# Rail Coach Factory, Kapurthala

**MD35131** **Date**: 10.01.2024

**Sub:** Issue of Specification No. MDTS 20322 Rev. 02.

Please find enclosed copy of Specification No. MDTS 20322 Rev. 02 for Schedule of Technical requirement for manufacture and supply of fully assembled FIAT bogie with air spring in secondary suspension for information and necessary action please.

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# Schedule of Technical Requirements for Manufacture and Supply of fully assembled FIAT Bogie with Air Spring in secondary suspension

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| Issue/Rev | Clause | Detail of Change | Date |
|---|---|---|---|
| 01 | | **Specification revised (Paras re-numbered). The major changes are as under:** | 19/03/2021 |
| | Para 4 | Infrastructure facility bi-furcated into Key M&P and General M&P requirements. | |
| | Para 6 | Ultrasonic testing requirements added in para 6.1. Protection of sheets with linseed oil added in para 6.4. | |
| | Para7 | Requirements of Jigs & Fixtures added. | |
| | Para 9 | Special manufacturing processes grouped & mentioned under single heading of Special manufacturing processes. Reference of MDTS213 added in Para 9.3 for Stress relieving & Para added for provision of test coupon of size 40x40 mm to verify stress relieving process.<br>Component level shot blasting added in Para 9.4(a).<br>Para 9.5(b) Time lag of 30 minutes max. between shot blasting and first primer coat added.<br>Para 9.7 & para 9.8 added to add press fit & tightening torque requirements. | |
| | Para 12 | Manpower requirements added. | |
| | Para 13 | Firm to submit traceability record as per QMF9700, added in Para 13.1. | |
| | Para 14 | Added to add IRIS requirements. | |
| | Para 15 | Scope of work & PO number also included in identification marking. | |
| | Para 16 | Elaborated. | |
| | Para 17 | Elaborated | |
| | | Annexure-II, III, IV & VI revised and Annexure-VII added. | |
| 02 | Para 8.2.1 b | Updated. | 10.01.2024 |
| | Para 8.3 d | Updated. | |
| | Para 9.7 a | Para updated. | |
| | Para 11 | Para 11.1, 11.3 & 11.4 revised. | |
| | Annexure-II, | Updated | |
| | Annexure- III, | In Para-2 MCF/ICF deleted & item no. 11 shifted to Annexure-IV | |
| | Annexure-V | Size of S.No. 35 revised. | |

**1 General:**

1.1 This schedule covers technical and infrastructure requirements for manufacture, testing and supply of fully assembled FIAT Bogie for use of Indian Railways (IR) coaches to operating and service condition as specified in Annexure-I.

**2 Scope of supply:**

2.1 Fully assembled FIAT Bogie complete with documentation specified in clause 13.1 shall be supplied in all respect conforming to drawings and specifications mentioned in tender/purchase order. However latest drawings and specifications are to be followed.

2.2 Wheel set assembly consisting of Axle, Wheel discs, Brake discs, Cartridge tapered roller bearings and Phonic wheel will be free supply from RCF, Kapurthala or purchaser.

2.3 Brake calipers unit including actuator and brake pads will be supplied by RCF, Kapurthala/ purchaser as free supply items.

**3 Certification & other requirements:**

3.1 The tenderer shall submit clause wise compliance to this specification.

3.2 The tenderer shall have valid latest ISO 9001 certification.

3.3 It is desirable that the tenderer is accredited with ISO-3834 certificate.

3.4 Successful tenderer shall have to follow and ensure IRIS guidelines (ISO/TS 22163-2017).

3.5 The tenderer shall provide list of M&P and past performance documents.

3.6 Evidence for the above shall be submitted along with tender document

3.7 For RCF's orders, approvals to be taken from Chief Design Engineer (CDE)/RCF whereas for other Rly. orders approvals to be taken from respective purchaser

3.8 Minor modifications in the assembly have to be done if required by Design/RCF.

**4 Infrastructural facility at manufacturer's premises in working order**

**4.1 Key M &P Requirements:-**

4.1.1 High definition (HD) plasma or LASER profile cutting machine with cutting capacity upto thickness of 12mm

4.1.2 CNC press brake of capacity 400 T with back gauging for accurate bending of bogie side frame bottom and top plate

4.1.3 Programmable Robotic welding machine and manipulator

4.1.4 Furnace with temperature controllers for stress relieving of bogie frame members of FIAT bogie

**4.1.5 For machining of bogie frame:**

Minimum 5-Axis CNC Machining center with probing facility with (for reference and inspection) minimum bed size 3 m x 4 m suitable for machining of bogie frame in single setting keeping the bogie frame in the horizontal position. Machine shall have 3-Axis movement of X, Y, Z axis & two rotational movements of milling head for drilling and facing with minimum in

range of ± 96° with least count of 2°. The minimum movement of tool head shall be 1.2 m.

OR

Minimum 5-Axis CNC Machining center with probing facility (for reference and inspection), minimum bed size 2.5 m x 4 m suitable for machining of bogie frame in single setting keeping the bogie frame in the vertical position. Machine should have 3-Axis movement of X, Y, Z axis & two rotational movements of milling head for drilling and facing in range of ± 96° with least count of 2°. The minimum horizontal movement of tool head shall be 1.2 m & vertical movement of tool head or table 2.9 m.

4.1.6 Shot blasting plant of suitable size to accommodate bogie frame & bolster with hanger type or monorail type conveyor.

4.1.7 Painting facility/painting booth with hanger type or monorail type conveyor

4.1.8 EOT crane of minimum 10 T capacity

4.1.9 CMM or Vernier caliper size 2.6 m with dial gauge accuracy 0.01 mm or Portable FaroArm having capacity to check all dimensions as mentioned in drawing

4.1.10 Bogie static load testing machine with rails of suitable length for static testing of assembled bogie

**4.2 General M&P requirements:**

Below listed M&Ps has to be ensured after placement of purchase order and before start of prototype manufacturing.

4.2.1 Hydraulic press for straightening of components of maximum 20 mm thickness

4.2.2 Hydraulic press of minimum 40T capacity for fitment of rubber metal bonded items.

4.2.3 Fixtures for fabrication and machining of bogie frame & bogie bolster at different stages.

4.2.4 Level surface plate of size 4000 mm x 3500 mm

4.2.5 CNC machining facility for edge preparation/ beveling of components required for manufacturing of bogie frame and bogie bolster.

4.2.6 Minimum 3-Axis CNC Machining Centre with probing facility (for reference and inspection), minimum bed size 1.5 m x 3.5 m suitable for machining of bogie bolster and cross section in single setting. Machine should have 3-axis movement in X, Y, Z axis of milling head for drilling and facing. However, machining of bogie bolster and cross section can also be done on 5-Axis machining centre.

4.2.7 Degreasing/ De-rusting plant

4.2.8 Arrangement to check air leakage of dome cum air reservoir of suitable capacity as mentioned in FIAT bogie drawing

4.2.9 Test rig for air leakage testing of pneumatic piping

4.2.10 Induction heater

4.2.11 Anti roll bar assembly fixture

4.2.12 Lifting Tackle/ Chain Slings for handling of sub assemblies and complete FIAT bogie

4.2.13 Adequate MAG welding sets (400A or more)

4.2.14 Adjustable impact wrenches and torque wrenches

4.2.15 Welding gauges

4.2.16 Bore gauge for different holes in bogie frame, bogie bolster & cross section

4.2.17 Vernier height gauge

4.2.18 Digital surface roughness tester

4.2.19 Digital dry film thickness tester

4.2.20 Thread gauges

4.2.21 Non destructive testing (NDT) facility like MPI & DPT

4.2.22 Ultrasonic thickness tester for checking thickness of brake beam/tube/castings

**5 Chemical & physical testing:**

Firm shall have following infrastructure in-house or tie-up with NABL approved lab:

a) Spectro analysis facility to check chemical composition

b) Hardness testing machine.

c) Universal testing machine of 40T.

d) Impact testing machine

**6 Raw material:**

6.1 Steel plates to be procured duly ultrasonic tested as per "Level-B to ASTM-A578" and surface discontinuities not exceeding the limits as given in para 6.2.2 of EN 10163-3:2004 (E). The firm shall produce OEM test certificate for the same.

6.2 The chemical composition and mechanical properties of steel plates shall conform to DIN EN 10025-5-2004, S355J2W+N or as per latest applicable RCF's drawings. To avoid corrosion in FIAT bogie frame, use of specified material grade to be ensured strictly by firm.

6.3 The steel plates to correct chemical composition shall be procured from SAIL/TISCO or other reputed global and indigenous manufacturers along with their test certificates only after getting approval from CDE/RCF. These test certificates shall be co-related with the stamping on the plates to be taken up for manufacture prior to commencement of work.

6.4 Raw material/steel plates to be procured protected with linseed oil to IS:77 and have to store raw material in covered shed only.

6.5 Samples shall be drawn and tested both for chemical composition and physical properties in the presence of inspecting agency before taking the raw material for manufacturing.

6.6 All records of physical, chemical and impact tests shall be made available to inspecting agency. All plates to be taken up for manufacture shall be visually checked for surface defects such as cracks, dents, pitting, bend, rust, scales, etc. All plates shall be free from all before mentioned defects.

**7 Jig & Fixtures:**

7.1 The firm shall have at least following fixtures and manipulators for fabrication, machining and assembly of bogie:

a) Bogie Side frame tack welding.
b) Bogie side frame full welding fixture having rotating facility for down hand welding.
c) Brake Beam tacking & full welding
d) Bogie frame tacking, full welding, rectification.
e) Bogie frame machining fixture.
f) Bogie assembly fixture
g) Side Frame yaw damper bracket assembly fixture
h) Bogie bolster assembly fixtures
i) Bogie bolster machining fixture
j) Control arm assembly arrangement
k) CP pin assembly fixture (Bolster sub assembly)
l) Horizontal manipulator, Vertical manipulator for brake beam assembly
m) Robotic welding manipulator for bogie frames & bolsters

7.2 Jig & fixture of bogie must have stopper and locator to ensure position of members as per drawings of bogie.

7.3 Firm should incorporate locaters / dowel, reference points as per RCF's advices in the Jigs / Fixtures for bogie.

7.4 Stopper of jigs are to be replaced periodically to ensure accuracy of bogie.

7.5 Jigs and fixtures should be calibrated every ninth month with advance measuring instruments.

**8 Manufacture of bogie assembly**

**8.1 General practices:**

a) Tack welding of all sub-assemblies to be carried out by using calibrated jigs and fixtures.
b) All the plates shall be degreased and de-rusted before manufacturing operations
c) Visual inspection for surface imperfection of rolled plates is to be carried out and sheets/plates without surface imperfections should be used in manufacturing.
d) All the plates shall be carefully straightened in straightening machine Hammers should not be used for straightening.
e) All nicks/cuts on the plates during cutting shall be finish ground before using them for sub-assembly/assembly
f) Centre to be marked on jig and fixtures and this centre must match with centre of bogie components/bogie assembly.
g) Before laying the plates on jig/fixtures clean all surfaces for any weld spatters with brush

h) Welded components or members shall be correctly matched and accurately levelled and clearances shall be ensured to result in perfect welds.

i) The surfaces and edges to be welded shall be ground smooth, uniform and shall be free from cracks, undercuts, slag and other defects that would adversely affect quality and strength of the weld.

j) As far as possible, weld the straight portion and curved portion of parts /members by down hand MIG / MAG welding using welding manipulator.

k) The edge preparation shall be in accordance with relevant drawing /specification.

**8.2 Fabrication and major assemblies of bogie:**

8.2.1 Bogie consists of following major assemblies:

a) Bogie frame ( Firm has to ensure as per latest MDTS 213 )

b) Bogie Bolster (Firm has to ensure as per MDTS-204001 Rev. 01 or latest)

c) Wheel sets

d) Control arm assembly

e) Primary suspension (springs to be fitted as per drawing of primary suspension)

f) Secondary suspension

g) Earthing equipment assembly (EDTS -101, Rev-C, amendment -1 with corrigendum 1 to 6 or latest)

h) Anti roll bar assembly

i) Cross section

j) Traction lever Assembly

k) Air suspension and FIBA piping arrangement.

l) Assembly of other left out items

8.2.2 Fabrication of components shall be carried out as per latest drawings.

**8.3 Assembly of FIAT Bogie:-**

Following point to be given special attention while assembly of complete bogie:

a) Specified torque in assemblies shall be ensured by firm.

b) Assembly of components shall be carried as per drawing.

c) Leakage-free dome cum air reservoir must be again checked for any air leakage before complete assembly of bogie.

d) Primary springs: Ends of primary springs to be kept on centering disc as shown in primary suspension drawing. Coupling of springs is to be ensured as per RDSO specification no. RDSO/2017/CG-01 Rev. 02 or latest

e) Compensating rings as specified in drawing shall be added below primary bump stop to ensure specified gap between bump stop and bump-stop tube.

f) Static load Testing, pneumatic air leakage testing and final inspection :

g) Parameters mentioned in relevant suspension drawing to be checked and ensured during static testing of each FIAT bogie.

h) Air leakage testing of each piping arrangement of air brake, air suspension and FIBA to be checked for each bogie and no leakage to be ensured.

**9 Special manufacturing processes:**

**9.1 Cutting of plates / components:**

a) Plates shall be cut by CNC LASER/High Definition (HD) Plasma profile cutting machine.

b) Beveling/edge preparation for welding shall be carried out on CNC beveling machine or CNC 3-Axis machining center.

c) Suitable manufacturing allowances may be added in components during cutting so as to achieve specified dimensions after complete fabrication and machining.

**9.2 Welding:**

9.2.1 Robotic welding shall be used for welding of bogie frame and bogie bolster as far as possible.

9.2.2 Manual MAG welding may be done for the areas which are inaccessible.

**9.2.3 Welding consumables:**

a) Welding consumables should be procured with test certificate from the authorized distributor of RDSO approved sources / manufacturers only.

b) **Shielding Gas:** MAG welding process using mixture of 82% Argon and 18% $CO_2$ gas as shielding media shall be used.

c) **Filler Metal :** Filler material shall be used as per specification no. EN440-G3Si1

**9.2.4 Requirements of welding activities:**

a) **Welder qualification:** Welder qualified with ITI or equivalent qualification and certified as per EN-287 or ISO9606-1 or latest shall be only be employed for all critical joints and positions in fabrication of bogie. The welder shall reveal high standard of workmanship. However, if welders employed are qualified to any other international approved standard, prior approval of RCF is to be taken.

b) Supervisor shall have sufficient welding knowledge having minimum qualification of diploma in mechanical engineering. Firm shall identify and nominate a welding coordinator responsible for all welding operations. The welding coordinator should preferably have qualification as per ISO 14731 of IWE/IWT/IWS, diploma awarded by Indian Institute of Welding or certificate from WRI/Trichy or AWTI/ICF.

c) Inspection and testing personnel shall have certification as per ISO 9712 level-2 or ASNT-level 2.

d) All welding equipments should be calibrated as per ISO 17662/BS EN 50504.

e) The firm shall carry out welding activities as per Welding Procedure Specification (WPS) no. 22 026 Part doc 100 & 22.026e latest revision or firm shall take prior approval for any

deviation from CDE/RCF.

f) Record of above details shall be maintained for verification.

**9.2.5 Quality of weld joints:**

a) Quality of weld joint to be ensured to level-3 to SIG Spec No N 027 101e.

b) Weld joints shall have uniform beading and smooth change over from weld deposited to parent metal.

c) Weld joints shall be free from cracks, creates, under cuts, overlaps, porosity, inclusion, blow holes etc

**9.2.6 Inspection of Weld Quality:**

a) Dye penetration test shall be conducted on complete weld lengths to ensure absence of cracks, undercuts, blow holes, porosity etc and record shall be maintained. Acceptance standard shall be as per IS:3658.

**9.2.7 Rectification of weld defects:**

a) All linear discontinuities are unacceptable and shall be removed and repaired by chipping/grinding and subsequent welding. The area is to be re-examined by dye penetration test again to verify complete rectification of observed defect.

b) Further rectification shall not be allowed if linear discontinuity is observed again during checking after rectification.

c) A test reports shall be submitted for review to inspecting agency.

d) Approval from CDE/RCF to be obtained for rectification of non-conformance for RCF's orders only. Such rectified products to be identified separately during delivery.

e) Special process monitoring records to be maintained and submitted to CDE/RCF as required. Process parameters to be maintained as per validated special process.

**9.3 Stress relieving:**

9.3.1 After complete fabrication of complete bogie frame, stress relieving shall be carried out as per procedure laid down in latest revision of specification no. MDTS213.

9.3.2 To verify the stress relieving process of bogie frame, firm has to provide 40 mm x 40 mm additional piece (which will be integral piece of side frame bottom plate) as per sketch enclosed at Annexure-VI

**9.4 Shot blasting:**

a) Component level shot blasting to be ensured so that flawed material should be segregated at component level only.

b) The entire bogie frame, bogie bolster and all bogie components shall be shot blasted as per latest MDTS of bogie frame and bogie bolster.

**9.5 Painting:**

a) Surface protection of all bogie components and assemblies shall be as per MDTS-166 rev 02 or latest. Latest paint system/instruction to be followed to achieve better corrosion

resistance in Bogie Frame.

b) Firm has to ensure that first primer paint coat is applied within 30 minutes after shot blasting.

**9.6 Machining of bogie frame and bogie bolster:**

a) After stress relieving bogie frame is to be checked for proper machining margins and suitable rectification on surface plate, if any, is to be carried out before commencement of machining.

b) Machining of bogie frame and bogie bolster/cross section is to be done on 5-axis CNC machining center and 3-axis CNC machining as indicated in clause 4.1.5 and 4.2.6 respectively.

c) Bogie frame and bogie bolster/cross section shall be suitably fixed on machining center using proper fixture in such a way that machining shall be done in single setting in horizontal/vertical position to achieve the dimension tolerances and the surface roughness as per latest drawing.

d) Single setting, means that a particular reference is taken by probe and machining is completed according to that reference taken and the program fed without any change in bogie frame /bogie bolster position in machining fixture.

**9.7 Press fit for rubber bonded items:**

a) Rubber metal bonded items for Control Arm, Traction Centre, Traction Lever and Roll Link for LHB FIAT Bogie shall be assembled with respective parts as per relevant drawings and pressure to be ensured as mentioned in Letter No.MD44121, dated 07.11.2023.

b) Sleeves of different sizes must be prepared for pressing the rubber metal bonded item.

**9.8 Tightening of nuts & bolts (Torque):**

Following procedure may be followed for tightening of nuts and bolts to specified torques as per drawings:

a) Clean the internal threads of holes and Nuts/bolts to ensure all the threads are free from contamination/foreign objects/substances.

b) Examine the threads and check the components for any damage.

c) Threads of the bolts/Nuts shall be lubricated with Grease.

d) Hand tightens the Bolt/Nut by using the suitable sized spanners and preferred tool

e) Check for correct Torque values with reference to the size and type of Bolts/ Nuts as given in the drawings

f) Ensure the Torque wrench is within its calibration date. (Do not use tool without the label of QA department which refers the due calibration date)

g) Adjust the Torque wrench according to size of the Nuts/Bolts.

h) Tighten fastener to desired torque by smooth applying pressure to wrench handle until a click is felt or heard in the wrench. This is caused by wrench head pivoting as the desired

torque is reached (do not continue to apply force after desired torque is reached, as this may damage the wrench)

i) Check the bolt/nut to ensure it has been torque correctly. In case of Nylock nut, ensure the torque value in torque wrench is set as per the respective drawing, because the torque value cannot be reduced once tightened as Nylock nut cannot be loosen again

j) Uncovered bolts threads to be applied with antirust lubricant.

**10 Quality control requirements, inspection and testing:**

10.1 There shall be a system to ensure traceability of the product from raw material stage to finished product stage.

10.2 Quality Assurance Plan (QAP) shall be prepared covering minimum requirements as specified in Annexure-VII for ensuring the quality of product at every stage and shall be got approved from RDSO or CDE/RCF or nominated agency and subsequently ensured by the tenderer.

**10.3 Stage inspection:**

10.3.1 The stage inspection for following major sub-assemblies and other components/sub-assemblies at every stage of manufacturing shall be carried out by the supplier and records shall be made available to the inspecting agency.

a) Side frame

b) Brake beam assembly

c) Bogie bolster and its air leakage test

d) Bogie frame after final machining

e) Cross section

f) Anti roll bar assembly

g) Control arm assembly

h) Fitment of primary springs as per relevant drawing

10.3.2 To ensure that flawed material is segregated at component level only after shot blasting, 100% visual inspection of each component is to be carried out and record of same is to be maintained.

10.3.3 The purchaser/inspecting agency shall have access at all reasonable times to the works where bogie assembly is being manufactured and material is stored and shall have the right to inspect die, jig and fixtures and measuring instruments being used by the manufacturer. All the facilities, man power, appliances, gauges, measuring instruments necessary for testing and inspection shall be provided by the manufacturer free of cost.

**10.4 Final Inspection:**

10.4.1 Final inspection of bogie complete shall be carried out for dimensional details and other parameters as per drawing and specification.

**10.4.2 Static testing:**

a) Static testing of bogie complete shall be carried out as per bogie suspension diagrammatic arrangement. Firm shall ensure that all the dimension during testing conform to as specified

in the drawing.

**10.4.3 Air Leakage testing:**

a) Pneumatic piping for air spring and FIBA piping to be checked for air leakage as per requirements mentioned in latest revision of drawing/specification or work instruction issued by Planning/RCF

b) Brake piping shall be tested for air leakage as per drawing/specification or work instruction issued by Planning/RCF

**11 Procurement of major bought-outs**

11.1 All major bought out items appearing in RDSO/RCF's latest vendor directory shall be procured from regular approved sources mentioned in latest respective vendor directory on UVAM pre-inspected by inspection agency as mentioned in Annexure-III.

11.2 Other major bought out items mentioned in Annexure – IV which are not included in RCF/ RDSO vendor directory shall be procured only from regular sources of RCF ensuring the quality of product.

11.3 All high tensile fasteners as per latest applicable drawing to be procured from sources mentioned in RCF's bulletin No. RCF MECH SB-M/2021/1 Revision No. 2 issued vide Letter No. MD44121, Dated 07.03.2023 or latest

11.4 Brake beam and other two seamless tubes shall be procured from M/s ISMT, Pune or M/s Maharashtra Seamless Tubes Ltd, Mumbai or latest approved regular sources of RCF conforming to their respective drawings and spec. No. DIN 1630, St 52.4 & DIN 2448 (Annealed & oil/grease free), both ends smooth with N10 finish, cut rectangular to centre line to tube. Desirable straightness shall be 1:1000. Prior approval from CDE/RCF shall be taken for any deviation in these properties before commencement of manufacture.

11.5 Sealant / Greases as per given below details to be procured from RCF approved sources only:

a) BLASOL 135 or Stanvac Molytec EP-N

b) High Lube SW2 of Carl Bechem Lubricants (India) Or Synthox HS-NS non staining high speed synthetic grease of M/s Stanvac.

Sealant and grease to be applied on the areas as mentioned in working instructions issued by Planning/RCF.

11.6 Any other important/ safety items if not covered above, RCF reserves the right to advise the tenderer for procurement of such item/items and it will be binding on tenderer.

**12 Man power:**

12.1 Only qualified personnel as mentioned in para 9.2.4 shall be deployed. Supervisors with minimum qualification of diploma in mechanical engineering shall be deployed for monitoring of production and quality control.

**13 Documentation:**

**13.1 Following documentation should be supplied with each bogie to consignee:**

a) Traceability record of bought out /sub systems fitted in each bogie as per latest RCF's quality format QMF 9700. (Manufacturer may add more info in this format, if required).

b) Dimension control charts, chemical & mechanical properties test certificates, NDT reports, stage inspection reports and other related reports

**13.2 Following documentation should be maintained for at least 15 years:**

a) Incoming raw material register

b) Stage inspection results including finished products inspection by external agencies results as per QAP

c) Record of all bought out pertaining to bogie assemblies, record of internal rejection, analysis and corrective and preventive actions taken to eliminate such defects in future production plan

d) Record for stress relieving of bogie frame

e) Record for start and completion timings of shot blasting and primer painting so as to ensure for primer painting within specified timing i.e. 30 minutes

f) Self Inspection Performa (SIP) of bogie frame fabrication, bogie bolster fabrication, surface preparation, stress relieving, painting, assembly of bogie, static testing , pneumatic test leakage and final inspection to be maintained

g) Record of maintenance schedule of machinery & plant and inspection record of measuring instruments, templates, gauges, etc.

h) Calibration and maintenance record of each jigs and fixtures

i) Record of training, quality assurance, safety parameters etc.

**14 First Article Inspection (FAI)*:**

14.1 FAI will be done by CDE/RCF or its authorized agency for first time supply or new vendors or design change or material change or new processes involved in manufacturing or major design modification for RCF's orders only. Successful tenderer would be required to submit quality assurance plan (QAP) and all relevant documents required for FAI including special processes. First article inspection exclusively to be performed for special processes i.e. **Cutting**, **Welding, shot blasting, stress relieving, machining, painting, press fit for rubber bonded items and Tightening of nuts & bolts (Torque).**

14.2 FAI of complete bogie complete to be carried out after passing above special processes

14.3 External provider shall carryout FAI as per ISO/TS 22163:2017 requirement prior to submission of documents to RCF.

14.4 Validation of all special process (including outsourced Special Process) shall be carried out as per requirement of ISO/TS 22163:2017.

14.5 After passing above, the firm shall have to supply two prototype bogies complete (one coach set) for fitment trial and final approval from CDE/RCF before bulk supply is made for RCF's orders only.

14.6 Audit inspection shall be done by CDE/RCF or its authorized agency in the firm to certify quality of bogie complete during regular production.

14.7 Firm has to fulfill all the requirements of ISO/TS 22163:2017.

14.8 Firm has to display working instruction and manufacturing processes parameters at their firm premises.

14.9 (*) FAI or Prototype Inspection or Pilot sample inspection

**15 Identification marking:**

15.1 The manufacturer’s name or initial with month and year of manufacture, serial unique number, scope of work and purchase order number shall be marked in finished products unless otherwise specified in the relevant drawings.

**16 Packing instructions**

16.1 All machined surfaces shall be applied with suitable rust preventive, which shall prevent it from corrosion & oxidation for a minimum period of one year of storage

16.2 The supplier shall ensure the safe transit and delivery of bogie complete to the place as advised by RCF by adopting suitable mode of transport. Handling transit damage, if any, shall be the cost of supplier.

16.3 All the items of body-bogie connection including yaw dampers as per relevant drawing shall be supplied as loose items along with bogie complete.

16.4 The surface shall be properly protected against rubbing/impact/ scratches during transportation via wagon / truck / trailers by wooden blocks / rubber pads at suitable locations in the transportation fixtures.

16.5 Due care should be taken to avoid mechanical damage during loading / transit / unloading. The packing should be such that while unpacking the consignment at RCF there should be no damage / dent mark to the finished products. Recyclable material should be used in packing of sub-assemblies as far as possible.

16.6 Transit insurance shall be in the scope of supplier.

**17 Warranty**

The manufacturer shall warrant the bogie frame and bolster for a period of 84 months from the date of supply or 72 months from the date of service whichever is earlier, for material, manufacture and workmanship as regards trouble-free and satisfactory service performance. If any defects are noticed during service with regards to manufacture/welding quality of the bogie complete, action shall be taken by the supplier to carry out any repairs/rectification or replacement at firm's own cost. The decision of the purchaser in this regard shall be final.

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**Annexure-I**

## OPERATING AND SERVICE CONDITIONS

### LEADING PARTICULARS OF LHB COACH WITH FIAT BOGIES (FOR GUIDANCE ONLY).

The leading particulars of the stock shall be as follows :-

| | |
|---|---|
| Gauge | 1676mm |
| Length over body | 23540mm |
| Bogie wheel base | 2560mm |
| Bogie centre distance | 14900mm |
| Axle load capacity | 16.25 tonnes |
| Width over body side (Max.) | 3240mm |
| Height from rail to top of roof | 4039mm |
| Maximum service speed | 160 km/h on Rajdhani Track |
| Height of centre-line of coupler from rail-level under tare conditions | 1105+0 mm<br>-15 |
| Wheel diameter | New – 915mm<br>Worn – 845mm |
| Weight of Bogie | 6.65 T (approx.) |
| Type of Bearing at journal | Cartridge tapered roller bearing (CTRB) |
| Primary Suspension | Coil Spring |
| Secondary Suspension | Air springs |
| Axle Guidance | Control Arm Articulated |
| Service Braking | Axle Mounted Disc Brake |
| Dampers | Vertical – Primary, Secondary<br>Lateral – Secondary<br>Yaw – Secondary |
| Other Accessories | Anti roll Bar, Traction Lever Assembly, Longitudinal stop Assembly etc. |

Annexure-II

## Other Applicable specifications

| S No. | Specification No. | Description |
|---|---|---|
| 1. | MDTS-213 latest revision | Bogie frame Assembly |
| 2. | MDTS-204001 Rev. 01 or latest | Bogie Bolster for FIAT Bogie |
| 3. | EDTS -101, Rev-C, Amendment -1 with corrigendum 1 to 6 or latest) | Earthing equipment assembly |
| 5. | RDSO spec. C-K 407 Rev 04 or latest | Air Suspension Control Equipment for air spring assembly |
| 6 | RDSO spec. no. RDSO/CG/S 123002 Rev. Nil or latest | Air Spring for Secondary suspension |
| 7. | MDTS-241 latest revision | Control arm upper & lower left & right |
| 8. | MDTS 166 Rev 02 or latest | Surface protection primer & final paint |
| 9. | RDSO/2017/CG-01 Rev. 02 or latest | Helical Coil Springs |
| 10. | RDSO/CG-18005 Rev. 01 or latest | Dampers |
| 11. | DIN EN 10025-5-2004, S355J2W+N | Weathering Structural Steel |
| 12. | IS:1865 | SGCI casting |
| 13. | DIN17182 | Weldable Steel castings |

Other specification mentioned in drawings.

**ANNEXURE-III**

## 1. Major Bought out items as per RDSO vendor directory:

| S. No. | Description |
|---|---|
| 1. | Primary spring (Inner) |
| 2. | Primary spring (Outer) |
| 3. | Primary shock absorber |
| 4. | Secondary Vertical damper |
| 5. | Lateral damper |
| 6. | Yaw damper |
| 7. | Air Suspension Control Equipment for air spring assembly to RDSO specification no. C-K 407 Rev-04 or latest |
| 8. | Air Spring for Secondary suspension to RDSO specification no. RDSO/CG/S 123002 Rev. Nil or latest |

## 2. Major Bought out items as per RCF vendor directory:

| S. No. | Description |
|---|---|
| 1. | **Set of Rubber Metal Bonded items consisting of following:** |
| | 1.1 Axle box pivot bush to Drg No. 1247488 latest alteration |
| | 1.2 Ball Joint Roll Link to Drg No. C53 973 REB BRED 8416 latest revision |
| | 1.3 Lateral Bump Stop to Drg No. C53 973 REB BRED 8374 latest revision |
| | 1.4 Traction Center Elastic Joint to Drg No. C53 973 REF BRED 8397 latest revision |
| | 1.5 Ball Joint Traction Lever to Drg No. C53 973 REF BRED 8403 latest revision |
| | 1.6 Rubber Pad for Primary Suspension to Drg no. 1901097 ver 08 or latest |
| | 1.7 Rubber Pad for longitudinal bump stop to Drg No. C53 973 REB BRED 8370 latest revision |
| | 1.8 Primary Bump Stop to Drg No.1227081 latest revision |
| 2. | Anti roll bar |
| 3. | Anti roll bar Fork |
| 4. | Roll link |
| 5. | Traction Center |
| 6. | Control arm Top |
| 7. | Control arm Lower Left |
| 8. | Control arm Lower Right |
| 9. | Brake support |
| 10. | Spring pot |
| 11. | Earthing equipment to specification no. EDTS -101, Rev-C, amendment -1 with corrigendum 1 to 6 or latest |
| 12. | Bite type fitting |

**ANNEXURE-IV**

**Other important bought out items:**

| S No | Description |
|---|---|
| 1. | Control Arm Support Right |
| 2. | Control Arm Support Left |
| 3. | Yaw Damper Bracket |
| 4. | Pipes of pneumatic brakes as per relevant assembly drawing |
| 5. | Fixation Ball Joint |
| 6. | Bolt (For Primary Vertical Stop) |
| 7. | Locking Pin |
| 8. | Bump Stop Bracket |
| 9. | Anti Roll Bar Bracket |
| 10. | Pin Bracket |
| 11. | Anti Roll Bar Bracket |
| 12. | Bearing (GE70TXE-2LS or equivalent) |
| 13. | Traction Lever |
| 14. | Cross Section |
| 15. | Safety Wire Rope Assembly For IR Fiat Bogie |
| 16. | Security Plate For Antiroll Bar Arrangement |
| 17. | Axle End Cover |
| 18. | Curve Roll |
| 19. | Horizontal Damper Bracket |
| 20. | Dome cum air reservoir assembly |

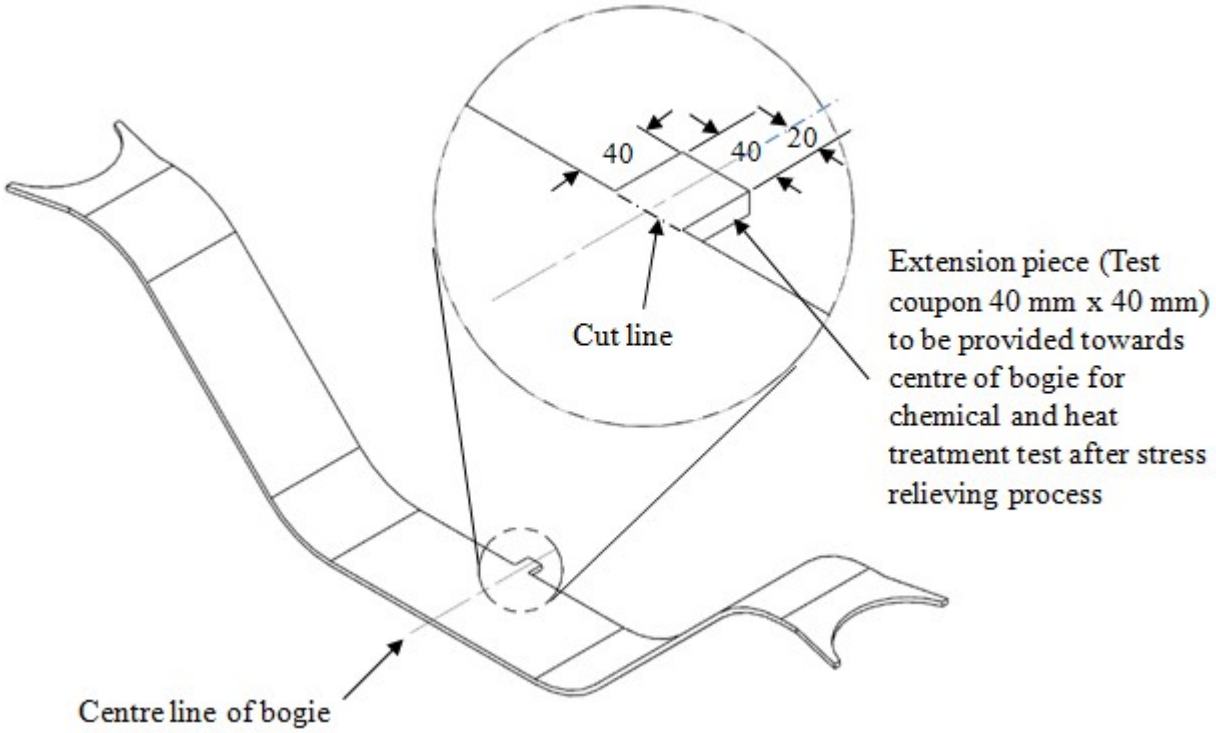
**Annexure-V**

**List of High Tensile Fasteners to be used on FIAT bogies:**

| S.N | PL. NO. | Description | Specification |
|---|---|---|---|
| 1 | 33670572 | HEX.HD.BOLT M16X70 | IS:1364-2002, PT-I, IS:1367-2002, PT-3, 10.9, CE, MDTS-057 |
| 2 | 33671310 | HEX.HD.BOLT M16X90 | |
| 3 | 33670640 | HEX.HD BOLT M20X100 | |
| 4 | 33670651 | HEX.HD.BOLT M24X150 | |
| 5 | 33670961 | HEX.HD BOLT M24X200 | |
| 6 | 33671357 | HEX HD BOLT M12X55 | |
| 7 | 33671175 | HEX.HD BOLT M12X100 | |
| 8 | 33670584 | HEX.HD BOLT M12X70 | |
| 9 | 33670559 | HEX.HD BOLT M16X65 | |
| 10 | 33670924 | HEX.HD BOLT M16X170 | |
| 11 | 33671345 | HEX HD BOLT M20X120 | |
| 12 | 33670614 | HEX.HD SCREW M16X120 | IS:1364-2002, PT-2, IS:1367-2002, PT-3, 10.9, CE, MDTS-057 |
| 13 | 33671308 | HEX.HD SCREW M16X100 | |
| 14 | 33670560 | HEX.HD SCREW M16X45 | |
| 15 | 33670948 | HEX.HD SCREW M16X60 | |
| 16 | 33670535 | HEX HD SCREW M10X25 | |
| 17 | 33670493 | HEX HD SCREW M10X16 | |
| 18 | 33670160 | HEX HD SCREW M24X100 | |
| 19 | 33670936 | HEX HD SCREW M10X30 | |
| 20 | 33670171 | HEX HD SCREW M16X50 | |
| 21 | 33670481 | HEX NUT M8 Prevailing Torque Type | DIN 6925, IS:1367-2002, PT-8, 10, A3B |
| 22 | 33670950 | HEX NUT M10 Prevailing Torque Type | |
| 23 | 33670470 | HEX NUT M12 Prevailing Torque Type | |
| 24 | 33670626 | HEX NUT M16 Prevailing Torque Type | |
| 25 | 33670500 | HEX NUT M20 Prevailing Torque Type | |
| 26 | 33670638 | HEX NUT M24 Prevailing Torque Type | |
| 27 | 33670511 | HEX NUT M30 | IS:1364-2002, PT-3, IS:1367-2002, PT-6, 10, MDTS-057 |
| 28 | 33670912 | HEX.SOCKET HD.CAP SCREW M12X45 | IS:2269-2006,IS:1367-2002, PT-3, 10.9, CE, MDTS-057 |
| 29 | 33670596 | HEX.SOCKET HD.CAP SCREW M8X25 | |
| 30 | 33670602 | HEX SOCKET HD CAP SCREW M12X60 | |
| 31 | 33671321 | HEX.SOCKET HD SCREW WITH FLAT POINT M12X25-45H | IS:6094-2006,PT-1, ISO 898, PT-5, MDTS-057 |
| 32 | 33672441 | HEX SOCKET COUNTER SUNK HD SCREW M8X70 | IS:6761-1994,12.9, MDTS-057 |
| 33 | --- | Hex. Head Screw For CTRB M20x60 Drg. no. CG-15067 | To be procured from sources mentioned in drawings |
| 34 | ---- | Hex. Head Bolt For Phonic Wheel Of CTRB M8x35 Drg. no. CG-15071 | |
| 35 | ---- | Hex. Head Screw For Earthing Device M8x30 Drg. no. CG-15070 | |
| 36 | 33670523 | HEX HD PLUG SCREW M22X1.5 | DIN 910, ST, IS:1367-02, PT-3, 10.9, A3C |

**Annexure-VI**

**Sketch for Extension Piece on Bottom plate of side frame**



## Annexure-VII

### Quality Assurance Plan (QAP)

**A. Jigs & fixtures:**

| S. No | Name of Process/Stage | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 1 | Tacking fixture, Welding fixtures, machining fixtures, assembly fixtures | All dimensions, finish as per drawings, | Measuring instruments, like Measuring Tape, Engineer Square, High Precision level instruments | 100% | As per drawings/specification | Calibration every nine month | Record to be maintained for every measurement taken, calibration carried out, corrective and preventive action taken. |
| | | Twist / Distortion | Visual, measuring instruments | 100% | No distortion/ twist in jigs/fixtures allowed | | |

**B. Raw material:**

| S. No | Name of Process | | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|---|
| 1 | Raw material inspection: plates, tubes | | Visual surface defects, distortion, pitting, linseed protection | Visual | 100% | Internal record, invoice, account of available stock & stock consumed | Communication with supplier, purchase orders (PO) details | Record to be maintained for every, sample taken, passed and rejected samples, corrective & preventive action taken. |
| | | | Rolling discontinuity / lamination | Ultrasonic Testing(UT) of plates/sheet | 100% | Level-B of ASTM-A578, Test certificates (TC) | Specific mention of UT tested plates/sheets/in PO | |
| | | | Material Dimensions | Manual, measuring instruments | 100% | As per drawing/ specification | Check po detail, MTC & calibration of instruments. | |
| | | | Chemical & mechanical properties | Lab testing, spectrometer, | 100% | As per specification | Check grade of mentioned in po, MTC & instrument calibration | |
| 2 | Welding consumables inspection | Shielding gas | Gas composition | Lab test certificates | 100% | As per specification | Correct composition of gas to be ordered, calibrated instruments | |
| | | Weld spool wire | Dimension, Material composition | Measuring instruments, lab test report | 100% | As per specification | Correct grade of material to be ordered, calibrated instruments | |
| 3 | Testing of Primers and Paint | | Test as per latest MDTS 166, | Test certificates | 100%` | As per specification | As per specification | |
| | | | Shelf life before use | Visual, Test certificates | 100% | Must have shelf life before application | FIFO to be followed | |

## C. Process/Stage inspection:

| S. No | Process | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 1 | Straightening of sheet/plates | Straightness, | Visual, Level Gauge, Hydraulic straightening machine | 100% | As per drawing/ specification | Roller load, handling of plates | Record to be maintained for every sample taken, passed and rejected samples, corrective & preventive action taken. |
| 2 | LASER cutting or high definition (HD) plasma cutting | Dimensions, Striations, Edge burr, roughness, burn | Manual, measuring instruments, | 100% | As per drawing | CNC Program, LASER parameters | |
| 3 | Bending of Bogie components | Dimensions, | Manual, , Vernier caliper, measuring tape, bevel protector, other measuring instruments/templates | 100% | As per drawing | CNC Program, spring back allowance | |
| 4 | Edge preparation | Dimension | Measuring instruments | 100% | As per drawing/specification | Angle of beveling tool, CNC parameters | |
| 5 | Shot blasting at component level | Surface finish, roughness | Visual, surface roughness Quality of sand / garnet, | 100% | Sa 2½ to latest ISO 8501-1 | Shot blasting duration. Shot size, shot speed | |

| S. No | Process | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 6 | Fabrication of bogie side frame/ bogie bolster/cross section | Dimensions /Tolerances of stage components | Measuring tapes, gauges, as per drawing | 100% | As per drawing/ specification | Control charts | |
| | | Welding parameters : current voltage, wire diameter, welding set, shielding gas flow rate | Visual, as per welding manual/procedures | 100% | As per welding manual/procedure | Certified & qualified welder to adjust the parameter, | |
| | | Fusion faces, Penetration joints | **Extension pieces (test coupons)** Visual, gauges | 2 pieces each for bogie frame, bogie bolster and cross section per bogie | Quality 3 of EN15050 | Certified & qualified welder, welding parameters, material composition | |
| | | Robot welding/MAG welding | Visual, program parameters | 100% | As per drawing/ specification | Welding procedure, weld speed, deposition rate | |
| | | Weld size | Weld gauges | 100% | As per drawing | Weld parameters / welders qualification | |
| | | Weld tensile strength, bend test | Measuring instruments, **test coupons,** as per drawing /specification | 2 pieces each for bogie frame, bogie bolster and cross section per bogie | As of sample taken as per specifications | Weld parameters / welders qualification | |
| | | Weld spatter, burn etc. | Visual | 100% | Nil spatter and burns allowed | Weld parameters / welders qualification | |
| | | Dye penetration check for weld | Manual, Dye penetration kit , as per specification | As per specification | Specification IS:3658 | Weld parameters / welders qualification | |

| S. No | Process | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 7 | Stress relieving of Bogie frame after fabrication | Furnace temperature, soaking temperature and duration | Visual, pyrometers, thermocouple, measuring instruments, **Extension piece(test coupon)** | 100% | As per drawing/ specification | Calibrated instruments, pyrometers, thermocouple, soaking duration as per specification | |
| 8 | Rectification of bogie frame after stress relieving /bogie bolster after fabrication | Dimensions, distortion, sufficient margins for machining | Visual, Measuring instruments | 100% | As per drawing / specification | Welding parameters, welding procedure, welding sequence | |
| 9 | Machining of Bogie frame | Machining in single setting on 5-axis machine Dimensions, machining margins | Visual, measuring instruments | 100% | As per drawing/specification | CNC machine settings, calibration of fixtures | |
| 10 | Machining of Bogie Bolster | Machining in single setting on 4-axis machine, Dimensions, machining margins | Visual, measuring instruments | 100% | As per drawing/specification | CNC machine settings, calibration of fixtures | |
| 11 | Shot blasting of assemblies | Masking of machined surfaces | Manual | 100% | As per drawing/specification | Masking of all machined surfaces to be ensured before shot blasting | |
| | | Surface finish, roughness | Visual, surface roughness Quality of sand / garnet, | 100.00% | Sa 2½ to latest ISO 8501-1 | Shot blasting duration. Shot size, shot speed | |

| S. No | Process | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 12 | Final Painting | Masking of machines surfaces | Visual | 100.00% | As per specification / drawing | Masking of all machined surfaces to be ensured before painting | |
| | | Base and hardener shelf life, proper mixing, rise of temperature during mixing, viscosity, pot life | Visual. Thermometer, watch, Viscometer | 100.00% | As per specification | As per specification | |
| | | DFT of anti corrosion epoxy primer coating, colour shade | Coating thickness gauge, colour shade cards | 100% | DFT and colour shade as per drawing/specification, | As per specification | |
| | | DFT of two component epoxy elastified paint, colour shade | Coating thickness gauge, colour shade cards | 100% | DFT and colour shade as per drawing/specification | As per specification | |

**D. Assembly inspection:**

| S. No | Process/ assembly | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 1 | Control arm and axle box pivot bush assembly | Dimensions /Tolerances of stage components and assembly | Measuring instruments, gauges, | 100% | As per drawing specification | Control charts | Record to be maintained for every sample taken, passed and rejected samples, corrective & preventive action taken. |
| | | Pressing force for axle box pivot bush | Measuring gauge | 100% | To be recorded and within range specified | Component dimensions to be verified, pressing speed | |
| | | Orientation of axle box pivot bush | Visual, measuring instruments | 100% | As per drawing | Fixture parameters | |
| 2 | Anti Roll bar assembly | Dimensions /Tolerances of stage components and assembly | Measuring instruments, gauges, | 100% | As per drawing/ specification | Control charts | |
| | | Pressing force for shrink fit of fork on antiroll bar | Measuring gauge | 100% | To be recorded and within range specified | Component dimensions to be verified, pressing speed | |
| | | Pressing force for Silent block in Roll link | Measuring gauge | 100% | To be recorded and within range specified | Component dimensions to be verified, pressing speed | |
| | | Free movement of bearing, | Manual | 100% | Must have free movement | Bearing unit's quality, Tolerances, allowances, surface finish. | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | Assembly of control arm with wheel set | Dimensions /Tolerances of stage components and assembly | Measuring instruments, gauges, | 100% | As per drawing /specification | Control charts | |
| | | Proper fit, torque for bolts, source of supply for bolts | Visual, torque wrench | 100% | As per drawing/specification | Dimensions of control arm, surface finish of machined surface, torque wrench, grade of bolts, source of supply for bolts | |
| 4. | Traction center, Traction lever | Dimensions /Tolerances of stage components and assembly | Measuring instruments, gauges, | 100% | As per drawing/specification | Control charts | |
| | | Proper fit, torque for bolts, source of supply for bolts | Visual, torque wrench | 100% | As per drawing/specification | Dimensions of traction center, levers, surface finish of machined surface, torque wrench, grade of bolts | |
| 5. | Secondary suspension assembly (Air spring) | Dimensions /Tolerances of stage components /assembly | Measuring instruments, gauges, | 100% | As per drawing/specification | Control charts | |
| | | Air leakage test of bogie bolster before assembly | Visual, test rig, soap solution | 100% | As per drawing/specification | Welding parameters for bogie bolster, bogie bolster machining | |
| | | Proper fit, torque for bolts, source of supply for bolts | Visual, torque wrench | 100% | As per drawing/specification | | |
| 6. | Primary suspension | Dimensions /Tolerances of stage components and assembly | Measuring instruments, gauges, | 100% | As per drawing/ specification | Control charts | |
| | | Orientation of spring/coupling on basis of L1 height | Visual, | 100% | Orientation of inner & outer spring ends as per drawings/RDSO specification | As per specification | |

**E. Final inspection:**

| S. No | Name of Process | Parameters for inspections | Mode of inspection/ Equipments Used | Sample Size and frequencies | Acceptance Limits/ Criteria/ Specified value | Corrective and Preventive Action | Traceability |
|---|---|---|---|---|---|---|---|
| 1. | Static load testing | All dimensions as per suspension diagrammatic arrangement, | Measuring instruments, | 100.00% | As per drawings | As per drawings | Record to be maintained for every sample taken, sample rejected & passed, corrective & preventive action taken |
| | | Air spring height adjustment | Manual, Measuring instruments, | 100% | As per drawing/specification | Leveling valve adjustment | |
| 2. | Air leakage testing of brake piping and air spring piping | Leakage, pressure drop as per specification | Manual, test rig, soap solution | 100% | As per drawing/specification | Fixing and mounting of air spring interfaces, bogie bolster machining | |
| 3. | Marking | Marking | Visual, | 100.00% | As per drawings/ Specification | As per drawings/ Specification | |