

6.7 Ultrasonic Test TABLE-1

Rim of all the wheels shall be ultrasonically tested.

6.8 Magnetic Particle Test

All wheels shall be tested for magnetic particle test.

6.9 Balancing Test

The test piece shall consist of the finished wheel (Applicable only when specified in the purchase order).

7. TEST METHODS

7.1 Tensile Test

The tensile test shall be carried out in accordance with the requirements of IS:1608 with Gauge Length  $5.65 \sqrt{S_0}$ , where  $S_0$  is the cross sectional area of the test piece.

7.2 Verification of Residual Stress

Two datum points 100 mm apart shall be marked in centre of the thickness of the rim on the flat surface on the side opposite the flange. A radial cut from the top of the flange to the bore shall then be made half way between the two datum marks. The distance between the datum marks shall then be measured. The reduction in distance between the datum marks should be greater than or equal to one mm.

7.3 Residual Imbalance

(Applicable only when specified in the Purchase Order)

The out of balance moment of the finished wheel shall not exceed the limits indicated in Table-1. For this purpose, the finished wheel shall mean where all parts of the wheel required to be machined have undergone their final machining. The exception is the case of the bore which is normally finish machined by the manufacturer responsible for the final assembly of the wheel to the axle.

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TABLE-1 Ultrasonic Test

LIMITS FOR OUT OF BALANCE MOMENT to air

Sl. No.	Application	Residual	Max. Imbalance
1.	Wheels for stock running at a speed $\geq 200$ kmph. The test shall be carried out only when specified in the purchase order.	50	
2.	Wheels for stock running at a speed $\geq 120$ and $< 200$ kmph.	75	
3.	Wheels for stock running at a speed $< 120$ kmph.	125	

7.4 Impact Test (U-Notch)  
 The impact test shall be carried out in accordance with the requirements of IS:1499.

7.5 Macroscopic Examination  
 The polished surface of the test piece shall be examined with a magnification not more than 5.

7.6 Brinell Hardness  
 The Brinell Hardness test shall be carried out in accordance with the requirements of IS:1500. The hardness survey test shall be carried out with a ball of nominal diameter of not more than 5 mm.

7.7 Ultrasonic Test  
 Ultrasonic test shall be carried out in accordance with the method detailed at Appendix A.

7.8 Magnetic Particle Test  
 Magnetic particle test shall be carried out preferably by 'Magnéflo' technique and shall not reveal any harmful surface defects. Wheels revealing harmful surface defects shall be rejected.

8. MECHANICAL PROPERTIES  
 The mechanical properties of the steel, used for the manufacture of wheels shall be in accordance the requirements of Table 2.

TABLE 2

MECHANICAL PROPERTIES						
Class of Wheel	Location of test piece	Tensile strength N/sq. mm. (Min.)	Minimum yield strength	Minimum Elongation Percentage	Hardness Range	Minimum Impact Strength in J/sq. at + 20 deg. C.
A	Location 1 of fig.1	900	50% of UTS	5.0	255 to 320	10
	Location 2 of fig.1	800	50% of UTS	7.0		
B	Location 1 of fig.1	930	50% of UTS	4.5	271 to 341	
	Location 2 of fig.1	800	50% of UTS	7.0		

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NUMBER OF CHECKS AND TESTS

The sampling plan and the number of checks and tests to be carried out shall be as mentioned in Table 3.

TABLE 3  
TYPE AND NUMBER OF TESTS

1. Type of checks and tests	Number of wheels per batch to be subjected to the checks & tests		Number of tests per wheel
	Class 'A'	Class 'B'	
Metallographical Analysis	1	1	1
	1	2	1
Verification of Residual Stress	1	2	1
Rim Tensile Test	1	2	1
Web Tensile Test	1	2	1
Impact Test	1	2	1

Sl. No.	Type of checks and tests	ASTM	
		Number of wheels per batch to be subjected to the checks & tests	Number of tests per wheel
		Total Number of wheels in a batch	
		<500	>500
		Class 'A'	
		<1000	>1000
		Class 'B'	
06	a) Macroscopic examination	1	2
	b) Metallographic * examination	1	2
07	Hardness Survey of Rim	1	2
08	Rim Hardness	100%	100%
09	Ultrasonic flaw detection	100%	100%
10	Appearance and Dimensions	100%	100%
11	Magnetic Particle test	100%	100%
12	Balancing (where applicable)	100%	100%

\* The micro structure shall be to fine pearlitic with ASTM grain size 6 to 8.

10. RETESTS

10.1 Should a wheel fail in any of the above tests the Purchaser or the Inspecting Officer shall select two more wheels from the same lot, and all of which may, with his permission, be reheat treated before the selection is made. Should either of the retested wheels fail to fulfil the conditions of any of the tests, the manufacturer may, with the concurrence of the Purchaser or the Inspecting Officer, reheat treat the bulk again, from which the Purchaser or the Inspecting Officer shall select two more wheels for further tests. Should the results of these repeat tests be satisfactory, the wheels represented shall be held to have passed the test. Should either of these wheels fail to fulfil the conditions of the test, the wheels represented, shall be rejected.

10.2 Only two reheat treatments shall be permitted in all.

11. ULTRASONIC FLAW DETECTION

All the wheels conforming to the stipulation of the above mentioned clauses shall be subjected to Ultrasonic testing and only those passing the test

shall be accepted. The method of testing and acceptance standard shall be as given in Appendix 'A'.

12. **ADDITIONAL TESTS**

The Purchaser/Inspecting authority may, in case of reasonable doubt, also resort to other forms of testing such as micro tests and sulphur print, etc., as mutually agreed to between the Purchaser/Inspecting authority and the manufacturer to satisfy that the wheels are free from defect of any kind.

13. **INSPECTION**

13.1 The Inspecting Officer or the Purchaser shall have free access to the works of the Manufacturer at all reasonable times. He shall be at liberty to inspect the manufacturer at any stage and to reject any material that does not conform to the terms of this specification. The Inspecting Officer or the Purchaser shall have the power to mark in some easily distinguishable manner all rejected wheels, but they shall not be marked in such a manner as to render them unsaleable to other parties.

13.2 Power shall be reserved to the Purchaser or the Inspecting Officer to be present at, and take such part, as he thinks fit, in all analysis and chemical and physical examinations which the manufacturer may make for his own purposes or under the terms of this specification, both of the wheels and/or other material in all stages of manufacture.

14. **TESTING FACILITIES**

14.1 The manufacturer shall supply the material required for testing, free of charge, and shall, at his own cost, furnish and prepare necessary test pieces, and supply labour and appliances for such testing as may be carried out in his own premises in accordance with this specification. Failing facilities at his own works for carrying out the prescribed tests, the manufacturer shall bear the cost of carrying out the test elsewhere.

15. **PROTECTION**

15.1 After inspection and approval, the wheels shall be carefully cleaned of all rust and protected with one coat of boiled linseed oil to IS:77 or any other rust preventive compound, approved by the Purchaser/Inspecting Officer.

15.2 Effective protection of finish machined surfaces of the wheels against impact damage during transit shall be ensured by the supplier before despatch.

APPENDIX A

(Ref. Clause 7.7)

Method of Ultrasonic Testing and Acceptance Standard for Cast Steel Wheels

The purpose of this method is to detect internal discontinuities in the rims of cast steel wheels. Ultrasonic inspection shall be made by following the procedure shown below and by using equipment which complies with the following requirements.

A-2 Equipment

A-2-1 The instrument shall be of pulse echo type and shall have an operating frequencies range of 2 to 5 MHz for the test method employed.

A-2-2 The transducers shall be of normal 0 type composed of highly sensitive Piezo electric ceramic crystal operating at 2 to 2.5 MHz and of appropriate dimensions to suit the method of test.

A-2-3 An automatic flaw alarm system shall preferably be used in conjunction with the Ultrasonic instrumentation.

A-2-4 A suitable couplant shall be used between the test surface and the transducer. An immersion testing technique could be used to facilitate automatic in-line testing.

A-3 Time of Inspection

Inspection shall be performed after final thermal processing.

A-4 Calibration

A-4-1 Calibration shall be conducted using a reference standard of a wheel or portion of a wheel rim containing simulated defects. The instrument sensitivity level should be adjusted to produce an approximately half full scale reflection from the reference standards indicated in A-4-2, A-4-3, A-4-4 and A-4-5.

A-4-2 For axial testing the reference standard shall be a 3.2 mm diameter flat bottom hole drilled perpendicular to the rim face and to a depth of 25.0 to 38.0 mm at the mid-thickness of the rim. See FIG.A1 of FIG.3.

- A-4-3 For radial testing the reference standard shall be a 3.2 mm diameter flat bottom hole drilled from the inside diameter of the rim essentially parallel to the rim face. The flat bottom hole shall be a minimum of 32 mm from the tread surface. See FIG.B-1 of FIG.3.
- A-4-4 The side of a small diameter hole of the order of .1.6 mm to 3.2 mm in diameter may be used when it is drilled at a distance from the testing surface equal to the depth of hole indicated in A-4-2 and A-4-3. The instrument shall be adjusted to give an equal test value to that of a 3.2 mm diameter flat bottom hole. This practice is an alternate for the reference standards of sections A-4-2 and A-4-3 (See FIG.A-2 and B-2 of FIG.3).
- A-4-5 For axial testing when determining loss of back reflection, the reference standard shall be a 9.5 mm diameter concave bottom hole drilled to a depth of 3.2 mm at the front rim face and perpendicular to the back rim face. (See FIG.C of FIG.3).
- A-4-6 Reference standards for the inspection of heat treated wheels shall be fabricated from heat treated wheels only.
- A-5 Scanning
- A-5-1 Wheels shall be inspected axially from either the front or back rim face and radially from the tread surface by manual or automatic scanning, FIG.3.
- A-5-2 One or more transducers shall be designed and located to give maximum coverage of the rim section-both radially and axially. Maximum possible area shall be scanned.
- A-5-3 In case of automatic scanning the speed of scanning shall permit detection of the reference standard discontinuities.
- A-6 Rejection
- A-6-1 Any wheel with a flaw indication equal to or larger than that obtained from the reference discontinuity shall be cause for rejection.
- A-6-2 Any indication from a discontinuity giving a loss of back reflection equal to or greater than the reference standard (covered in A-4-5), during axial scanning may be cause for rejection.
- A-6-3 Ultrasonic indications that result from wheel geometry or spurious electrical signals shall not be valid cause for rejections.

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When automated equipment is used, the final disposal of rejectable wheels may be determined by manual testing of the questioned areas.

**A-7 Marking**

The side of wheel diameter hole of the order of 0.2 mm shall be marked with a diameter hole of 0.2 mm. The markings shall conform to the above Ultrasonic stipulations shall be stamped "UT" as indicated under clause 5.1.4.5. The marking shall be stamped on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The reference is given in clause 5.1.4.5. The marking shall be stamped on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

**विवरण अनुसूची  
Specification Section**

ख. न. मा. सं. 19/93 का अनुसूची-11  
R.D.S.C. का अनुसूची-11  
The marking shall be stamped on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The marking shall be stamped on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

Reference shall be made to the specification of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The marking shall be stamped on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

**Scanning**

Wheels shall be scanned with an ultrasonic instrument. The scanning shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The scanning shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

One or more producers shall be designated and shall be responsible for the scanning of the wheels. The scanning shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

In case of automated scanning, the scanning shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The scanning shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

**Retention**

The wheels shall be retained for a period of 30 days. The retention shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The retention shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

The wheels shall be retained for a period of 30 days. The retention shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The retention shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

The wheels shall be retained for a period of 30 days. The retention shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm. The retention shall be done on the side of the wheel diameter hole of 0.2 mm to a depth of 0.2 mm.

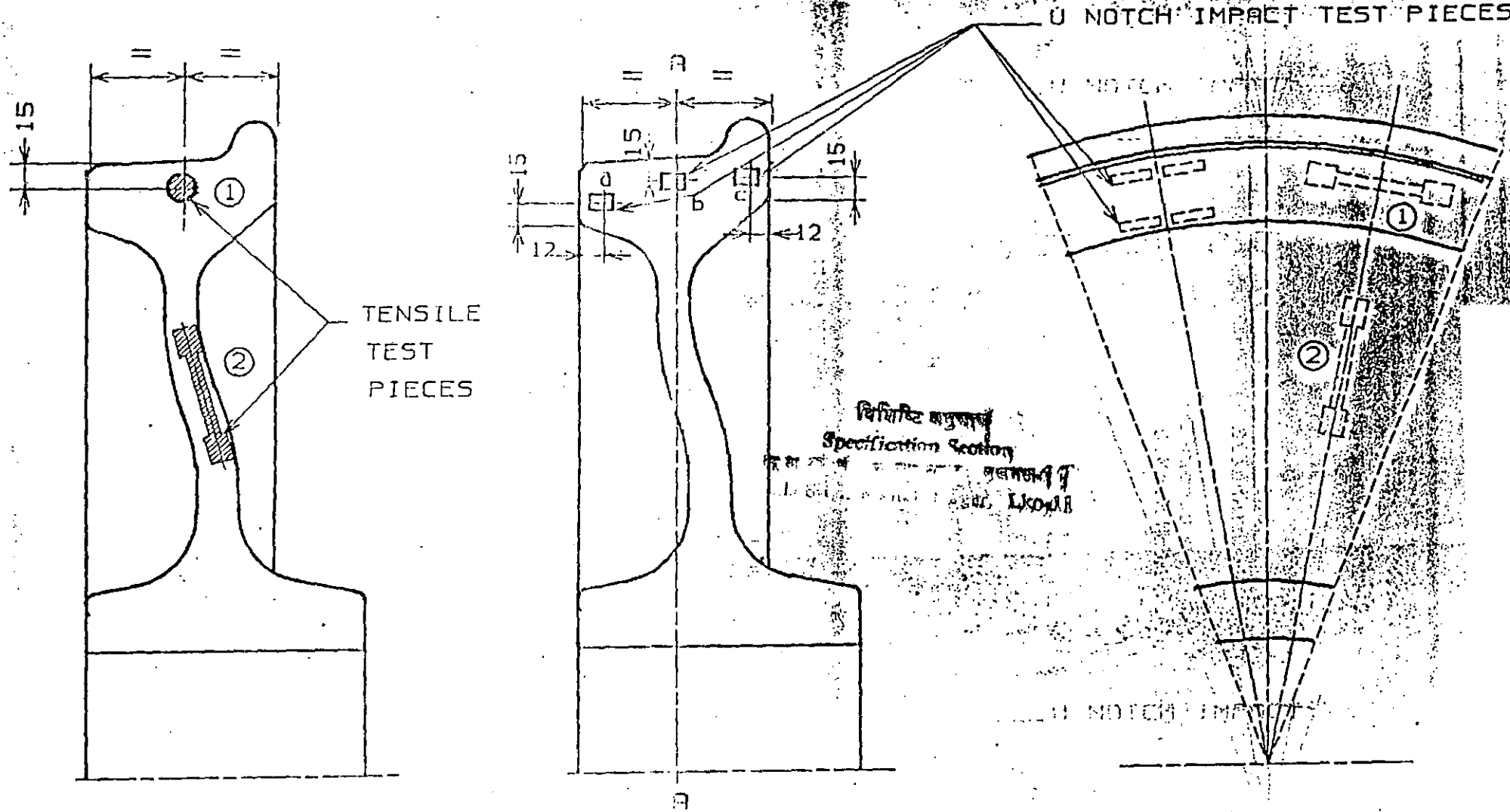
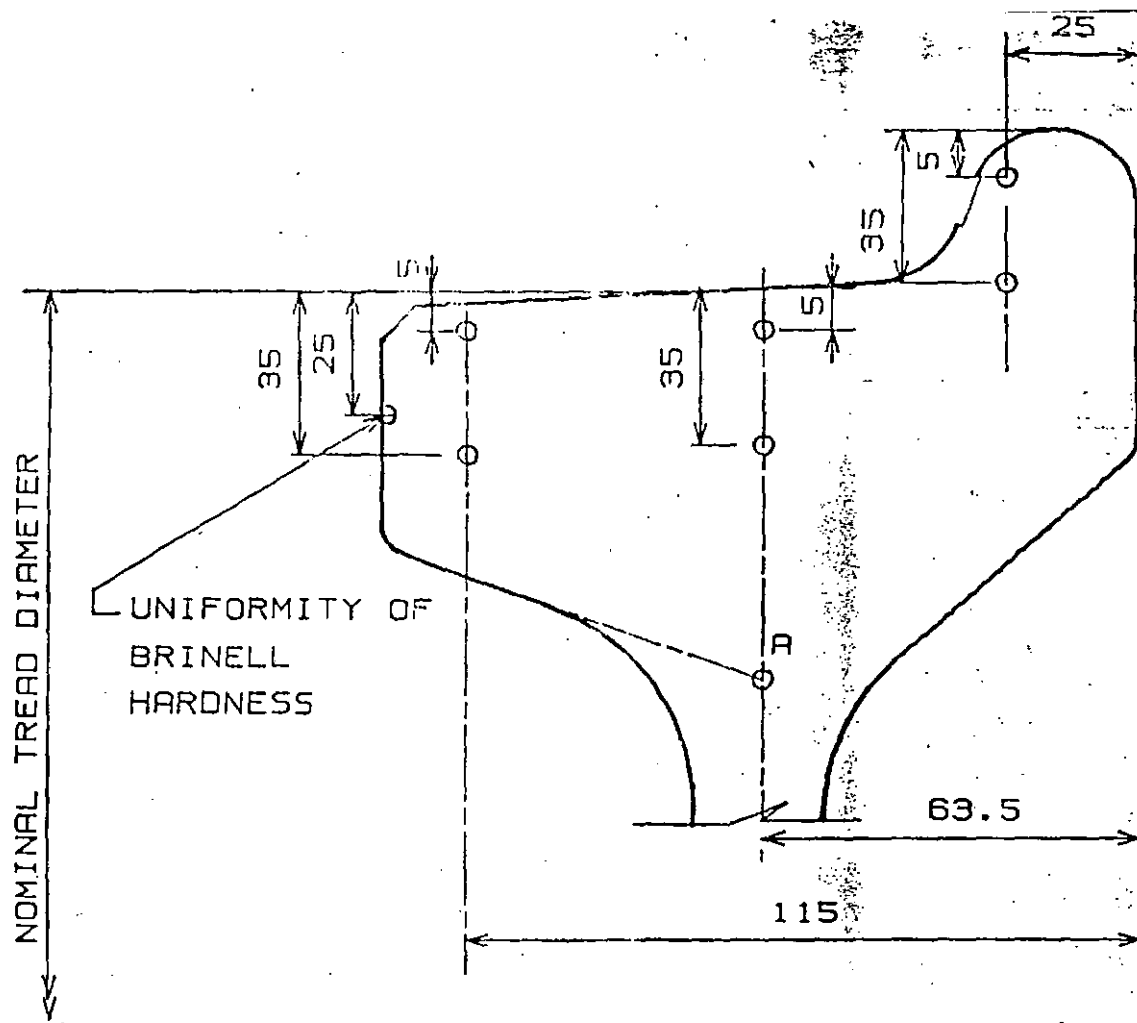


FIG.1- POSITION OF TENSILE AND IMPACT TEST PIECES

( REFER (LAUSE 6.3, 6.4 & 8)

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**FIG.2- LOCATION FOR BRINELL HARDNESS MEASUREMENT**

(REFER - CLAUSE 6.6)

FIG. A1- REFERENCE STANDARD

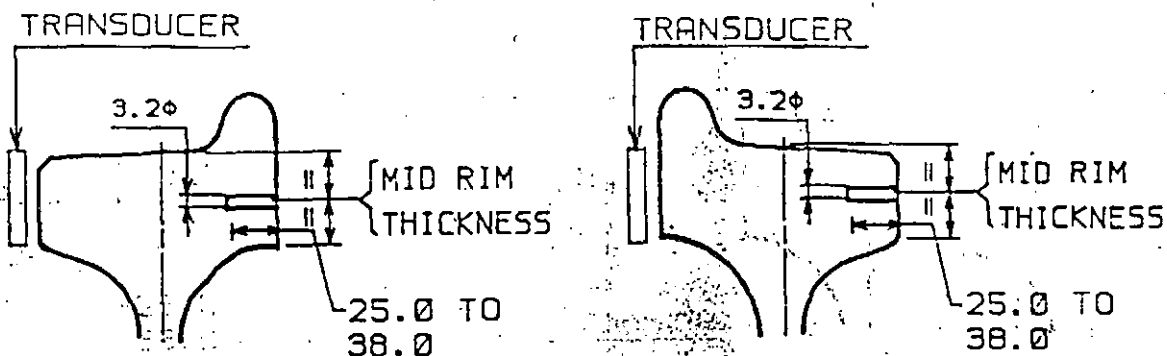


FIG. A2- ALTERNATIVE REFERENCE STANDARD

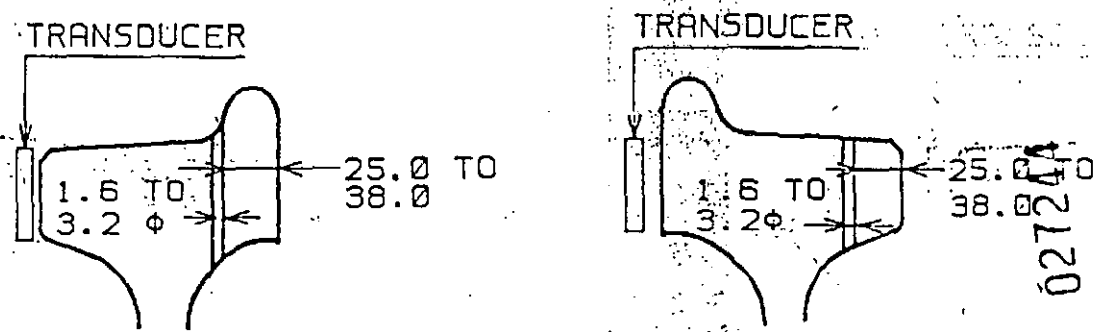


FIG 'A'- TYPICAL REFERENCE STANDARD FOR RIM FACE TEST

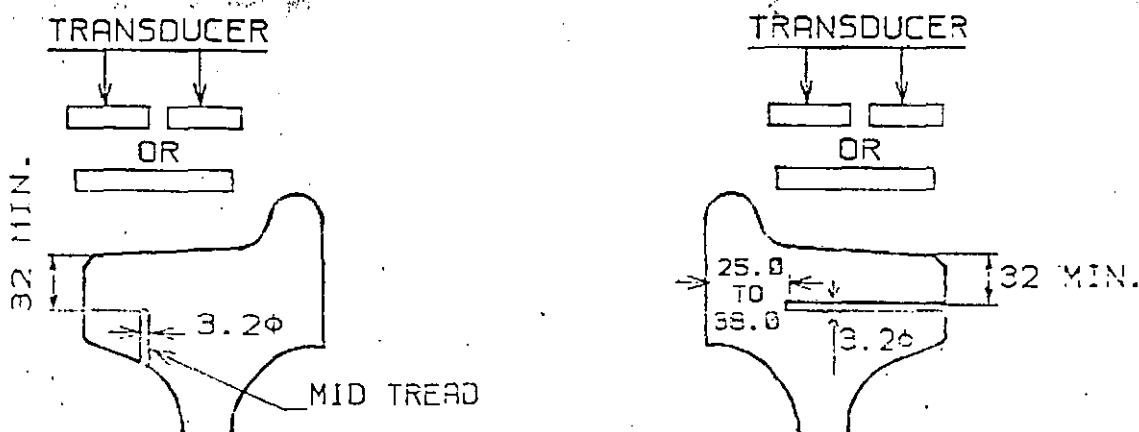
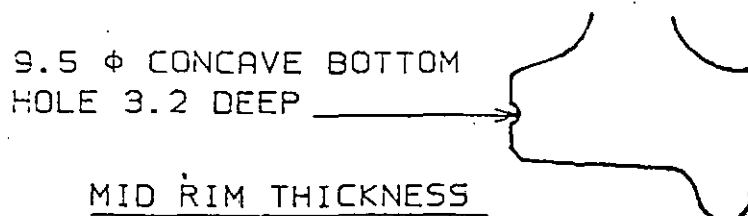


FIG B1- REFERENCE STANDARD

FIG B2- ALTERNATE REFERENCE

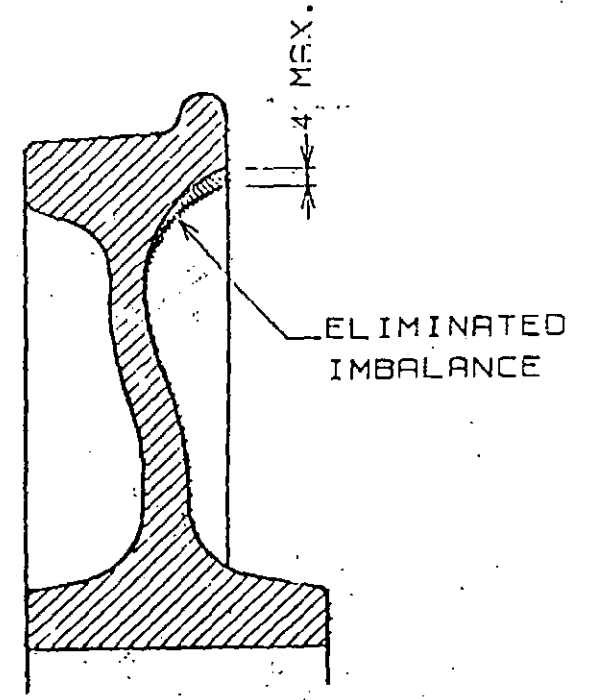
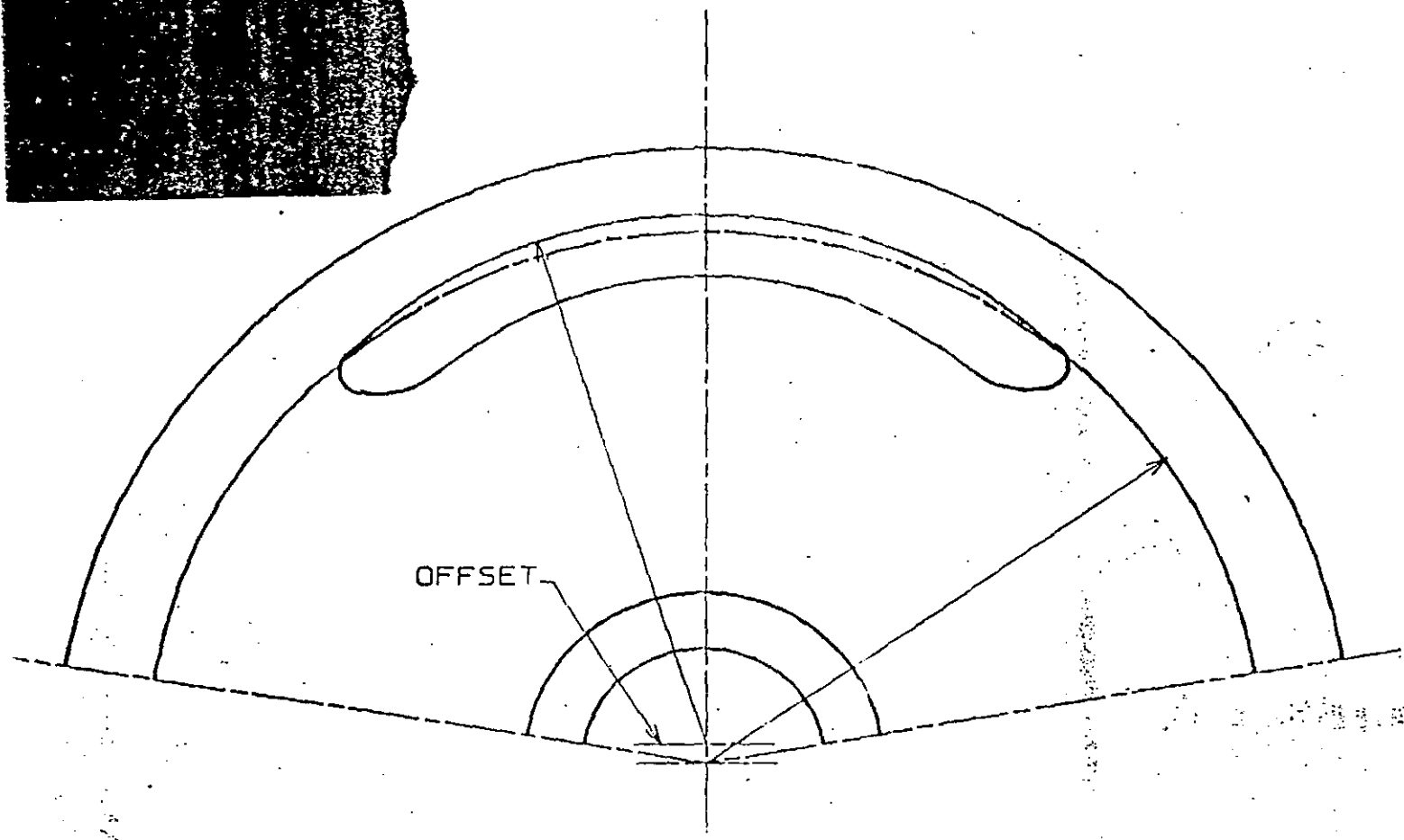
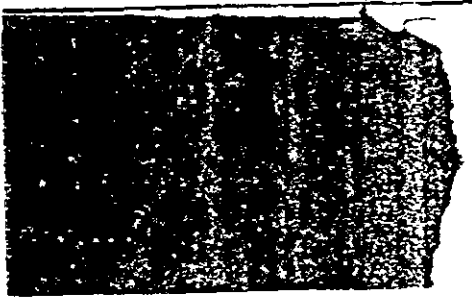
FIG 'B'-TYPICAL REFERENCE STANDARDS FOR RIM TREAD TEST



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FIG 'C' TYPICAL SIGNIFICANCE STANDARDS TO DETERMINE LOSS OF BACK REFLECTION

FIG 3- REFERENCE STANDARDS FOR ULTRASONIC TESTING OF THE WHEEL RIM



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FIG. 4- ELIMINATION OF IMBALANCE  
(REFER - CLAUSE 4.4)