



भारत सरकार
रेलवे विभाग

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

**SPECIFICATION FOR THREE AXLE CAST STEEL TRIMOUNT
AND FLEXI-COIL BOGIE FRAMES & BOLSTERS
FOR BROAD GAUGE LOCOMOTIVES**

**SPECIFICATION NO. MP.0.4900.04
(Revision 01)**

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SPECIFICATION FOR THREE AXLE CAST STEEL TRIMOUNT AND FLEXI-COIL BOGIE FRAMES & BOLSTERS FOR BROAD GAUGE LOCOMOTIVES

1. SCOPE

- 1.1 This specification covers the technical requirements for manufacture and supply of three-axle trimount cast steel bogie frames (RDSO Drawing No. SK.DL-3812 & 3813) for WAG5, WAM4, WDM2, WDM3, WCAM1 & WDS6 class of locomotives and for three-axle flexi-coil Mk-I cast steel bogie frames and bolsters (RDSO Drawing No. 29.04.01 to 29.04.04) for WAP1 and WAP4 locomotives.
- 1.2 The bogie frames / bolsters shall be supplied conforming to the relevant drawings as indicated in the purchase order in all respects.

2. DEFINITION

Wherever "Inspecting Official" has been mentioned in this document, it shall be taken as "Authorized Representative of Inspecting Agency" as mentioned in the Purchase Order.

The bogie frames & bolsters, which are to be supplied to Railways as per this specification against a Purchase order, shall henceforth be referred as "castings" in this specification.

Other terms and their definitions used in this specification are:

"STR" means Schedule of Technical Requirements.

"QAP" means Quality Assurance Plan.

"Manufacturer" means the manufacturer of castings.

"Purchase Order" means purchase order for castings.

3. REQUIREMENTS FOR TENDERERS

The tenderer shall fulfill the following requirements to be eligible for supplying cast bogie frames / bolsters for BG locomotives as per this specification:

- 3.1 The tenderer shall have a well-established steel foundry producing quality castings with adequate quality control organization. The foundry shall have approval as Class 'A' foundry as per IS: 12117.
- 3.2 The tenderer shall fulfill all the requirements given in STR No. MP.STR.VL-01.01.03 titled "Infrastructure, Manufacturing, Testing & Quality Control Requirements for Three Axle Cast Steel Trimount and Flexi-coil Bogie Frame & Bolster for Locomotives".

4. INSTRUCTIONS FOR THE PURCHASER

- 4.1 The tenderer shall be an RDSO Approved Vendor and the current RDSO Vendor List QA-1/0001 should contain the firm's name for supply of Cast Co-Co Bogie Frame & Bolster for locomotives.
- 4.2 Inspection of castings shall be carried out by QA-I Wing of RDSO. Purchaser shall clearly indicate the Inspecting Agency in the Purchase Order.
- 4.3 The purchase order for castings shall bear reference of this specification.
- 4.4 The purchaser is required to obtain a clearance from RDSO for any deviations from the latest drawing(s) / specification(s) for castings.

5. REFERENCE TO SPECIFICATIONS & STANDARDS

The firm shall have a copy of latest versions of following specifications & Standards / Codes:

Sl.	Spec. No.	Description
1.	ASTM A -370	Test Methods and Definitions for Mechanical Testing of Steel Products
2.	ASTM A -488	Practice for Steel Castings, Welding, Qualification of Procedures and Personnel
3.	ASTM E -125	Reference Photographs for Magnetic Particle Indications on Ferrous Castings
4.	ASTM E -186	Reference Radiographs for Heavy Walled (2 to 4½ Inch) Steel Castings (51 to 114 mm)
5.	ASTM E -390	Standard Reference Radiographs for Steel Fusion Welds
6.	ASTM E -446	Reference Radiographs for Steel Castings up to 2 inch (51 mm) in Thickness
7.	IS: 1608	Mechanical Testing of Metals – Tensile Testing
8.	IS: 1757	Method for Charpy Impact Test (V Notch) for Metallic Materials
9.	IS: 2074	Ready Mixed Paint, Air Drying, Red Oxide Zinc Chrome, Priming - Specification
10.	IS: 2932	Enamel, Synthetic, Exterior: (a) Under Coating (b) Finishing - Specification
11.	IS: 4163	Method for Determination of Inclusion Content in Steel by Macroscopic Method
12.	IS: 4897	Deviations on Untoleranced Dimensions & Mass of Steel Castings
13.	IS: 5530	Recommendations for Production, Rectification And Repair of Steel Castings by Metal Arc Welding Process
14.	IS: 7310 Part I	Approval Tests for Welders working to Approved Welding Procedures
15.	IS: 7318 Part I	Approval Tests for Welders when Welding Procedure Approval is not required
16.	IS: 12117	Norms for Classification of Steel Foundries for Quality Assurance

6. DEVIATION(S)

Deviations are normally not acceptable. If deviations from the prescribed drawing(s) / specification(s) is desired by the supplier, specific request with the details of the deviation(s) from the original design, material specifications, dimensions etc with proposed change and reasons indicating the unavoidable circumstances, shall be submitted to the purchaser. The purchaser may consider such request after careful evaluation of the proposal from safety & reliability point of view and commercial implications subject to Para 4.4 of this specification. Such authorization for deviation shall be applicable to the specific purchase order only.

The supplier shall not commence manufacture with the proposed deviations till the purchaser grants written authorization for acceptance of the request for deviation.

7. QUALITY ASSURANCE PLAN

- 7.1 On receipt of the purchase order, the firm shall ensure that QAP for castings are submitted in duplicate to RDSO for approval or for renewal, outlining all aspects of manufacturing and quality control required to obtain a quality product. However, the firm may not be required to submit fresh QAP if it has already obtained QAP approval of RDSO for the said product. The QAP approval for castings shall be valid for 05 years and thereafter it shall be required to be resubmitted to RDSO for approval. Any change in the process or machinery involved in manufacture of casting shall also require resubmission of QAP for approval.

The QAP should contain the following details:

- i) The casting manufacturing processes and control procedures at each stage of manufacturing indicating acceptable criteria. It should include checks for properties of mould & core, chemical composition & mechanical properties of metal, heat treatment details etc.
 - ii) The dimensional check sheets including bogie trammeling and machining indicating tolerances.
 - iii) Checks for surface quality for various casting defects in critical and non-critical areas.
 - iv) Checks to be carried out for internal defects in critical and non-critical areas.
 - v) Method for maintaining record of defects in casting, rectification and inspection.
 - vi) Proof load test arrangement and details.
 - vii) Any other miscellaneous stipulations necessary for maintaining the quality of castings.
- 7.2 The manufacturer shall commence the manufacturing of castings only after the receipt of QAP approval from RDSO. The firm shall strictly follow the stipulations of QAP during manufacture.

8. DETAILED REQUIREMENTS FOR CASTINGS

8.1 Material Properties

The material of the bogie frame / bolster shall conform to the stipulations given in Para 8.1.1 to 8.1.4. Each casting shall be provided with at least 04 nos. of standard test coupons equivalent to ASTM A-370 Fig. 3. The test coupons shall be located in such a way that they represent the whole casting. These test coupons shall be cast integrally and shall be heat-treated along with the castings.

After heat treatment of the casting, initially two test coupons shall be detached for checking the mechanical and metallurgical properties of the casting. The other two test coupons shall only be detached when the casting properties are obtained within the prescribed limits. These test coupons shall be stamped with identification marking and shall bear the Inspecting Agency's seal. The tests for checking of chemical composition, mechanical properties and impact strength shall be carried out on the test specimen prepared from these test coupons. The stamped coupons must be preserved at least for the warranty period of the corresponding casting.

8.1.1 Chemical Composition

Carbon.....	: 0.18 to 0.25%
Manganese.....	: 0.80 to 1.20%
Silicon.....	: 0.20 to 0.50%
Molybdenum.....	: 0.10 to 0.20%
Vanadium	: 0.15% (max.)
Chromium	: 0.25% (max.)
Nickel.....	: 0.40% (max.)
Aluminum.....	: 0.06% (max.)
Sulphur.....	: 0.025% (max.)
Phosphorus.....	: 0.025% (max.)

8.1.2 Carbon Equivalent

The Carbon equivalent shall be calculated as below:

$$\text{Carbon Equivalent (C.E)} = C + \text{Mn}/6 + (\text{Cr} + \text{Mo} + \text{V})/5 + (\text{Ni} + \text{Cu})/15$$

To ensure that the casting can be welded at ambient temperature using RDSO recommended low hydrogen type electrode without preheating the casting, the manufacturer shall adjust the chemical composition within the limits prescribed in Para 8.1.1 in such a way so that the carbon equivalent of the casting material does not exceed 0.42 and also the properties given in Para 8.1.3. to 8.1.4 of this specification are achieved.

8.1.3 Mechanical Properties

The checks for mechanical properties of the material shall be conducted on a standard round tensile specimen prepared from the test coupons. Tensile test shall be conducted as per IS: 1608. The mechanical properties of the material for castings shall conform to the values given below:

Properties	Values
Ultimate tensile strength (UTS)	520 N/mm ² (Minimum)
Yield Strength (YS)	330 N/mm ² (Minimum)
Elongation in $5.65 \sqrt{S_0}$ (where S_0 is Cross Sectional Area in mm ²)	23 % (Minimum)
Reduction in Area (RA)	40 % (Minimum)

8.1.4 Impact Strength

The impact strength of the material shall be conducted as per IS:1757 on 03 nos. of specimen prepared from the test coupons for Charpy V-notch Impact Test. Impact test results must conform to the stipulations given below:

At 0⁰C : 27 Joules (Average)
26 Joules (Minimum)

8.2 Heat Treatment

After knock out, fettling and cleaning, the castings shall be visually inspected. To achieve the desired casting properties, the heat treatment shall be carried out on the castings in which hot tears / cracks are within the specified limits and which are found acceptable. Before heat treatment, the castings should be sufficiently cleaned to achieve better heat treatment results. Due care should be taken to ensure that cores do not block the internal cavities. The furnace used for heat treatment shall be effectively controlled by thermocouples having associated graphical recording equipment.

The following heat treatment procedure is recommended for the castings:

8.2.1 Normalizing

The following normalizing procedure is recommended:

- The castings to be charged in the furnace at 300⁰C or below.
- They should be heated up to soaking temperature of 910 ± 20⁰C at a temperature increment rate not exceeding 75 Degrees/hour.

- c. The castings should then be soaked at the soaking temperature for at least 2½ hours depending upon the maximum section thickness of the casting at the rate of 1 hour soaking period for every 25 mm section thickness.
- d. Finally, the casting is to be taken out from the furnace and cooled in still air.

Note:

The blowers etc should not be used for cooling of castings in open air as it can result in development of cracks due to localized stresses as a result of uneven cooling of the casting.

8.2.2 Tempering

The following tempering procedure is recommended:

- a. The castings to be charged in the furnace at 300⁰C or below.
- b. They should be heated up to suitable temperature below the Austenitic Transformation Temperature but not less than 540⁰C at a temperature increment rate not exceeding 75 Degrees/hour.
- c. The castings should then be soaked at this temperature for at least 2½ hours depending upon the maximum section thickness of the casting at the rate of 1 hour soaking period for every 25 mm section thickness.
- d. The casting is then to be cooled inside the furnace to a temperature of at least 300⁰C.
- e. Finally, the casting is to be cooled to room temperature.

8.2.3 Stress Relieving

Castings that have been weld repaired in critical areas or have welds whose depth exceeds 20% of the wall thickness shall be fully stress relieved as per the following procedure recommended:

- a. The castings to be charged in the furnace at 300⁰C or below.
- b. They should be heated up to suitable temperature below the Tempering Temperature but not less than 540⁰C at a temperature increment rate not exceeding 75⁰C / hour.
- c. The castings should then be soaked at this temperature for at least 2½ hours depending upon the maximum section thickness of the casting at the rate of 1 hour soaking for every 25 mm section thickness.
- d. The casting is then to be cooled inside the furnace to a temperature of at least 300⁰C.
- e. Finally, the casting is to be cooled to room temperature.

8.2.4 Microstructure

Microstructure shall be a homogenized ferrite and pearlite with equi-axed grains of size ASTM No. 6 or finer.

8.2.5 Record of Heat Treatment

The manufacturer shall maintain all the records of the heat treatment process carried out for each bogie frame / bolster including original graph and shall submit the records to the Inspecting Official.

8.3 Casting Quality

8.3.1 Surface Quality

8.3.1.1 All castings shall be inspected for surface quality. The Steel Castings Research Trade Association (SCRATA) comparators shall be used for the definition of surface quality of steel castings. Surface conditions exceeding the acceptable SCRATA comparator levels are unacceptable. The acceptance criteria for various surface defects in castings shall be as per the levels given in Table -1.

TABLE - 1
ACCEPTABLE LEVELS OF SCRATA COMPARATOR
FOR SURFACE INSPECTION

Surface Inspection Parameter	Acceptable SCRATA levels		
	For surfaces to be machined	For Non-Machined Surface	
		Critical areas	Non-critical areas
Surface roughness	A4	A3	A3
Inclusion	B4	B4	B4
Porosity / Gas	C3	C2	C3
Laps/Cold Shuts (Wrinkles)	D4	D2	D3
Scrubs	E4	E3	E3
Chaplets	F4	F3	F3
Cutting Marks for risers, runners & test coupons only.	G4	G2	G3
Grinding Marks	H4	H3	H4
Metal removal marks-weld	J3	J2	J3

Notes:

- .1 Beaded core holes must be free of sharp notches.
- .2 Un-beaded core holes, sharp edge should be chamfered and should be free of sharp notches.
- .3 For hot tears and cracks see Para 8.3.2.

- .4 Weld repairs on interior as-cast surfaces need not be blended to the casting surface. However, the weld shall not have any undercut or notch.
- .5 Parting lines may have fins up to 4 mm height as long as they are free from sharp edges.
- .6 Riser stubs shall not project by more than 5 mm above the as-cast surface. Edges of the riser stub shall be blended to the contour of the casting.

8.3.1.2 The surface conditions exceeding the limits given in Table -1 up to a depth of 10% of wall thickness in critical areas and up to a depth of 20% of wall thickness in non-critical areas shall be repaired by grinding or weld repair without violating the minimum wall thickness requirements. Surface conditions exceeding these stipulations are not acceptable.

8.3.2 Visual Inspection for cracks / hot tear

The critical areas of three-axle trimount bogie frame are shown in **Fig. 1**. Critical areas of three-axle flexi-coil Mk-I bogie frame are shown in **Fig. 2** and that of bolster for three-axle flexi-coil Mk-I bogie are shown in **Fig. 3**.

Total amount of hot tears / cracks in the castings shall not exceed the following limits:

8.3.2.1 For critical areas

The total length (cumulative) of cracks / hot tears in the casting shall not exceed 150 mm in length.

8.3.2.2 For non-critical areas

The total length (cumulative) of cracks / hot tears in the casting shall not exceed 350 mm in length.

8.3.2.3 All castings where cracks / hot tears are within the acceptable limits as specified in Clause 8.3.2.1 shall be repaired by welding as per details given in Clause 14. The cracks within the above prescribed limits shall be removed / repaired. All bogie frames / bolsters where cracks / hot tears are beyond the acceptable limits shall be rejected.

8.3.3 In case of flaw occurring consistently or cracks / hot tears occurring at particular locations repeatedly in three consecutive castings, the production for supply of castings shall be stopped and the manufacturer shall review the foundry process and adjust as necessary to re-establish the desired quality levels in the area of concern. Correction of the process shall be considered complete when three consecutively produced castings exhibit desired quality levels in the area of concern also.

8.4 Radiographic Inspection

- 8.4.1 Even after checking the castings for surface finish and their visual inspection for cracks and hot tears, they can still have some internal defects. These internal defects of the castings shall be checked by radiographic examination. The foundry process of the manufacturer should be able to achieve castings with radiographic quality levels indicated in **Table-2** or better, both in “critical areas” and “non-critical areas”. Radiographs shall be graded in accordance with **ASTM E-446** and **ASTM E-186** (i.e. Reference Radiographs for Steel Castings).

TABLE-2

ACCEPTABLE RADIOGRAPHIC QUALITY LEVELS FOR CASTINGS

Category	Type	Acceptable Radiographic Quality Levels	
		For Critical Areas	For Non-Critical Areas
Shrinkage	CA	3	4
	CB	3	4
	CC	3	4
	CD	3	4
Inclusion	B	3	4
Gas Porosity	A	3	4
Crack	D	Nil	Nil
Hot Tears	E	Nil	Nil
Chaplets	F	Nil	Allowed

The castings having defects exceeding the above radiographic quality limits shall not be accepted.

Notes:

- .1 For section thickness less than 2”, ASTM E-446 reference radiographic standards shall be used.
 - .2 For section thickness of 2” to 4.5”, ASTM E-186 reference radiographic standards shall be used.
- 8.4.2 The interpretation of the results of radiography film by the inspecting Official shall be final and binding to the manufacturer. While evaluating the results of radiographic test, he shall bear in mind that interpretation of result is subjective and hence should be done with utmost care.

8.4.3 **Monitoring of Radiographic Quality**

The casting shall qualify the appropriate quality levels as shown in Table-2 or better in “critical areas” as well as in “non-critical areas”.

Monitoring of Radiography of Castings in Critical Areas

The manufacturer shall radiograph critical areas of each casting as shown in Fig. 1, 2 & 3 to confirm that the casting satisfies the appropriate quality levels as per Table-2.

Monitoring of Radiography of Castings in Non-critical Areas

The manufacturer shall radiograph the non-critical areas in one quadrant of the casting at a frequency of 01 in 10 castings manufactured by the firm. The castings should meet the quality level 4 or better as shown in Table-2.

A different quadrant will be radiographed on each 01 in 10 castings until all quadrants have been inspected.

8.4.4 **Assessment of Radiographic Quality and Corrective Action**

Since minor radiographic quality variations from casting to casting may exist, variations in radiographic quality shall be assessed as follows:

Any critical area which exhibits a radiographic quality level greater than the levels shown in Table-2, shall require corrective actions as given in Para 8.4.5.

Any non-critical area which exhibits a radiographic quality level greater than the levels shown in Table-2, shall require corrective actions as given in Para 8.4.6.

8.4.5 **Corrective Action for Critical Areas**

In case of flaw occurring consistently at particular locations repeatedly in three consecutive castings, the production for supply of castings shall be stopped and the manufacturer shall review the foundry process and take remedial steps as necessary to re-establish desired quality levels in the area of concern. Correction of the process shall be considered complete when three consecutively produced castings exhibit desired quality levels in the area of concern also.

8.4.6 **Corrective Action for Non-Critical Area**

In case, unacceptable defect occurs in any quadrant, all the other quadrants of the concerned casting need to be subjected to

radiographic test. This full testing of all the quadrants shall be continued for next two bogie frames.

In case of flaw occurring consistently at particular locations repeatedly in three consecutive castings, the production for supply of castings shall be stopped and the manufacturer shall review the foundry process and take remedial steps as necessary to re-establish the desired quality levels in the area of concern. Correction of the process shall be considered complete when three consecutively produced castings exhibit desired quality levels in the area of concern also.

- 8.4.7 All test reports of radiographic inspection shall be submitted to the Inspecting Official for review.

8.5 Magnetic Particle Inspection

- 8.5.1 Each casting shall be subjected to magnetic particle test on all accessible surfaces of the critical areas as shown by the hatched areas and thick lines in **Fig.1** for three-axle tri-mount bogie frame, hatched areas in **Fig.2** for three-axle flexi-coil Mk-I bogie frame and **Fig.3** for bolster of three-axle flexi-coil Mk-I bogie. Magnetic particle inspection of critical areas shall be done for the detection of linear indications only. Any linear indication shown by the magnetic particle test in excess of **ASTM E-125** reference photographs degree **1-3 A, 1-3 B & 1-3 C** shall require rectification subject to the Para 8.3.2.
- 8.5.3 The test report of magnetic particle inspection shall be submitted to the Inspecting Official for review.

9. DIMENSIONS AND TOLERANCES

- 9.1 All the machined surfaces shall have dimensions and tolerances as indicated in the relevant drawings.
- 9.2 Non-machined surfaces but critical to “form, fit and function”, shall also be maintained as specified in the relevant drawings.
- 9.3 The tolerance on un-toleranced casting dimensions on all other non-critical areas shall be as per IS: 4897.
- 9.4 The squareness of the bogie frame / bolster shall be checked by tramming. Tramming diagrams for three-axle tri-mount and three-axle flexi-coil Mk-I bogie frames are shown in **Fig. 4** and **Fig. 5** respectively while that for bolster of three-axle flexi-coil Mk-I bogie is shown in **Fig. 6**.
- 9.5 Detailed dimension control charts shall be prepared for inspection of each casting in which measurements of all dimensions including critical dimensions shall be recorded and kept for evaluation and verification by the Inspecting Official.
- 9.6 Gauges, fixtures, templates and accurate measuring instruments shall be used to ensure the correctness of the dimensions. Such gauges, fixtures,

and templates shall be calibrated / checked periodically for correctness and accuracy.

10. WALL THICKNESS

Minimum wall thickness of critical areas of the casting shall not be less than the dimension shown on the relevant drawing. Wall thickness of all other areas shall not be less than 1.5 mm below the dimension shown on the relevant drawing. The maximum wall thickness shall be governed by overall weight permitted for castings mentioned in Clause 11.

The manufacturer shall determine the established weight of clean castings by taking the average weight of first 10 production castings after approval of sample casting.

The tolerance on other un-toleranced dimensions shall be governed by IS: 4897.

11. PERMITTED CASTING WEIGHT

All machined castings shall be within $\pm 5\%$ of the nominal machined casting weight as specified in the relevant RDSO drawings.

If the casting is to be supplied un-machined, then weight of clean castings shall be within $\pm 5\%$ of the established weight of the relevant casting as mentioned in Para 10.

12. PROOF LOAD TEST

To check the manufacturing quality, 01 casting out of a lot of 25 castings or 01 casting per order if the order is for less than 25 castings shall be subjected to proof load test as per the arrangement shown in **Fig.7** for three-axle tri-mount bogie frame and **Fig.8 & Fig.9** for three-axle flexi-coil Mk-I bogie frame and bolster respectively.

The following procedure shall be adopted for proof load test of castings:

- a) The bogie frame / bolster shall be kept on tables as per the arrangement shown in the relevant figure.
- b) Dial gauges shall be mounted at the locations on the transoms and side frames as shown in the specified figure and should be set at zero before proof load test.
- c) The bogie frame / bolster shall be loaded as per the loads given in the specified figure and the loads shall be sustained for a minimum period of 10 minutes.
- d) Deflections in dial gauges shall be recorded under loaded condition.
- e) Loads shall be removed gradually and readings of dial gauges shall be recorded.

There should not be any sign of deformation / permanent set or any cracks. The detection of cracks shall be checked by Radiography and

Magnetic Particle / Dye Penetrant test on critical areas as shown in relevant figures.

If the casting fails in proof load test, a detailed investigation should be done including 100% radiographic inspection for defects, wall thickness checks etc of the failed casting to identify the cause of failure.

The failure details including the cause detected and the corrective action taken should be properly documented to avoid such occurrence in other castings.

As a precautionary measure, two castings manufactured before and after the failed casting must be thoroughly investigated for the cause of casting failure in proof load test.

13. MISCELLANEOUS STIPULATIONS

13.1 Marking of Castings

The bogie frame / bolster assembly shall be placed on properly leveled marking table in order to check:

- .1 Profile and Geometry
- .2 Distortion, if any
- .3 Machining allowances

Record of above checks shall be made in the Dimension Control Charts approved by the Inspecting Agency.

13.2 Machining of Castings

The bogie frame / bolster shall be machined at all the required locations as indicated in the relevant RDSO drawings, preferably in one setting.

13.3 Identification Markings

Each casting shall have identification marking at an easily visible location, suitably cast on a non-machined outer face. The identification marking shall contain the following:

- a) Manufacturer's Monogram.
- b) Bogie Serial No. or Bolster Serial No.
- c) Month & Year of Manufacture.

13.4 Manufacturing Records

Manufacturing records shall be preserved for at least seven years for all castings with details of heat number, test coupons, radiographic results and proof load tests results duly correlated with the casting serial No. and year of manufacture.

13.5 Record of Defects and Rectification

The manufacturer shall preserve the record of all defects observed on the castings by marking locations of defects on relevant sketches for at least seven years from the date of manufacture. The sketch shall also indicate type and size of defects observed and the rectifications carried out on each bogie frame. Record of defects and rectifications shall be supplied to the purchaser.

13.6 Painting

Each bogie frame / bolster shall be given one coat of Red Oxide Zinc Chromate to **IS: 2074** (Primer) followed by a finish coat of 25-micron DFT black synthetic enamel to **IS: 2932** (Top Coat). The paint shall be of RDSO / ICF approved brands procured from RDSO / ICF approved firms.

Rust preventive coatings shall be applied on all machined surfaces before packing.

13.7 Packing

13.7.1 While packing, due care shall be taken by the manufacturer to protect all machined surfaces against any possible damage during transit / handling. Also, it has to be ensured by the manufacturer that the castings do not incur any type of damage(s) during transit / handling that may result in unsafe operation of castings in service. Suitable wooden planks and fasteners may be used to avoid such damages.

13.7.3 All quality records of the castings including Dimensional Control charts, Test certificate for Chemical, Mechanical and Impact test properties, Radiography, MPT, DPT and Heat treatment records etc. shall be supplied along with the castings and the same shall be the property of Purchaser.

13.8 Supply of semi-finished casting

Purchaser shall normally place orders for fully finished casting. However, if an order is placed for semi-finished casting, the purchaser shall ensure that the soundness of the casting does not deteriorate due to the manufacturing activities which shall be undertaken on the casting during finishing and assembly operation at the purchaser's premises. The purchaser shall provide dimensional check sheet for inspection of semi-

finished casting, as normal dimensional check sheet for supply of finished castings would not be applicable.

14. CASTING REPAIR

14.1 Repairable Casting defects within limits as defined in various relevant Para mentioned in this specification shall be repaired and tested as laid down.

14.2 For casting defects other than the cracks / hot tears, efforts shall be made to remove the defect by only grinding without violating the minimum wall thickness limit.

If the defect is not removable by grinding, repair by welding shall be resorted to. The defect shall be removed by gauging / pneumatic chipping and proper groove preparation shall be done. Before welding, the area shall be offered to the Inspecting Official and written clearance shall be obtained.

14.3 Weld repair procedures shall be in accordance with IS: 5530 and the welder qualification shall be in accordance with IS: 7310/IS: 7318 Part-I. Welding electrodes shall be as defined in the latest relevant weld procedure approved by RDSO.

14.4 Any rectification to be carried out on the casting involving welding should be done prior to stress relieving. However, after stress relieving, minor crack(s) may sometimes be revealed, which shall be repaired by welding followed by local peening with prior intimation to the Inspecting Official.

14.5 Records of defects observed, method of repairs and observation after repair shall be maintained and shall be submitted to the Inspecting Official.

14.6 Acceptance Standards for Weld Repair:

A weld shall be acceptable if:

14.7.1 It is reasonably smooth without excessive deformity or cracks where the weld is started or ended.

14.7.2 Proper fusion exists between weld metal and base metal.

14.7.3 It is free of undercuts.

14.7.4 The weld and heat-affected zone has no cracks.

14.7.5 Visual surface porosity is not in excess of 1.5 mm diameter and is not less than 150 mm apart.

14.7.6 Internal porosity and slag inclusions when determined by radiography are minimal and do not exceed Grade-2 for porosity and Grade-3 for slag inclusion standards of ASTM E-390, Vol-II.

15. INSPECTION & REJECTION

- 15.1 The manufacturer shall supply all labour, appliances, tools and gauges necessary for the testing and inspection of the castings at his own cost in accordance with this specification.
- 15.2 The Inspecting Official or the Purchaser shall have free access to the works of the manufacturer at all reasonable times and he shall be at a liberty to inspect the manufacture of castings at any stage and to reject any material that does not conform to this specification but associated with the manufacture of castings.
- 15.3 The inspection shall be carried out by the Inspecting Agency at the end of the following stages of manufacture of castings:
 - .1 Visual inspection after knockout and fettling.
 - .2 Inspection after normalizing and tempering.
 - .3 Detachment and stamping of integral test coupons.
 - .4 Check for chemical composition, mechanical properties and microstructure of the material.
 - .5 Radiographic Examination & Magnetic Particle Inspection - Defect evaluation and Corrective action.
 - .6 Inspection after completion of rectification.
 - .7 Dimensional check after machining including tramming and wall thickness.
 - .8 Weighment of machined / Un-machined clean castings depending on the supply conditions.
 - .9 Inspection during proof load test.
- 15.4 The representative of Inspecting Agency shall also make a general check on the condition of pattern, chills & chaplets, mould / core preparation and their properties, identification markings, quality of scrap used, composition of molten metal, shrinkage test on molten metal, slag analysis, tapping and pouring temperatures etc.
- 15.5 Use of gas cutting to trim the castings to achieve the required profile or desired dimensions of the castings is not permitted. Castings that bear mark of such gas cutting activity are liable to be rejected.
- 15.6 The manufacturer shall manufacture the castings in stages as detailed above. The manufacturer shall start each manufacturing stage of bogie frame / bolster only after receipt of clearance of previous stage by the Inspecting Agency.
- 15.7 Before the final clearance of the casting by Inspecting Agency, inspection checks and compliance reports at different stages of manufacture along with all relevant specifications shall be submitted to the Inspecting Official for verification.

- 15.8 Castings which fail to comply with any of the requirements / stipulations of this specification shall be rejected and disposal details recorded.
- 15.9 The Consignee / Purchaser can reject castings which show unacceptable defects subsequent to its acceptance at manufacturer's works by the Inspecting Agency. The manufacturer shall be duly intimated about it. The decision of the purchaser in this regard shall be final.

16. WARRANTY

The manufacturer shall undertake warranty for a trouble free and satisfactory service performance of castings supplied by them for a period not less than 05 years from the date of commissioning into service. Any repair(s) / rectification(s) required due to defects observed during service in these castings within the warranty period on account of metallurgical and/or manufacturing deficiency and workmanship shall be carried out on site by the supplier at his own cost. The firm shall be required to arrange replacement, if the casting is considered unserviceable due to defects observed during warranty period on account of metallurgical and/or manufacturing deficiency and workmanship by the purchaser. The decision of the purchaser in this regard shall be final.

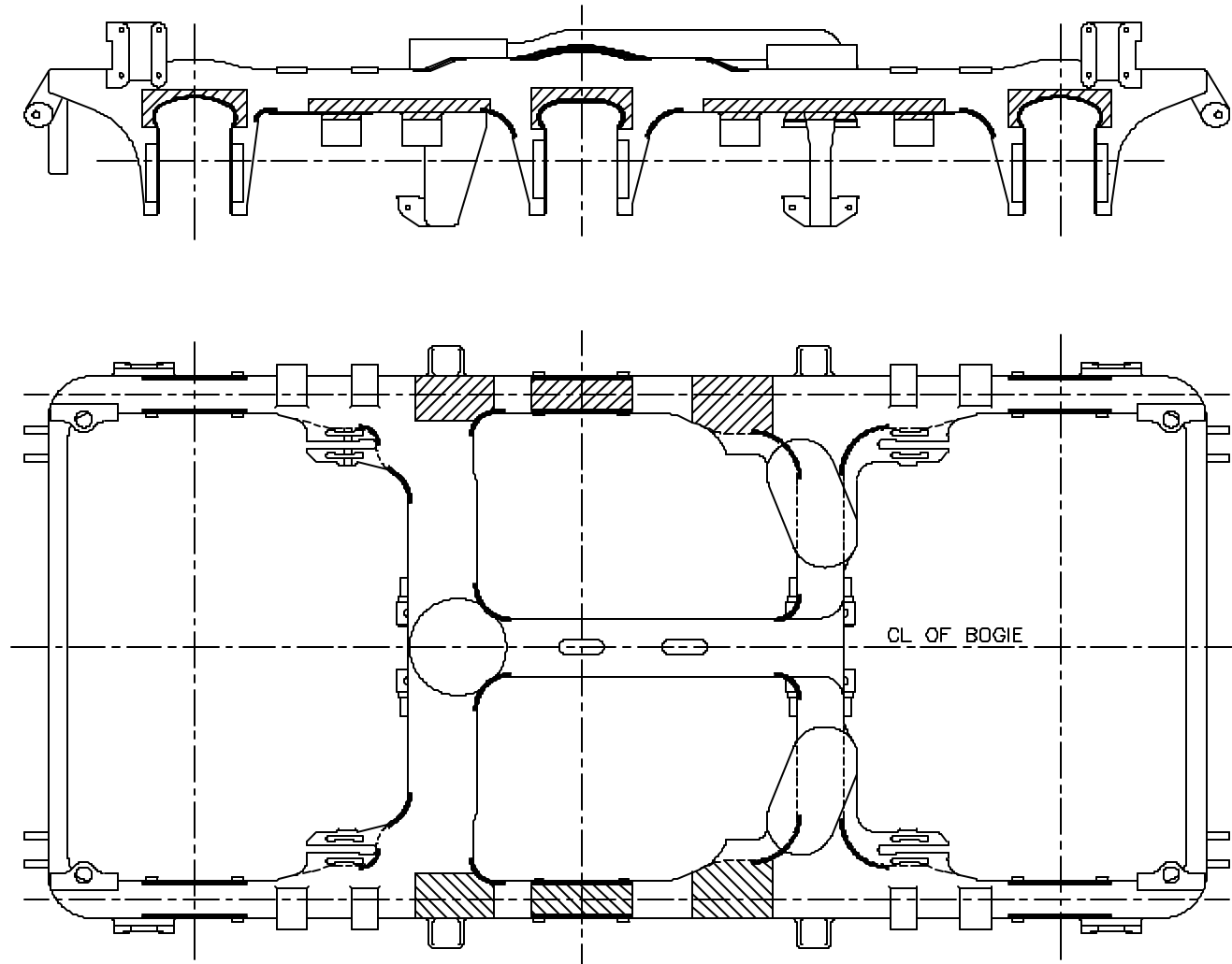


Fig. 1

CRITICAL AREAS OF THREE-AXLE TRIMOUNT BOGIE FRAME
(Critical Areas are shown with hatched / thick lines)

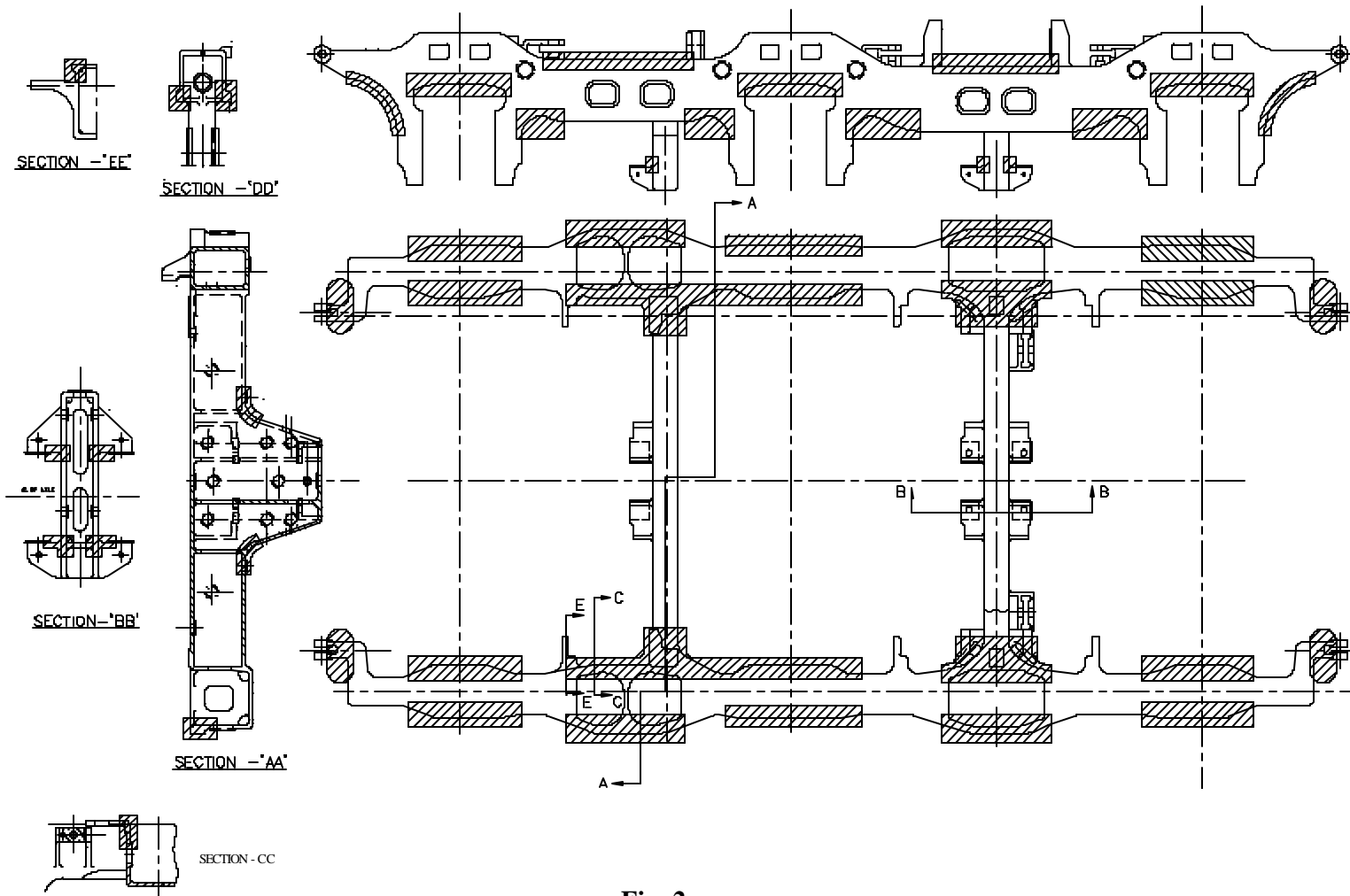


Fig. 2

CRITICAL AREAS OF THREE-AXLE FLEXI COIL Mk – I BOGIE FRAME
 (Critical Areas are shown hatched)

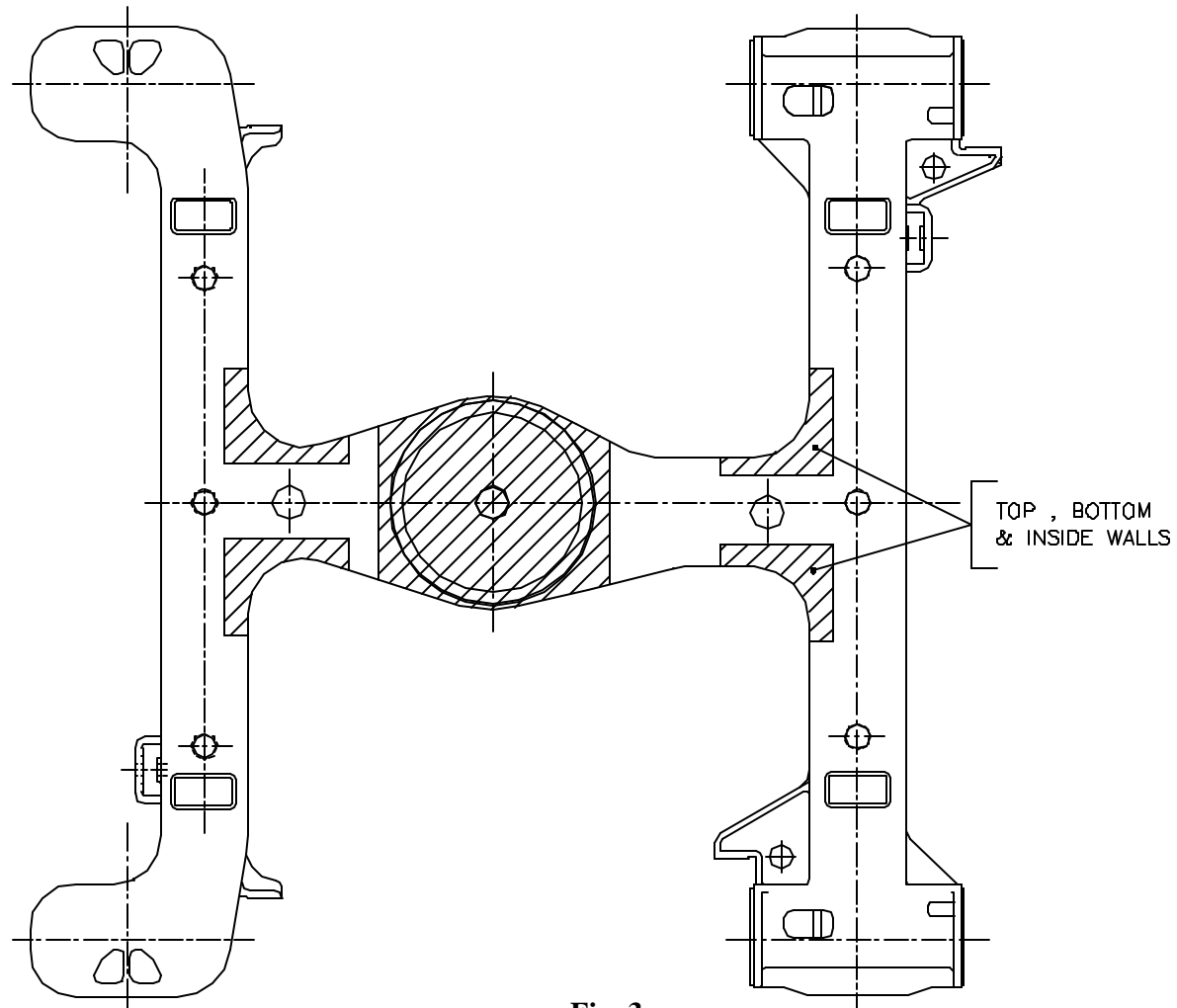


Fig. 3

CRITICAL AREAS OF BOLSTER FOR THREE-AXLE FLEXI COIL Mk – I BOGIE FRAME
(Critical Areas are shown hatched)

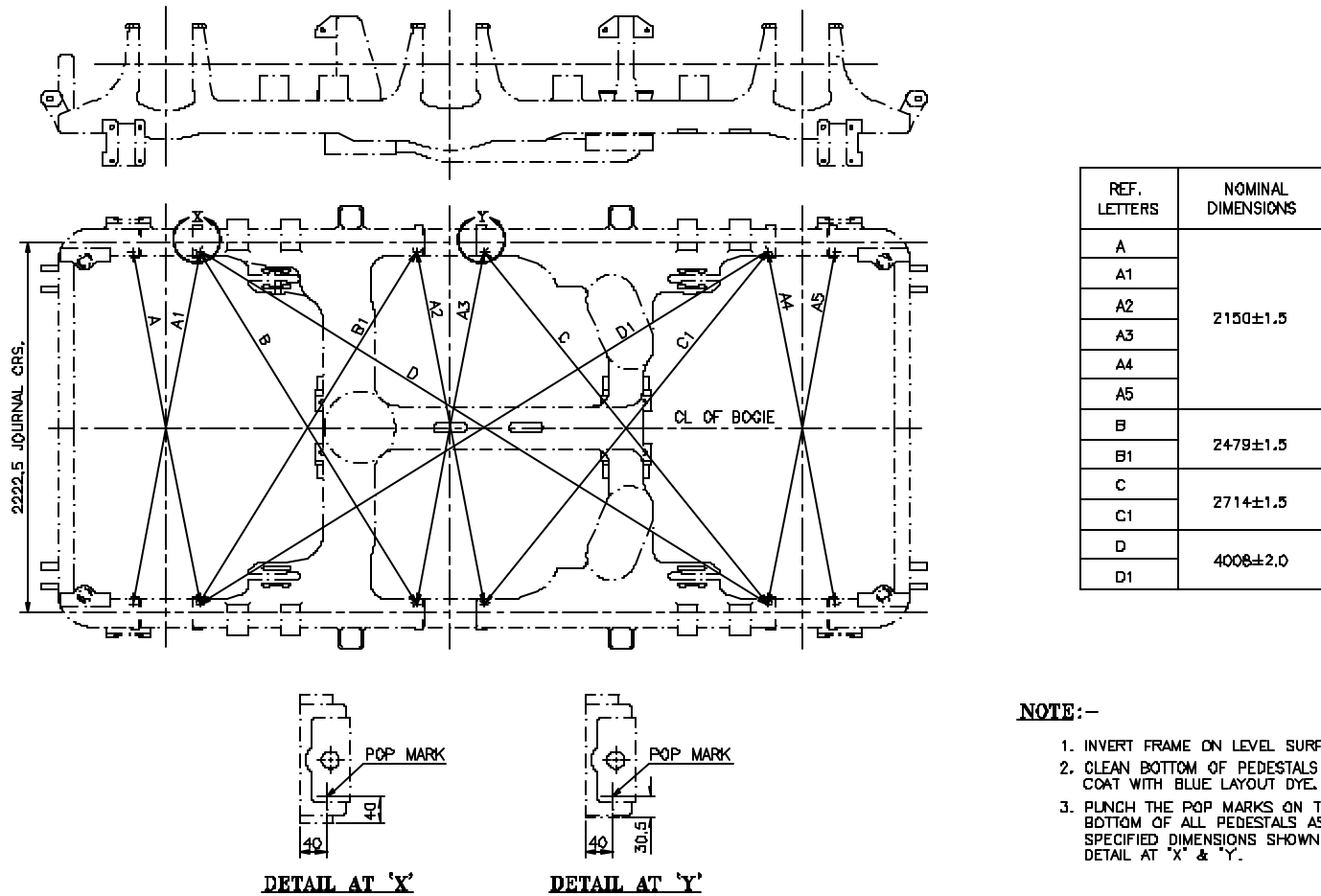


Fig. 4
TRAMMING DIAGRAM FOR THREE-AXLE TRIMOUNT BOGIE FRAME

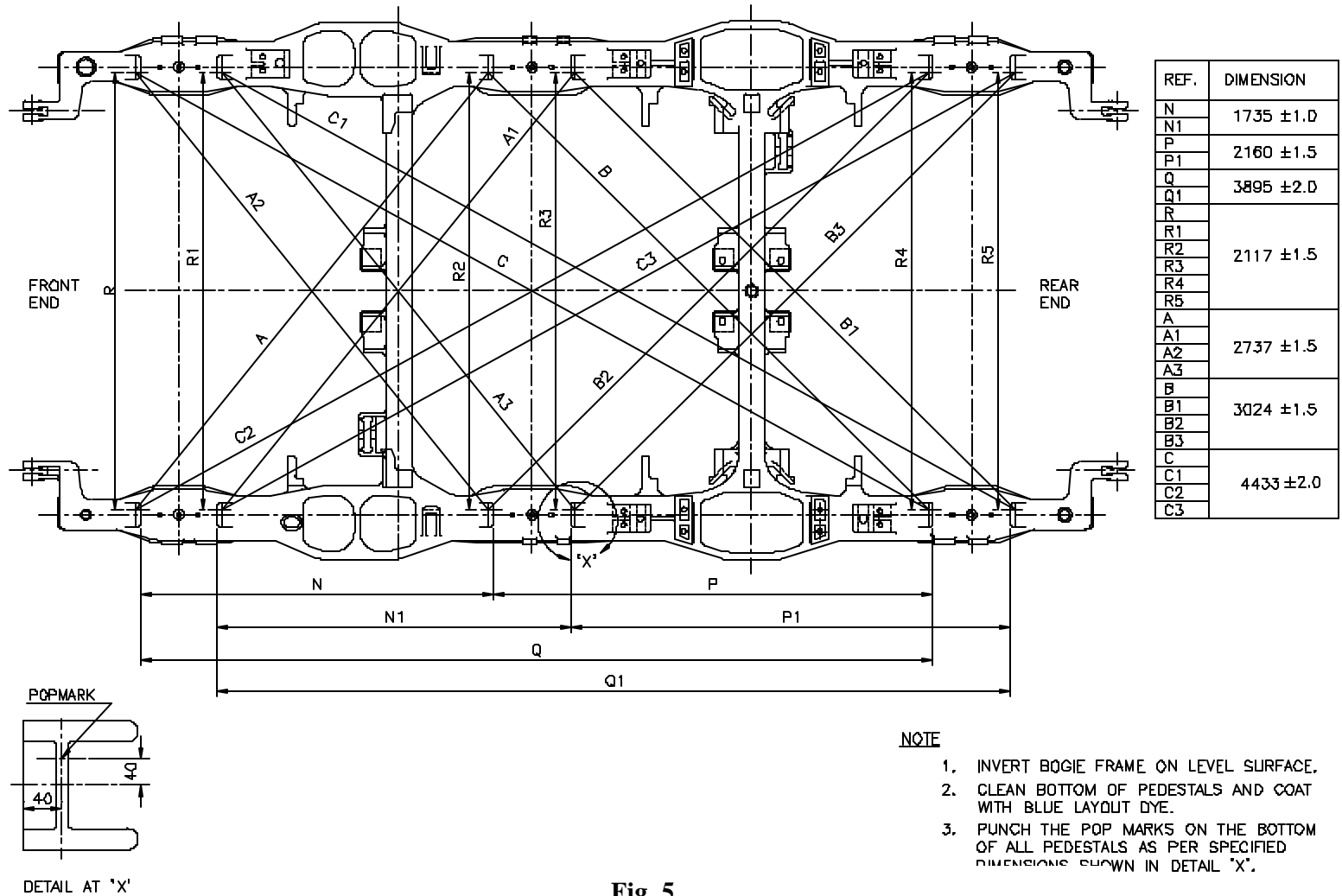
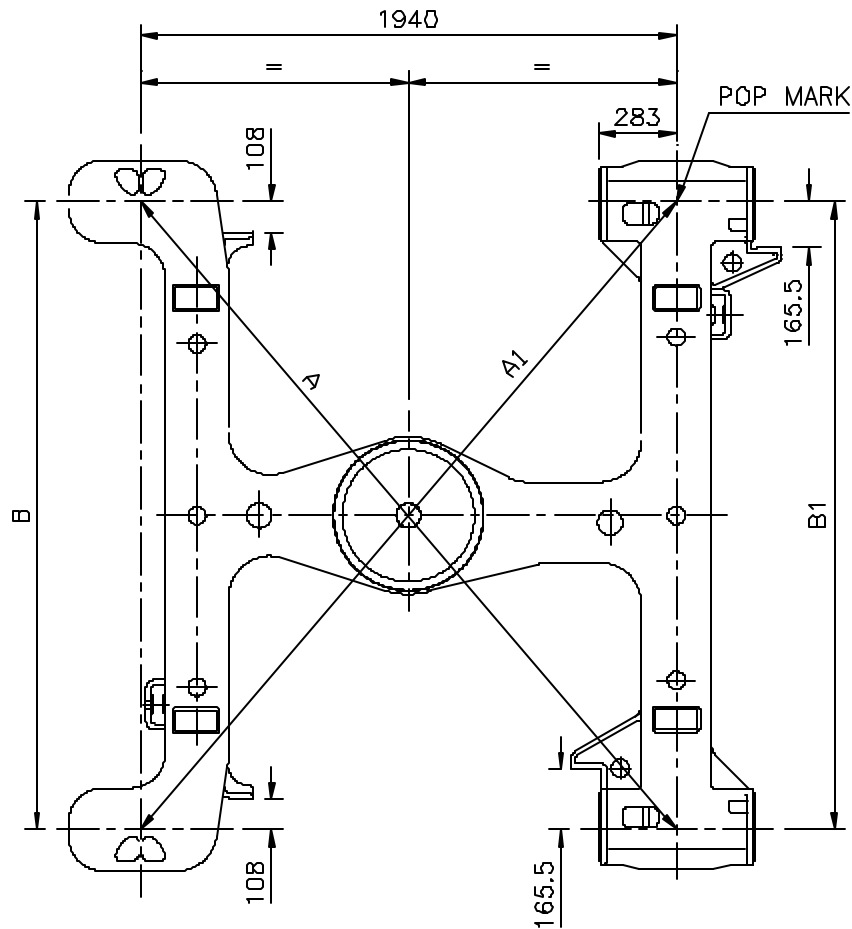


Fig. 5

TRAMMING DIAGRAM FOR THREE-AXLE FLEXI-COIL Mk - I BOGIE FRAME



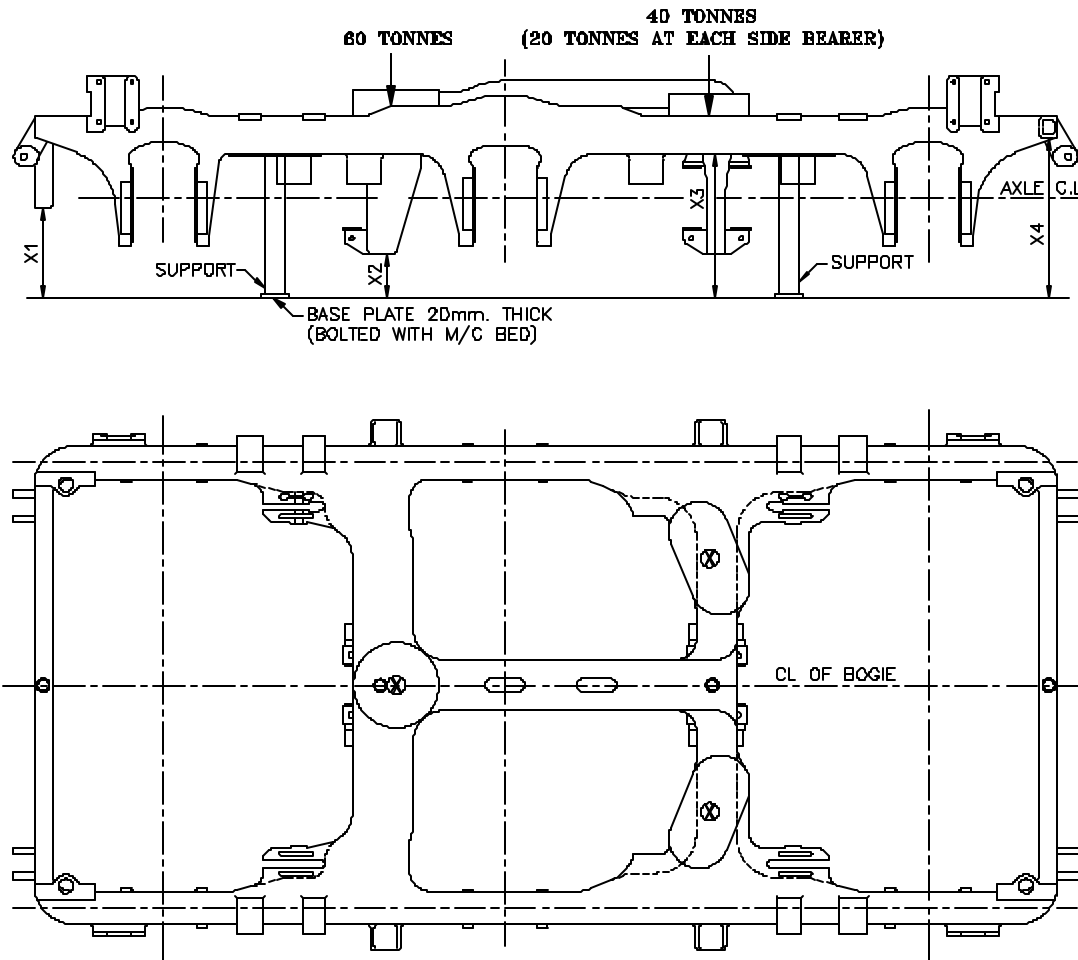
REF.	DIMENSIONS
A	2988 ± 1.5
A1	
B	2273 ± 1.5
B1	

NOTE

1. PLACE BOLSTER ON LEVEL SURFACE.
2. COAT ENDS OF BOLSTER WITH BLUE LAYOUT DYE.
3. PUNCH THE POP MARKS AS PER SPECIFIED DIMENSIONS.

Fig. 6

TRAMMING DIAGRAM FOR BOLSTER OF THREE-AXLE FLEXI-COIL Mk - I BOGIE FRAME



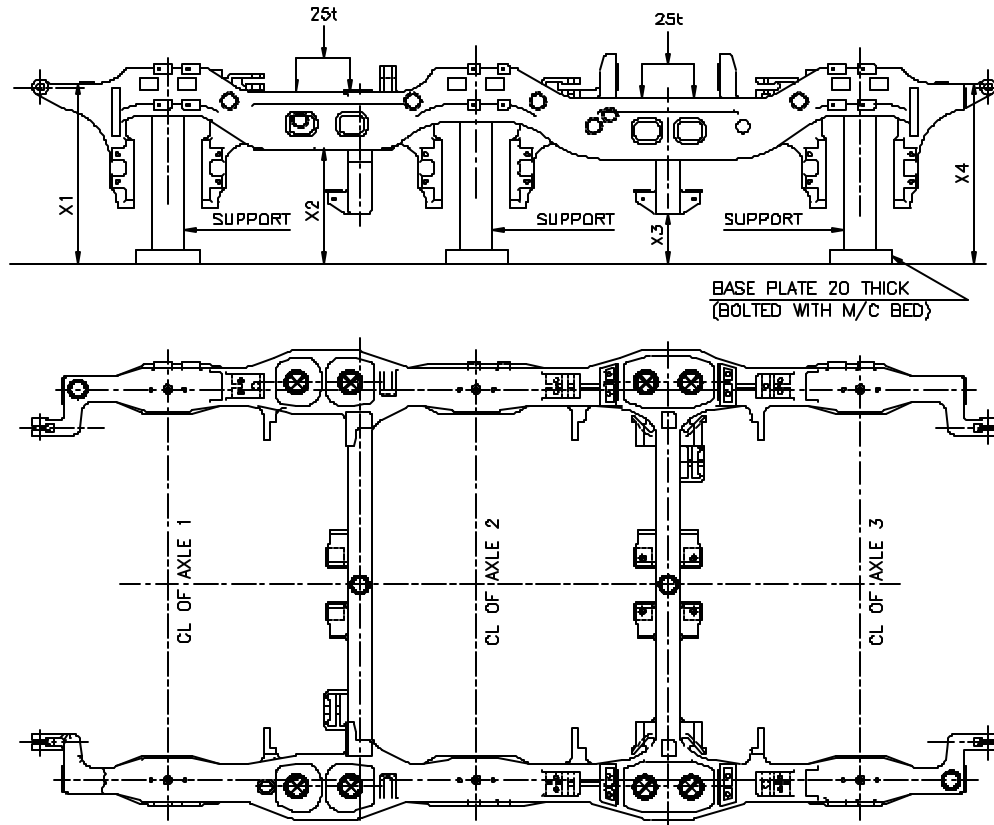
PROCEDURE FOR PROOF LOAD TEST

1. THE BOGIE FRAME SHALL BE PLACED ON THE LEVEL SUPPORTS AS SHOWN IN DIAGRAMS THE SUPPORTS SHALL BE SUFFICIENTLY STRONG AND RIGID SO THAT IT DOES NOT AFFECT THE RESULTS OF PROOF LOAD TEST.
2. DIAL GAUGE SHALL BE PLACED ON THE LOCATION INDICATED BY (O) IN THE DIAGRAM PRIOR TO THE LOADING. THE READING OF DIAL GAUGES SHALL BE SET TO ZERO (0). READING OF THE DIAL GAUGES (X1,X2,X3,X4) SHALL BE RECORDED.
3. THE LOAD OF 100 TONNE SHALL BE APPLIED AT THREE LOCATION INDICATED BY (⊗) ON THE TOP OF BOGIE FRAME AS INDICATED IN DIAGRAM.
4. VARIATION OF LOAD TEST SHALL NOT BE MORE THAN 2%.
5. THE LOAD SHALL BE SUSTAINED FOR 10 MINUTES.
6. AFTER LOADING, READING OF DIAL GAUGE SHALL BE RECORDED.
7. THE LOAD THEN SHALL BE REMOVED AND READING OF DIAL GAUGES SHALL BE RECORDED.
8. THERE SHALL BE NO PERMANENT SET/DEFORMATION IN THE BOGIE FRAME AFTER COMPLETE WITHDRAWL OF LOAD.
9. AFTER PROOF LOAD TEST, THE CRITICAL AREAS OF THE BOGIE FRAME AS SHOWN IN FIG.1
10. THERE SHALL BE NO CRACK IN THE CASTING.

DIAL GAUGE LOCATIONS	READING OF DIAL GAUGES							
	BEFORE LOADING (A)		AFTER LOADING (B)		AFTER REMOVAL OF LOAD (C)		PERMANENT SET (A-C)	
	L.H.	R.H.	L.H.	R.H.	L.H.	R.H.	L.H.	R.H.
X1								
X2								
X3								
X4								

Fig. 7

PROOF LOAD TEST ARRANGEMENT FOR THREE-AXLE TRIMOUNT BOGIE FRAME



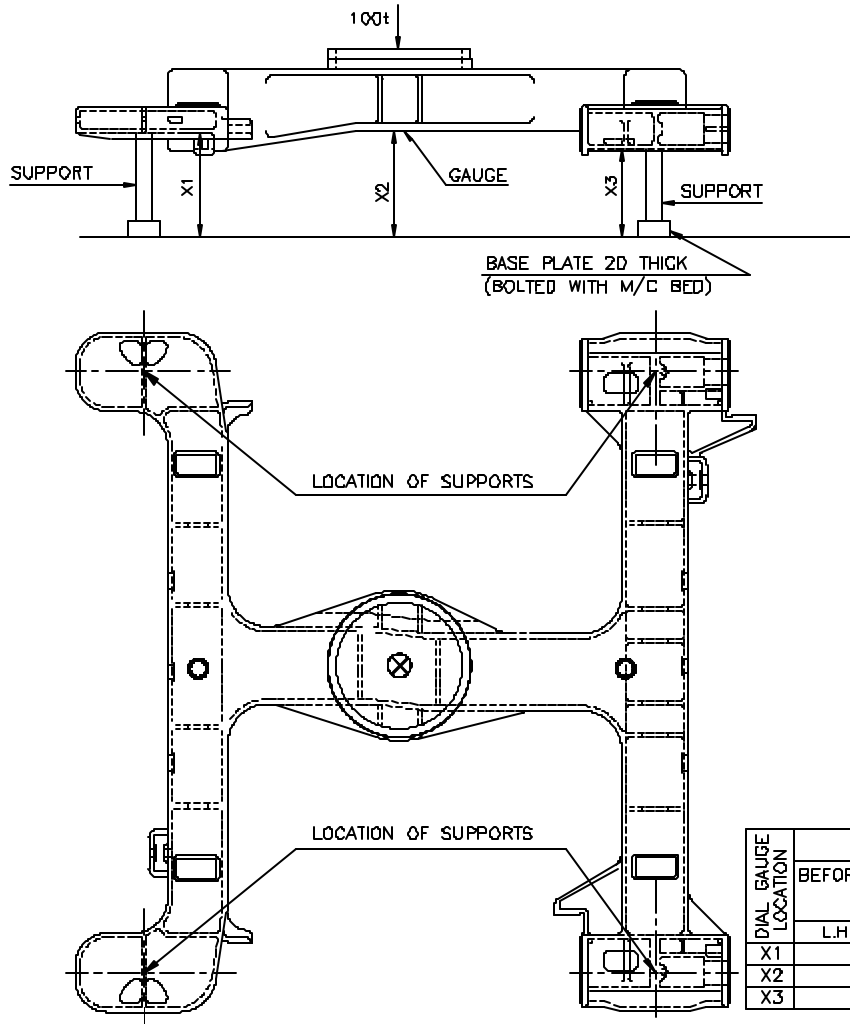
PROCEDURE FOR PROOF LOAD TEST

1. THE BOGIE FRAME SHALL BE PLACED ON THE LEVEL SUPPORTS AS SHOWN IN DIAGRAM. THE SUPPORTS SHALL BE SUFFICIENTLY STRONG AND RIGID SO THAT IT DOES NOT AFFECT THE RESULTS OF PROOF LOAD TEST.
2. DIAL GAUGE SHALL BE PLACED ON THE LOCATIONS INDICATED BY (⊙) IN THE DIAGRAM PRIOR TO THE LOADING. THE READING OF THE DIAL GAUGES SHALL BE SET TO ZERO. READING OF THE DIAL GAUGES (X1,X2,X3,X4) SHALL BE RECORDED.
3. THE LOAD OF 100t SHALL BE APPLIED AT FOUR LOCATIONS INDICATED BY (⊗) AT THE SECONDARY SPRING LOCATIONS.
4. VARIATION OF TEST LOAD SHALL NOT BE MORE THAN 2%.
5. THE LOAD SHALL BE SUSTAINED FOR 10 MINUTES.
6. AFTER LOADING, READING OF DIAL GAUGES SHALL BE RECORDED.
7. THE LOAD THEN SHALL BE REMOVED AND READING OF THE DIAL GAUGES SHALL BE RECORDED.
8. THERE SHALL BE NO DEFORMATION IN THE BOGIE FRAME.
9. AFTER PROOF LOAD TEST, THE CRITICAL AREAS OF BOGIE AS SHOWN IN FIG. 2 SHALL BE CHECKED BY MAGNETIC PARTICLE TEST.
10. THERE SHALL BE NO CRACK IN THE CASTING.

DIAL GAUGE LOCATION	READING OF DIAL GAUGE								
	BEFORE LOADING (A)		AFTER LOADING (B)		AFTER REMOVAL OF LOAD (C)		DEFORMATION (A-C)		
	L.H.	R.H.	L.H.	R.H.	L.H.	R.H.	L.H.	R.H.	
X1									
X2									
X3									
X4									

Fig. 8

PROOF LOAD TEST ARRANGEMENT FOR THREE-AXLE FLEXI-COIL Mk - I BOGIE FRAME



PROCEDURE FOR PROOF LOAD TEST -

1. THE BOLSTER SHALL BE PLACED ON THE LEVEL SUPPORTS AS SHOWN IN DIAGRAM. THE SUPPORTS SHALL BE SUFFICIENTLY STRONG AND RIGID SO THAT IT DOES NOT AFFECT THE RESULTS OF PROOF LOAD TEST.
2. DIAL GAUGE SHALL BE PLACED ON THE LOCATIONS INDICATED BY (●) IN THE DIAGRAM PRIOR TO THE LOADING. THE READING OF THE DIAL GAUGES SHALL BE SET TO ZERO. READING OF THE DIAL GAUGES (X1,X2,X3) SHALL BE RECORDED.
3. THE LOAD SHALL BE APPLIED ON THE LOCATION INDICATED BY (⊗) AT THE CENTRE PIVOT BOWL.
4. VARIATION OF TEST LOAD SHALL NOT BE MORE THAN 2%
5. THE LOAD SHALL BE SUSTAINED FOR 10 MINUTES.
6. AFTER LOADING, READING OF DIAL GAUGES SHALL BE RECORDED.
7. THE LOAD THEN SHALL BE REMOVED AND READING OF THE DIAL GAUGES SHALL BE RECORDED.
8. THERE SHALL BE NO DEFORMATION IN THE BOLSTER.
9. AFTER PROOF LOAD TEST, THE CRITICAL AREAS OF BOLSTER AS SHOWN IN FIG. 3 SHALL BE CHECKED BY MAGNETIC PARTICLE TEST.
10. THERE SHALL BE NO CRACK IN THE CASTING.

DIAL GAUGE LOCATION	READING OF DIAL GAUGE								
	BEFORE LOADING (A)		AFTER LOADING (B)		AFTER REMOVAL OF LOAD (C)		DEFORMATION (A-C)		
	L.H.	R.H.	L.H.	R.H.	L.H.	R.H.	L.H.	R.H.	
X1									
X2									
X3									

Fig. 9

PROOF LOAD TEST ARRANGEMENT FOR BOLSTER OF THREE-AXLE FLEXI-COIL Mk - I BOGIE FRAME