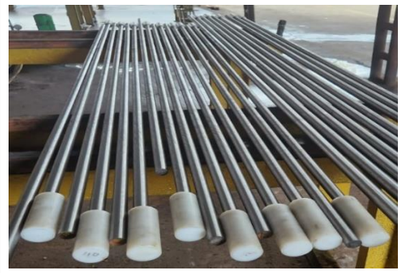
Final Reasoned Document on "Rev. 03 to Specification No. RDSO/2017/CG-01 Technical Specification for Hot Coiled Cylindrical Springs for use in Suspension of I.R. Coaches having FIAT & Trainset Design Bogies" (Based on technical discussion with firms at RDSO on Date 05.11.2024)

Para No.	Description of Para	Comments of ICF/Chennai	Comments of RSK/GWL	Comments of Southern Railway	Comments of M/s Frontier Springs	Comments of M/s G.B. Springs	Comments of M/s Abok Springs	Comments of M/s Chemin Springs	Comments of Sunflag Iron & Steel	Comments of Jyaswal Neco Industries	Remarks/Decision of RDSO
1.0	**PREAMBLE:** Indian Railways had entered into Transfer of Technology (TOT) agreement with M/s LHB, Germany for procurement of 24 numbers of all Stainless Steel Light Weight, High Speed Coaches suitable for operations at 160 kmph on existing Indian Railways track and upgradable to 200kmph. These coaches used FIAT design bogies which are provided with helical coil springs in primary and secondary suspension. ***This specification is developed for manufacturers of coil springs for FIAT Bogie & Vande Bharat Coaches. The specification may be altered or upgraded in future on the basis of experience gained.***									OK	In view of comments received, para is retained as it.
2.1.1	This specification is applicable for high performance cylindrical springs used in the suspension of IR coaches of LHB design having FIAT bogies, Vande Bharat Coaches and similar other applications. Described springs are manufactured out of circular section hot wound round bars.									OK	In view of comments received, para is retained as it.
2.1.2	Procurement of Spring Steel to be used in the manufacture of these springs shall be done only from reputed manufacturers approved by RDSO or any other agency nominated by the RDSO for the purpose.									OK	In view of comments received, para is retained as it.
2.1.3	Spring Steel bars duly inspected and passed by RDSO or any other agency nominated by the RDSO for the purpose shall be used for manufacture of springs.									Agreed	In view of comments received, para is retained as it.
2.1.4	The technical conditions for the delivery and supply of cylindrical springs shall be as follows: • As per special technical provisions as appear on the drawings. • As per technical provisions of this specification, in as much as these do not conflict with the special provisions mentioned in the drawings.									Agreed	In view of comments received, para is retained as it.
2.1.5	Following shall be applicable when this item appears in RDSO's vendor directory: "All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11, Version No. latest with title "Vendor-Changes in approved status" and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways."									Agreed	The para is re-examined and revised as follows: Following shall be applicable when this item appears in RDSO's vendor directory: "All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11, Version No. 2.7 (or latest) with title "Vendor-Changes in approved status" and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways."
2.1.6	The Government of India policy on 'Make in India' shall apply.									Agreed	In view of comments received, para is retained as it.
2.2	**List of Reference Specification:**									Agreed	In view of comments received, para is retained as it.
3.1	Depending upon their loading condition, springs have been divided into two categories shown in the Table below: **Category A**: Axial and transverse stiffness and/or bowing defined **Category B**: Only axial stiffness defined									Agreed	In view of comments received, para is retained as it.
4.1	**Choice:** The following grades of steel may be chosen for use by spring manufacturers: **Finished Bar Diameter 'd' (mm)** / **Material Grade** / **Norm No.** 25 mm to 65mm. / 52Cr Mo V4 / ISO 683 Part-14 Or EN10089 For rod diameter over 65 mm, the material must be explicitly stated on the drawing.									Agreed	The para is re-examined and revised as follows: For finished rod diameter 25-65mm, material shall be grade 52CrMoV4 to specification ISO 683 Part-14 or EN 10089. In case dia is out of this range, material must be stated in the relevant drawing.

4.2.1	Since the duty cycle of springs covered by this specification will be very tough, following restrictions are considered essential for the raw material composition: Maximum Sulphur (S) content - 0.015% by weight Maximum Phosphorous (P) content - 0.015% by weight For 52CrMoV4, Vanadium (V) content - 0.14 to 0.20% by weight For 52CrMoV4, Molybdenum (Mo) content - 0.20 to 0.30% by weight									Agreed	The para is re-examined and revised as follows: Maximum Sulphur (S) content - 0.010% by weight Maximum Phosphorous (P) content - 0.015% by weight For 52CrMoV4, Vanadium (V) content - 0.14 to 0.20% by weight For 52CrMoV4, Molybdenum (Mo) content - 0.20 to 0.30% by weight.
4.3	**Manufacture:**										
4.3.1	Steel shall be manufactured by Blast furnace/DR (Direct Reduction) followed by Basic Oxygen for primary steel making and secondary refining in ladle refining furnace/ladle furnace with vacuum degassing facility followed by continuous casting. Appropriate electromagnetic stirring to be used to ensure homogeneity in the material with reduced gas levels Nitrogen content 70.0 ppm (max.), Oxygen content 20.0 ppm (max.) and Hydrogen content 2.0 ppm (max.) in liquid steel. Steel manufacturers shall use Hydris and Cylox tubes in liquid stage to ensure specified contents of Hydrogen & Oxygen. Proper arrangement for this is to be done by manufactures in VD stage. For nitrogen content and confirmation of H2 & O2 content in liquid steel, vacuum tubes and spectrometry may be used. Suitable chilling media should be used to chill the samples taken in vacuum tubes. Any other method instead of vacuum degassing used during the secondary metallurgy process is also acceptable provided that it has not any negative influence on the final product.									Agreed	The para is re-examined and revised as follows: Steel shall be manufactured by Blast furnace/DR (Direct Reduction) followed by Basic Oxygen/EAF for primary steel making and secondary refining in ladle refining furnace/ladle furnace with vacuum degassing facility followed by continuous casting. Alternatively, steel manufacturing through EAF process is also permitted subject to input raw material shall have minimum 20% sponge iron/pig iron. This should be followed by secondary refining in ladle refining furnace/ladle furnace with vacuum degassing facility followed by continuous casting. Appropriate electromagnetic stirring to be used to ensure homogeneity in the material with reduced gas levels Nitrogen content 70.0 ppm (max.), Oxygen content 15 ppm (max.) and Hydrogen content 2.0 ppm (max.) in liquid steel. Steel manufacturers shall use Hydris and Cylox tubes to ensure specified contents of Hydrogen & Oxygen in liquid stage. Proper arrangement for this is to be done by manufactures in VD stage. For nitrogen content and additional test for confirmation of H2 & O2 content in liquid steel, vacuum tubes and spectrometry may be used. Suitable chilling media should be used to chill the samples taken in vacuum tubes. Any other method instead of vacuum degassing used during the secondary metallurgy process is also acceptable provided that it has not any negative influence on the final product. Proper record of above tests should be maintained for every heat produced and same shall be made available as when required by inspecting /RDSO officials.
4.3.2	All the Spring Steel bars/rods manufacturers shall have Integrated Steel Plant for manufacturing of Spring Steel (SS) Rounds used for manufacture of springs.										Deleted
4.4	**Marking on Billets:** Following information shall be hot stamped/pasted on stickers on one cross section of each billet by the steel manufacturer: • Code of the Steel manufacturer • Cast number • Month & Year • Size Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and "traceability.									Agreed	The para is re-examined and revised as follows: Following information shall be hot stamped/pasted on stickers on one cross section of each billet by the steel manufacturer: Grade Cast number Month & Year Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and "traceability
5.0	**BLACK BARS (AS ANNEALED):**									Agreed	In view of comments received, Heading of Para is retained a it.
5.1.1	The bars shall be manufactured by hot rolling process and the size of the ingots, billets or continuous cast billets (raw material) for any given size of bar shall be such that a minimum rolling reduction ratio of 16:1 from the minimum cross sectional area of the ingot or continuous cast billets to the maximum cross-sectional area of the product is ensured, to have freedom from "Primary" dendritic structure.									Agreed	In view of comments received, para is retained as it.

5.1.2	Spring steel rounds may be manufactured through Ingot-forging- rolling route also by maintaining minimum reduction ratio of 16:1. Hydrogen content shall be limited to 1.5 ppm (Max.) and nitrogen content shall be limited to 0.007% (Max.). In case of foreign manufacturer of springs, not having any RDSO approved vendor for raw material (Spring Steel Rounds) in the country in which springs are being manufactured, raw material shall be sourced from the sources approved in QAP only. Moreover, as Railway officials posted in foreign countries can also conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Agreed	In view of comments received, para is retained as it.
5.2.1.1	Visual checks should indicate that bars are smooth and free from distortion, twist, kinks and harmful defects namely seams, folds, laps, cracks, holes deep pits, grooves & excessive scaling which may lead to impairing of their serviceability.									Agreed	In view of comments received, para is retained as it.
5.2.1.2	The permissible depth of seams and laps in the bars shall not be more than 1% of the bar diameter or 0.3 mm whichever is less.									Agreed	In view of comments received, para is retained as it.
5.2.1.3	Auto MFL (Magna-flux Leakage) testing is an effective method for crack detection of bright bars (rods) whereas Magnetic Particle Testing (MPT) testing is a suitable for crack detection of black bars. Hence, Para is revised as follows: "Carry out Magnetic Particle Testing (MPT) testing on 100% annealed black bars to ensure surface completely free from cracks, seam, inclusions, lap, etc. For sub surface crack detection, Auto Ultrasonic Test (UT) on 100 % bars to be done. Test method and test infrastructure for Magnetic Particle Testing (MPT) and Auto UT should be as per applicable EN standard or any other equivalent standard. The Qualification of testing personnel shall be minimum level-II from ISNT/ASNT. Probing surface shall be from curved surface and not from the end surface. Black bars duly passed in Magnetic Particle Testing (MPT) and Auto UT shall only be supplied by bar manufacturers."									Agreed	The para is re-examined and revised as follows: Carry out Auto MFL (Magna-flux Leakage) testing and Auto Ultrasonic Test (UT) on 100% black bar before annealing and repeat Auto MFL (Magna-flux Leakage) testing and Auto Ultrasonic Test (UT) after annealing (if supplied as black bar) to ensure surface completely free from cracks, seam, inclusions, lap, etc. For sub surface crack detection. Test infrastructure for Auto MFL (Magna-flux Leakage) should be capable to detect surface cracks up to 0.3mm in black bar and Auto UT setting for at least 0.8X10mm SDH as per any applicable national/international standard. The Qualification of testing personnel shall be minimum level-II from ISNT/ASNT. Probing surface shall be from curved surface and not from the end surface. Black bars duly passed in Auto MFL (Magna-flux Leakage) and Auto UT shall only be supplied by bar manufacturers.
5.2.1.4	Auto MFL is replaced with MPT & Para is revised as follows: "Proper record of bars failed in Magnetic Particle Testing (MPT)/Auto UT and further disposal should be recorded."									Agreed	The para is re-examined and revised as follows: Proper record of bars failed in Auto MFL (Magna-flux Leakage)/Auto UT and further disposal should be recorded.
5.2.2	**Hardness:** Hardness of as annealed bars shall be 248 BHN (Max.) as per Table 6 of EN 10089 (latest).									Agreed	In view of comments received, para is retained as it.
5.2.3.1	Diameter of as annealed black bars shall be such that which enables reduction in its diameter after peeling and centerless grinding/polishing by at least 3% of nominal bar diameter or 1 mm whichever is more. For placing the purchase order for black bars, spring manufacturer should ensure proper allowance for above operations so that the finished diameter of rods must be as per Para 6.2.2.2.									Agreed	In view of comments received, para is retained as it.
5.2.3.2	Ovality of the bars should be controlled in such a manner so as to ensure minimum removal of the material by at least 3% of nominal bar diameter or 1 mm whichever is more.									Agreed	In view of comments received, para is retained as it.
5.2.4.2	**Microscopic:** • Entire cross-section should have even annealed structure with depth of rim decarburization not more than 0.4mm. • Average grain size of the bar shall be as per ASTM no.6 or finer. • In longitudinal section, non-metallic inclusion rating shall not be worse than 1.5 A, B, C, D for both thick and thin series when compared to the chart for determining the inclusion content of secondary refined steels (Fig.2) of IS:4163 (latest). Alternatively, non-metallic inclusion at every heat may be checked by the steel procedure in accordance to ASTM E45.									Agreed	The para is re-examined and revised as follows: • In longitudinal section, non-metallic inclusion rating shall not be worse than 1.0 A, B, C, D for thick and 1.5 A, B, C, D thin series when compared to the chart for determining the inclusion content of secondary refined steels (Fig.2) of IS:4163 (latest). Alternatively, non-metallic inclusion at every heat may be checked by the steel procedure in accordance to ASTM E45.
5.3	**Marking on Black Bars (As Annealed):** Following information shall be hot stamped/pasted on									Agreed	The para is re-examined and revised as follows:

	stickers at the one extreme end of each bars: • Name and trademark of the manufacturer • Type of steel • Smelt number • Nominal diameter • Nominal length • Year Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and traceability.										Following information shall be hot stamped/pasted on stickers at the one extreme end of each bars: • Code of the manufacturer • Smelt number • Nominal diameter • Nominal length • Month/Year Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and traceability.
6.0	**"RODS (PEELED, GROUND & POLISHED AS ANNEALED BARS):**									Agreed	In view of comments received, para is retained as it.
6.1.1	Rods (peeled, ground & polished as annealed bars) shall be manufactured out of bars described in Para 5 above.									Agreed	In view of comments received, para is retained as it.
6.1.5	Straightened and as annealed black bars shall be peeled, ground & polished to make rods used for manufacture of springs. Peeling and ~~grinding/~~polishing of as annealed black bars is mandatory requirement. As annealed black bars should be procured from raw material suppliers and should be ~~centerless ground~~/polished on ~~centerless grinding~~ polishing machine available with the spring manufacturers just before spring manufacturing. For any deviation, approval of RDSO must be taken with detailed technical justification.									Agreed	The Para is reviewed & revised as follows: Straightened and as annealed black bars shall be peeled, ground/polished to make rods used for manufacture of springs. Peeling and grinding/polishing of as annealed black bars is mandatory requirement. As annealed black bars should be procured from raw material suppliers and should be centerless ground/polished on centerless grinding/ polishing machine available with the spring manufacturers just before spring manufacturing. For any deviation, approval of RDSO must be taken with detailed technical justification.
6.2.1.1	On the surface, defects which can be seen by the naked eyes (e.g. cracks, wrinkling, longitudinal grooves, burned spots, tool marks & dent marks) or depressions from handling and transport are not permitted.									Agreed	In view of comments received, para is retained as it.
6.2.1.2	Carry out Auto MFL (Magna-flux Leakage) testing on 100% annealed rods to ensure surface completely free from cracks, seam, inclusions, lap, etc. For sub surface crack detection, Auto Ultrasonic Test (UT) on 100 % rods to be done. Test method and test infrastructure for Auto MFL and Auto UT should be as per applicable EN standard or any other equivalent standard. The Qualification of testing personnel shall be min level-II from ISNT/ASNT. Probing surface shall be from curved surface and not from the end surface. Rods duly passed in Auto MFL and Auto UT shall only be supplied by the manufacturers.									Agreed	The Para is reviewed & revised as follows: Carry out Magnetic Particle Testing (MPT) on 100% annealed rods to ensure surface completely free from cracks, seam, inclusions, lap, etc. For sub surface crack detection, Ultrasonic Test (UT) on 100 % rods to be done. Test method and test infrastructure for Magnetic Particle Testing (MPT) and UT should be as per applicable EN standard or any other equivalent standard. The Qualification of testing personnel shall be min level-II from ISNT/ASNT. Probing surface shall be from curved surface and not from the end surface. Rods duly passed in Magnetic Particle Testing (MPT) and UT shall only be supplied by the manufacturers.
6.2.1.3	Proper record of rods failed in Auto MFL/UT and further disposal should be recorded.									Agreed	The Para is reviewed & revised as follows: Proper record of rods failed in Magnetic Particle Testing (MPT) /UT and further disposal should be recorded.
6.2.1.4	The surface quality of the rod shall be as per Clause 5.3.2.1 of EN 13298. The maximum R_a value of the surface of the bar before coiling shall not exceed 2.5 µm.									Agreed	In view of comments received, para is retained as it.
6.2.2.1	The limit for out of straightness of rods shall be within 1mm/m length maximum.									Agreed	In view of comments received, para is retained as it.
6.2.2.2	The diameter of straight rods must be within the following limits: **Diameter of Rods in mm** / **Tolerance in mm** 18 - 30 / ± 0.105 30 - 50 / ± 0.125 50 - 80 / ± 0.150									Agreed	In view of comments received, para is retained as it.
6.3	**CORROSION PROTECTION OF BARS/RODS:**										In view of no comments received, para is retained as it.
6.3.1	A thin corrosion protection layer shall be provided on the bars/rods before dispatch. Corrosion protection of the bars/rods shall be as per Clause 3.0 of ICF/MD/Spec-155 issue 01, Rev.01 (or latest). The bars/rods shall be coated with Lacquer, cellulose, pigmented, finishing, glossy to IS:5691-1970 (or latest) to a Dry Film Thickness of 3-5 microns. After the application, coating is dried up, bio-degradable material shall be used for packing. If any plastic material is used for packing, necessary government									Agreed	In view of comments received, para is retained as it.

	guidelines should be followed.										
6.3.2	Corrosion protection shall be adequate to last for period of two months under storage in covered place. This shall not be in the form of oil/grease to prevent rods slippage during end tapering operation. The chemical used be such as to burn off or vaporize during heating at a temperature of 150 ^{0}C & above leaving no residue. To avoid metal to metal contact, plastic caps shall be provided on each bars/rods as shown in Figure below: 								Sunflag will use plastic spiral rings for 25 mm to 40 mm dia. Above 40 mm diameter we will use plastic caps made of teflon or plastic material.	Agreed	The comments of M/s Sunflag Iron & Steel are acceptable and para is revised as follows: Corrosion protection shall be adequate to last for period of two months under storage in covered place. This shall not be in the form of oil/grease to prevent rods slippage during end tapering operation. The chemical used be such as to burn off or vaporize during heating at a temperature of 150 ^{0}C & above leaving no residue. To avoid metal to metal contact, plastic spiral rings (for 25 mm to 40 mm rod dia.) and plastic caps (above 40 mm rod dia.) shall be provided on each bars/rods as shown in Figure below: 
6.3.3	Sample check of bars/rods should be carried out for checking of rusting and straightness of bars/rods before manufacturing process. The stacking of bars/rods may be done according to the production schedule. The long storage of bars/rods should be avoided as it leads to loss of straightness and initiation of rusting.									Agreed	In view of comments received, para is retained as it.
6.4	**PACKAGING & TRANSPORTATION OF BARS/RODS:** The bars/rods are very sensitive item and need to be packed and transported very carefully. The following guidelines to be followed while packaging & transportation of bars/rods:									Agreed	In view of comments received, para is retained as it.
6.4.1	Spread the bars/rods on the inspection table before packaging & transportation. Check for any process defects in the bars/rods like lobbing, pitting, bend, tool marks, scratch lines, chips or dent marks etc. and segregate them with proper identification. If the segregated defective bars/rods are in recovery condition, recover them by passing through centerless grinding or cutting operations. Ensure that bars/rods ends are free from burrs.									Agreed	In view of comments received, para is retained as it.
6.4.2.	Ensure proper coating of corrosion protection layer on full face of bars/rods as per Para 6.3 of this specification.								Okay, Sunflag will apply the dipping method for oil application.	Agreed	In view of comments received, para is retained as it.

6.4.3	Weigh the bundles and identify them with tags detailing size, grade, length, heat no., P.O. no., weight etc. Bundle weight should be approximate in between 1200 Kg to 1300 Kg. Pack the bars/rods in the bundle so that bars/rods are in the center of the bundle as shown in the figure.   Put at least four straps on the bundle with strapping clips. Put two straps each at approximately 600 mm from the end of both sides of bundle. The other two straps shall be placed by proper spacing from the end straps. Tight the straps by a manual/pneumatic tensioner and tight the clip to clamp the bundle.									Agreed	In view of comments received, para is retained as it.
6.4.4	Tie the Tag on the Tag Wire and ensure that the following: • Colour Code is matching with bundle. • Heat No. is matching with bundle. Stamping details of bars/rods are matching with Tag details (Heat No., Grade & Size).									Agreed	In view of comments received, para is retained as it.
6.4.5	Insert the Hollow Polyurethane tube to cover the entire bundle so that moisture should not enter inside the packed bundle. Thereafter, wrap with HDPE cloth and strap with steel straps on 5 locations for 6-meter material.  									Agreed	In view of comments received, para is retained as it.
6.4.6	Weigh the bundles and identify them with tags detailing the size, grade, length, heat no., P.O. no., weight etc. record the readings in the Internal inspection format/job card with the details of P.O. no., heat no., grade, quantity etc. Stack the packed bundles (prime & reject) in the designated location and handover to Logistic for dispatch. Non-conforming bars/rods, if any generated during the operation shall be kept separately with identification.  Any other packing arrangement of bars/rods better than above may be approved by RDSO depending on case to case basis.									Agreed	In view of comments received, para is retained as it.
6.4.7	Any other precaution in packing as may be deemed fit for safe transportation shall be taken by the bars/rods suppliers to avoid damage during transportation.									Agreed	In view of comments received, para is retained as it.
7.1.1	**Environment Condition:** Range of environmental temperature: -10 ^{0}C to + 50 ^{0}C (average + 35 ^{0}C) Parking temperature: 70 ^{0}C Humidity range: up to 100% (for max. 5 months) Rainfall: up to 2500 mm, very heavy and continuous Maximum altitude: up to 1000 m (salty environment) Shock and vibrations: Extremely dusty, humid and salty along-with industrial pollutants									Agreed	In view of comments received, para is retained as it.

<table>
<tr><td>7.1.1.2</td><td>The coil springs shall function in accordance with this specification when subjected continuously to an atmosphere containing dust in concentration up to 1.6 mg/m^3.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Not applicable</td><td rowspan="4">In view of comments received, para is retained as it.</td></tr>
<tr><td>7.1.1.3</td><td>The coil springs shall function in accordance with this specification when subjected continuously to a humid and salt laden atmosphere with maximum pH value of 8.5, sulphate content of 7 mg per litre, maximum concentration of chlorine 6 mg per litres and maximum conductivity of 130 micro Siemens/cm.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Not applicable</td></tr>
<tr><td>7.1.1.4</td><td>The coil springs shall function in accordance with this specification when subjected to high wind in certain areas with wind pressure reaching 150 kg/m^2.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Not applicable</td></tr>
<tr><td>7.1.1.5</td><td>The coil springs shall function in accordance with this specification when exposed to solar radiation in the range from 0 Kw/m^2 to 1 Kw/m^2.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Not applicable</td></tr>
<tr><td>7.1.2</td><td>Manufacturing Sequence of Springs:

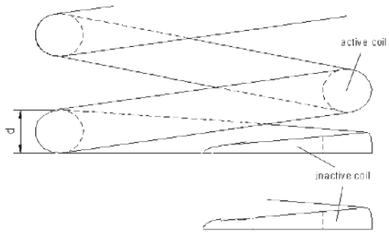
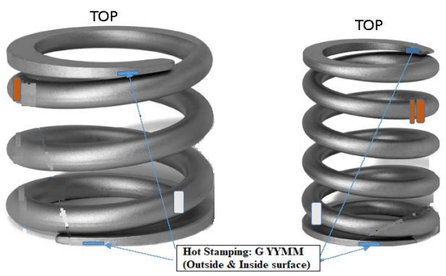
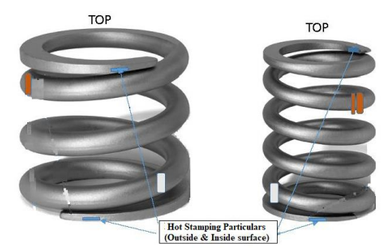
Manufacturing sequence shall include the following operations, in order given below:

<table><tr><th>S. No.</th><th>Process</th></tr><tr><td>1.</td><td>*Formation of ends & Stamping</td></tr><tr><td>2.</td><td>Hot coiling</td></tr><tr><td>3.</td><td>Quenching</td></tr><tr><td>4.</td><td>Tempering</td></tr><tr><td>5.</td><td>Scragging</td></tr><tr><td>6.</td><td>End grinding</td></tr><tr><td>7.</td><td>Cleaning/sand blasting</td></tr><tr><td>8.</td><td>Crack Testing (Magnetic Particle Testing)</td></tr><tr><td>9.</td><td>Shot Peening</td></tr><tr><td>10.</td><td>Crack Testing (Magnetic Particle Testing)</td></tr><tr><td>11.</td><td>Phosphating</td></tr><tr><td>12.</td><td>Load-Deflection Testing & Marking</td></tr><tr><td>13.</td><td>Painting</td></tr><tr><td>14.</td><td>Load-Deflection Testing (if required) & Marking</td></tr><tr><td>15.</td><td>Colour Coding & Packing</td></tr></table>*Formation of ends & Stamping:

Alternate method apart from mentioned in the specification for end formation & marking/stamping may also be accepted subject to prior approval of Jt. Director/Director, Carriage Directorate, RDSO.</td><td></td><td></td><td></td><td>Manufacturing sequence shall include the following operations, in order given below:

1. *Formation of ends & Stamping
2. Hot coiling
3. Quenching
4. Tempering
5. Scragging
6. End grinding
7. Cleaning
8. Shot Peening
9. Crack Testing (Magnetic Particle Testing)
10. Load Load-Deflection Testing & Marking
11. Phosphating
12. Painting
13. Load Load-Deflection Testing (if required) & Marking
14. Colour Coding & Packing</td><td></td><td></td><td></td><td></td><td>Not applicable</td><td>The comments of Frontier Springs are not acceptable as during shot peening process, compressive stresses are developed on the outermost surfaces of the coil springs, making it more difficult to identify cracks afterward. Moreover, OEMs (M/s Grueber & M/s Axtone) have also recommended for performing Magnetic Particle Inspection (MPI) before the shot peening operation. Hence, as a quality control measure, para is retained as it.</td></tr>
<tr><td>7.2</td><td><u>Formation of Ends</u>:</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Not applicable</td><td>In view of comments received, para is retained as it.</td></tr>
<tr><td>7.2.3</td><td>“Proper care should be taken during the formation of ends of the springs. Correct ends formation shall be ensured as shown in Figure below:

  </td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>In view of no comments received, para is retained as it.</td></tr>
<tr><td>7.2.4</td><td>To avoid spring end biting on first active coil at exactly 1.0 turn, 02 steps ends tapering process may be adopted.</td><td></td><td></td><td></td><td></td><td></td><td></td><td>There is no description given about the term “02 steps end tapering process”. Please elaborate the term.</td><td></td><td>Not applicable</td><td>The comments of Chemin Springs are acceptable and para is revised as follows:
“To avoid spring end biting on first active coil at exactly 1.0 turn, sharp corners at the taper ends should be avoided. The tips should be smooth, uniform in thickness & rounded at the ends as shown in Figure below:</td></tr>
</table>

											
7.3.1	The ends of rods (Para 7.2) shall be heated in an electric, oiled or LPG fired indirect heating furnace which are equipped with temperature controller and recorders. Temperature to which these ends shall be heated should be predetermined according to composition of the material. The stamping operation must be completed before 850 ^{0}C. Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for bars and springs.			.						Not applicable	In view of no comments received, para is retained as it.
7.3.2	After the ends have attained desired temperature, following particulars shall be legibly hot stamped on both tapered ends (outer & inner side) in serial order. ** *** **** **** **Manufacturer's Code** **Month & Year of Production** **Drawing Code** **Heat Code (in three letters/ digits)** **Raw Material Supplier's Code (in two digits)** e.g. - - - MMYY - - - **- - -** **- -** The location of stamping particulars on springs must be in the middle of the dead-end coils as shown in figure below, so that the chances of initiation of fatigue do not occur. The material code shall be legibly hot stamped on both tapered ends of each spring in such a way that the particulars are visible on the outer & inner surface of the ineffective coils and they do not get erased during end grinding or interfere with the performance of the spring. For drawing codes of springs Annexure-I may be referred.  Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and traceability.	Material code has been removed and RM suppliers code (in two digits) has been added. This is acceptable and may be incorporated in the specification. Accordingly, code for RM suppliers may please be added in the specification.				Clause No. 7.3.2, We should either punch heat number / code or raw material supplier code; I mean both are not needed as there is complete traceability at our end with either information to the vendor with heat number or to heat number with raw material supplier code.		The Drawing code shall be legibly hot stamped on both tapered ends of each spring in such a way that the particulars are visible on the outer & inner surface of the ineffective coils and they do not get erased during end grinding or interfere with the performance of the spring. For drawing codes of springs Annexure-I may be referred		Not applicable	1. The comments of ICF & GB Springs are not acceptable as codes for Raw Material suppliers listed in RDSO Vendor Directory have already been decided and advised to spring manufacturers vide letter No. SV. FIAT Spring dated 13.11.2023. If vendor codes are added in specification and some new vendors are included in RDSO vendor directory, then it will require revision in specification. 2. The comments of Chemin Springs are acceptable and para is revised as follows: "After the ends have attained desired temperature, following particulars shall be legibly hot stamped on both tapered ends (outer & inner side) in serial order. ** *** **** **** **Manufacturer's Code** **Month & Year of Production** **Drawing Code** **Heat Code (in three letters/ digits)** **Raw Material Supplier's Code (in two digits)** e.g. - - - MMYY - - - **- - -** **- -** The location of stamping particulars on springs must be in the middle of the dead-end coils as shown in figure below, so that the chances of initiation of fatigue do not occur. The stamping particulars shall be legibly hot stamped on both tapered ends of each spring in such a way that the particulars are visible on the outer & inner surface of the ineffective coils and they do not get erased during end grinding or interfere with the performance of the spring. For drawing codes of springs Annexure-I may be referred.  Any deviation or exception from above may be

											accepted if vendor establishes alternate method will not have any negative implication on quality and traceability."
7.4.7	During hot coiling process, temperatures in different chambers and soaking time for different types of coil springs should be digitally displayed on furnace along-with rod diameter automatically.				During hot coiling process. temperatures in different chambers displayed on furnace automatically. Rod diameter and soaking time for different types of coil springs displayed on board due to continuous heat treatment and coiling process.					Not applicable	The comments of Frontier Springs are in line with the relevant para. Hence, para is retained as it.
7.5.1	Temperature of the coiled spring just after coiling and before quenching should be 830 ^{0}C - 860 ^{0}C. With minimum time lag, coiled rods (called springs) as per Para 7.4 shall be oil quenched in a suitable quenching medium. The temperature of which is maintained within 40 ^{0}C - 70 ^{0}C in order to ensure optimum quenching conditions. Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for bars and springs.									Not applicable	In view of no comments received, para is retained as it.
7.5.2	The quenching oil shall be kept at constant temperature range of 40 ^{0}C - 70 ^{0}C. The content of the quenching pool shall be adequately dimensioned with minimum 20,000 liters of quenching oil and should be checked regularly for water and dirt content and filter it by centrifuge etc. and top up by fresh oil, if required. Record for the same checking shall be kept ready. The properties of quenching oil i.e. appearance, density, kinematic viscosity, flash point, cooling rate etc. should also be checked regularly.									Not applicable	In view of no comments received, para is retained as it.
7.5.3	After quenching operation, tempering of springs shall be done in a continuous conveyor type tempering furnace. For producing required level of temper and hardness, springs shall be heated to pre-determined temperature range for sufficient length of time. The temperature of the spring just before entering the tempering furnace should be 80 ^{0}C – 120 ^{0}C. Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for bars and springs.								OK	Not applicable	In view of no comments received, para is retained as it.
7.5.4	Furnace used for tempering shall be electric, oil or LPG fired indirect heating type equipped with independent pyrometer for each zone to control temperature within ± 10 ^{0}C. The tempering should be done in temperature range of 400 ^{0}C - 500 ^{0}C. Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for bars and springs. During tempering process, temperatures in different chambers and soaking time for different types of coil springs should be digitally displayed on furnace along-with rod diameter automatically.				During hot coiling process, temperatures in different chambers displayed on furnace automatically. Rod diameter and soaking time for different types of coil springs displayed on board due to continuous heat treatment.	The word approximate be added with the 400 C° - 500 C°.				Not applicable	The comments of Frontier Springs are not understood. The comments of GB Springs are not technically acceptable. Hence, para is retained as it.
7.5.5	Since the heat treatment is carried out with the aim to achieve a homogenous fine grain structure, the tempered martensitic distribution across the complete cross-section of the active coil should be as under for various steel materials. The tempered martensitic distribution across the complete cross-section of the active coil should be uniformly distributed and hardness difference from core to surface should not be more than 20 BHN. The hardness shall be as per ISO 683-14 or EN 10089 (latest). The values for the surface hardness shall be between 419 - 486 BHN**. ** *Conversion of hardness from HRC to BHN is taken from conversion table.*									Not applicable	In view of no comments received, para is retained as it.
7.5.6	Springs should be water cooled after tempering to approximately 100 ^{0}C. Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for bars and springs.									Not applicable	In view of no comments received, para is retained as it.
7.6.1	Each and every spring shall be hot scragged three times in quick succession. Scragging load/height should be as laid down in the drawing. In case there is no indication in the									Not applicable	In view of no comments received, para is retained as it.

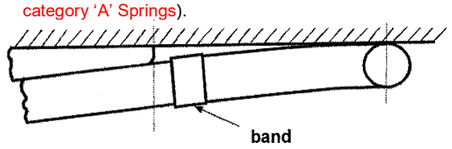
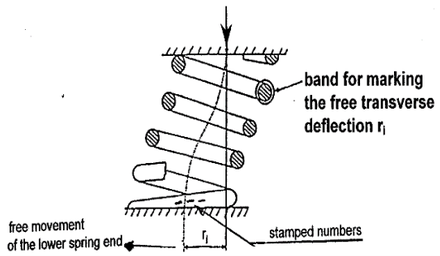
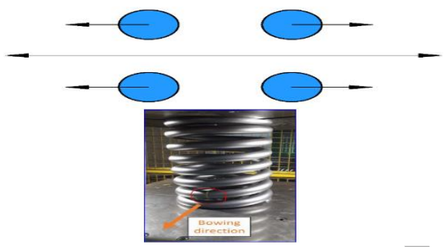
	drawing, the springs shall be scragged home. The scragging load in such cases should not exceed 1.5 times the theoretical axial load, corresponding to home length. The hot scragging temperature should be more than 90 ^{0}C.										
7.6.2	Long duration scragging is to be introduced as a process check at regular intervals and necessary documents of the test results are to be maintained. For long duration scragging, the spring shall be compressed three times, holding it at the home load for two minutes in the first two strokes and for 48 hours at the last stroke.									Not applicable	In view of no comments received, para is retained as it.
7.6.3	The scragged spring should not show further permanent set on subsequent loading.									Not applicable	In view of no comments received, para is retained as it.
7.6.4	Permanent set shall not exceed 2 mm of free height of primary spring, which is measured before scragging. Similarly, permanent set shall not exceed 3.5 mm of free height of secondary spring, which is measured before scragging.				Permanent set shall not exceed 2 mm of tree height of primary Scragging spring, which is measured after one stroke scragging. Similarly, permanent set shall not exceed 3.5 mm of free height of secondary Scragging spring, which is measured after one stroke scragging.					Not applicable	The comments of Frontier Springs are not acceptable and as a quality control measure, para is retained as it.
7.7.2	The springs shall be grounded on automated grinding machine in enclosed chamber with effective cooling system. It is important that cooling during the grinding process is carried out flawlessly. Tip cutting should never be done as it will reduce the number of coils. End grinding machine fixture to hold coil spring should be checked daily with right angle. End grinding machine should be equipped with adequate coolant facility, controlled speed, feed rate, concentration etc. to prevent burning of end coils during grinding. The details of equipment used to check the temperature, quantity, frequency & feed rate of coolant etc. should be shown to inspection authority during inspection.									Not applicable	In view of no comments received, para is retained as it.
7.7.4	End grinding feed rate shall be decided on the basis of mean coil diameters & rod diameters of coil springs. Chart for deciding the feed rate should be displayed and shown to the inspection authority during inspection.									Not applicable	In view of no comments received, para is retained as it.
7.9.1	Before shot peening process, all springs should be thoroughly cleaned followed by Magnetic Particle Testing (MPT) process. ~~All~~ The springs shall be shot peened in a continuous type shot peening machine, preferably with self-sieving arrangement in accordance with EN 13298 Annex C to improve fatigue life of the spring. During shot peening, it should be ensured that the springs are shot peened uniformly over the entire area of the springs. The intensity and coverage should be checked with the help of Almen strip in accordance with EN 13298 Annex C. Almen Intensity should be checked minimum two times per shift of production. The minimum coverage (When checked visually) should be 90% and intensity when checked with Almen strip Type - A in accordance with EN 13298 Annex C should be between 0.4 mm and 0.6 mm.	One shot blasting operation before MPI test to remove iron scales and dirts. One shot peening operation just before phosphating is essential to increase fatigue life of spring. Axtone, Poland and Grueber, Germany are following operation sequence with one shot blasting before MPI (EMCD0 test and one shot peening just before phosphating operation. (for Axtone FAI of VB primary spring enclosed. From Grueber, affirmation was obtained through direct interaction on 12.10.2023 during their visit at ICF). This subject was discussed at RDSO meeting on 20.06.2023. Meeting minutes enclosed (Point No. 5).								Not applicable	The comments of ICF are acceptable and para is revised a follows: "Before shot peening process, all springs should be thoroughly cleaned/shot blasted followed by Magnetic Particle Testing (MPT) process. The springs shall be shot peened in a continuous type shot peening machine, preferably with self-sieving arrangement in accordance with EN 13298 Annex C to improve fatigue life of the spring. During shot peening, it should be ensured that the springs are shot peened uniformly over the entire area of the springs. The intensity and coverage should be checked with the help of Almen strip in accordance with EN 13298 Annex C. Almen Intensity should be checked minimum two times per shift of production. The minimum coverage (When checked visually) should be 90% and intensity when checked with Almen strip Type - A in accordance with EN 13298 Annex C should be between 0.4 mm and 0.6 mm."

<table>
<tr>
<td>7.9.1.2</td>
<td>The number of samples to be mounted on the “sample carrying spring” depends on the free length (L_o) of the spring and shall be as follows:
<table><tr><th>Free length (L_o) of the Spring</th><th>Nos. of Almen test samples & Locations</th></tr><tr><td>$L_o \geq 500$ mm</td><td>6 samples to be mounted, 3 on the inside of the spring, the 3 remaining samples on the outside of the spring, the samples shall be located at the two ends and in the middle section of the spring.</td></tr><tr><td>$500 > L_o \geq 300$</td><td>4 samples to be mounted, 2 on the inside of the spring, the 2 remaining samples on the outside of the spring, the samples shall be located at the two ends of the spring.</td></tr><tr><td>$L_o < 300$ mm</td><td>2 samples to be mounted, 1 on the inside of the spring, the other one sample on the outside of the spring, the samples shall be located in the middle section of the spring.</td></tr></table></td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.9.1.3</td>
<td>To ensure effective shot peening on more critical inside of the spring, the mounting locations of 4 Almen strip holders shall be, 2 on bottom inside & outside and remaining 2 on top inside & outside of the springs. The Almen strip holder shall be fixed between in-active coil and first active coil at approx. 0.1 turn from the end tip of the spring.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.9.1.5</td>
<td>Speed chart of rotational speed and linear movement of coil spring based on wire diameter, mean coil diameter and other relevant parameters for shot peening operation should be displayed.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.9.3.1</td>
<td>After phosphate treatment, all the springs shall be painted as per RDSO Specification No. M&C/PCN/132/2021 (latest) for Painting of Helical Coil Springs of LHB Coaches and Similar Applications (Single Pack).</td>
<td></td><td></td><td></td><td></td><td>Alternate to painting powder coating should be permitted the process is as under: (letter enclosed).</td><td></td><td></td><td></td>
<td></td>
<td>The comments of GB Springs are not acceptable as in powder coating, entire spring must be brought near to melting temperature of powder coating. It is energy intensive & sensitive to temperature & humidity. Grueber had recommended high perform dip varnish. Further M&C Directorate/RDSO has issued a new Paint Specification No. M&C/PCN/132/2021 for painting of helical coil springs of LHB coaches and similar applications (single pack), which is already being followed at RSK & ICF. Hence para is retained as it. Moreover, alternate painting scheme has also been permitted in RDSO Specification No. RDSO/2017/CG-01 with some test requirements.</td>
</tr>
</table>

<table>
<tr>
<td>7.9.3.2</td>
<td>Any other proven painting scheme, may also be permitted with approval by RDSO, depending on case to case basis subject to complying at least the following tests requirements:

<table>
<tr><th>S. No.</th><th>Tests</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Resistance to Salt Spray Test (1000 hours) according to EN ISO 9227</td><td>No rusting, cracking, flaking, blistering & corrosion</td></tr>
<tr><td>2.</td><td>Evaluation of Degree of Rusting according to EN ISO 4628-3</td><td>Ri1 or better</td></tr>
<tr><td>3.</td><td>Evaluation of Degree of Cracking according to EN ISO 4628-4</td><td>1(S3) or better</td></tr>
<tr><td>4.</td><td>Evaluation of Degree of Flaking according to DIN EN ISO4628-5</td><td>0(S0) or better</td></tr>
<tr><td>5.</td><td>Evaluation of Degree of Blistering according to EN ISO 4628-2</td><td>2(S2) or better</td></tr>
<tr><td>6.</td><td>Evaluation of Detachment and corrosion around the scratch according to EN ISO 4628-8</td><td>≤ 3 mm, no delamination</td></tr>
<tr><td>7.</td><td>Evaluation of Adhesion according to EN ISO 2409</td><td>Cross-cut Rating (GT):
≤ GT0-1</td></tr>
<tr><td>8.</td><td>Fire Protection according to EN 45545-2</td><td>Hazard level- HL3 R9</td></tr>
</table>
</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>The para has been re-viewed and slightly revised as follows:

“Any other proven painting scheme, may also be permitted with approval by RDSO, depending on case to case basis subject to complying at least the following tests requirements:
<table>
<tr><th>S. No.</th><th>Tests</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Resistance to Salt Spray Test (minimum 1000 hours) according to EN ISO 9227</td><td>No rusting, cracking, flaking, blistering & corrosion</td></tr>
<tr><td>2.</td><td>Evaluation of Degree of Rusting according to EN ISO 4628-3</td><td>Ri1 or better</td></tr>
<tr><td>3.</td><td>Evaluation of Degree of Cracking according to EN ISO 4628-4</td><td>1(S3) or better</td></tr>
<tr><td>4.</td><td>Evaluation of Degree of Flaking according to DIN EN ISO4628-5</td><td>0(S0) or better</td></tr>
<tr><td>5.</td><td>Evaluation of Degree of Blistering according to EN ISO 4628-2</td><td>2(S2) or better</td></tr>
<tr><td>6.</td><td>Evaluation of Detachment and corrosion around the scratch according to EN ISO 4628-8</td><td>≤ 3 mm, no delaminati on</td></tr>
<tr><td>7.</td><td>Evaluation of Adhesion according to EN ISO 2409</td><td>Cross-cut Rating (GT):
≤ GT0-1</td></tr>
<tr><td>8.</td><td>Fire Protection according to EN 45545-2</td><td>Hazard level- HL3 R9</td></tr>
</table>
</td>
</tr>
<tr>
<td>7.9.3.3</td>
<td>The Type and Acceptance Test Reports of brand and make of paint, which are applied on springs shall be kept ready during Inspections. As quality control measure, type tests of brand and make of paint which is used for applications on springs, shall be conducted once in a year from NABL certified Lab and report of the same shall be kept ready during Inspections.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
</table>

7.9.4.1	The comments of ICF are acceptable and para is revised as follows: In addition to the stamping at end coil of the spring (Para 7.3), each spring is to be marked with a band of bronze, copper or brass. The band is secured with a cyanogen acrylate adhesive (e.g. Loctite Js 496), or with a compression joint. The following are to be stamped on the band: - Spring length under test load corresponding to tare condition in mm - Value "r_i" of the free transverse deflection in (mm) under test load corresponding to tare condition (only for category 'A' Springs).  Further, the direction of free transverse deflection "r_i" of every flexi-coil spring (category 'A') is to be marked with a band of aluminum adhesive tape (e.g. Tesaflex 171). The band is to be attached to the painted spring as in the sketch below:  									Not applicable	In view of no comments received, para is retained as it.
7.9.5.1	Coil spring must be marked with a band fixed in the direction of the bowing with following information: • Serial No., L_A/F_A and Angle engraved. The bands are placed in the direction of the deflection. • Angle between bowing directions of a spring submitted to axial force F_{C0} (usually equal to Tare Load F_A) on one hand and to an axial force F_{C1} (usually equal to a static axial force F_j corresponding to a functioning mode of the vehicle which it belongs) on the other hand shall be $\leq 30^0$. Bowing (angle, force, direction) for primary outer & inner springs shall be as per Cause 9 of EN 13298:2003.									Not applicable	In view of no comments received, para is retained as it.
7.9.5.2	During assembly of spring set, ensure that bowing marks on the springs shall be directed parallel to riding direction and oriented to the outside of the bogie.  									Not applicable	In view of no comments received, para is retained as it.
7.9.5.3	Copper (Cu) band adhesion should be such that it lost through the life of coil spring in service.									Not applicable	In view of no comments received, para is retained as it.
7.9.5.4	In addition to Copper (Cu) band, a one inch wide translucent strip of yellow colour shall also be provided for over entire height of coil spring to indicate bowing direction.									Not applicable	In view of no comments received, para is retained as it.

<table>
<tr>
<td>7.9.6</td>
<td><u>Grouping and Colour Coding of Coil Springs:</u>

<s>Grouping and Colour Coding of FIAT bogie springs for identification shall be as per RCF letter no. MD23151 dated 31.03.2015.</s> For identification of springs to be used in different types of LHB & Vande Bharat coaches, paint the middle coil of following springs with colour indicated against each group as shown below:

<table>
<tr><th rowspan="2">Group</th><th colspan="2">Primary springs</th><th colspan="2">Secondary springs</th><th rowspan="2">Colour to be done on the middle coil</th></tr>
<tr><th>Outer spring</th><th>Inner spring</th><th>Outer spring</th><th>Inner spring</th></tr>
<tr><td>1.</td><td>1267411</td><td>1267412</td><td>1269514</td><td>1269513</td><td>Green</td></tr>
<tr><td>2.</td><td>---------</td><td>---------</td><td>1277146</td><td>1277145</td><td>Blue</td></tr>
<tr><td>3.</td><td>1277142</td><td>1277143</td><td>1268836</td><td>1268837</td><td>Yellow</td></tr>
<tr><td>4.</td><td>LG01100</td><td>LG01101</td><td>LG05101</td><td>LG05100</td><td>Black</td></tr>
<tr><td>5.</td><td>RDSO/CG0DRG-23012</td><td>RDSO/CG0DRG-23013</td><td>---------</td><td>---------</td><td>Red</td></tr>
</table>
</td>
<td>Like FIAT springs, colour code shall be introduced for Vande Bharat springs also.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>The comments of ICF are acceptable. In terms of M/s Axtone suggestion regarding Grouping of Vande Bharat Spring sets, para has been revised as follows:

<u>Grouping and Colour Coding of Coil Springs:</u>

For identification of springs to be used in different types of LHB & Vande Bharat coaches, paint the middle coil of following springs with colour indicated against each group as shown in Table ‘A’ & Table ‘B’ below:

<u>Table ‘A’: Grouping & Colour Coding of FIAT Coil Springs</u>

<table>
<tr><th rowspan="2">Group</th><th colspan="2">Primary springs</th><th colspan="2">Secondary springs</th><th rowspan="2">Colour to be done on the middle coil</th></tr>
<tr><th>Outer spring</th><th>Inner spring</th><th>Outer spring</th><th>Inner spring</th></tr>
<tr><td>1.</td><td>1267411</td><td>1267412</td><td>1269514</td><td>1269513</td><td>Green</td></tr>
<tr><td>2.</td><td>---------</td><td>---------</td><td>1277146</td><td>1277145</td><td>Blue</td></tr>
<tr><td>3.</td><td>1277142</td><td>1277143</td><td>1268836</td><td>1268837</td><td>Yellow</td></tr>
<tr><td>4.</td><td>LG01100</td><td>LG01101</td><td>LG05101</td><td>LG05100</td><td>Black</td></tr>
</table>

<u>Table ‘B’: Grouping & Colour Coding of Vande Bharat Coil Springs</u>

<table>
<tr><th colspan="3">Primary Outer Spring (Drg. No. MT18Br2001449-8, Alt.-Latest)</th></tr>
<tr><th>Grade</th><th>Stiffness (N/mm)</th><th>Colour to be done on the middle coil</th></tr>
<tr><td>I</td><td>545.51 – 571.84</td><td>Blue</td></tr>
<tr><td>II</td><td>571.85 – 598.17</td><td>Green</td></tr>
<tr><td>III</td><td>598.18 – 624.49</td><td>Red</td></tr>
<tr><th colspan="3">Primary Inner Spring (Drg. No. MT18Br2001448-8, Alt.-Latest)</th></tr>
<tr><td>I</td><td>387.6 – 401.2</td><td>Blue</td></tr>
<tr><td>II</td><td>401.21 - 414.8</td><td>Green</td></tr>
<tr><td>III</td><td>414.81 – 428.4</td><td>Red</td></tr>
</table>

<u>Note:</u> In case of Vande Bharat coil springs, it is suggested to use same coloured primary outer springs in bogie, primary inner springs can be any. Because matching of both primary inner and outer colour will result in few springs left over unused, which can not be grouped with any other set to use in bogie. Some bogies can have different sets also for the same reason, will not a problem as static load testing shimming is to be carried out by spring manufacturers accordingly.</td>
</tr>
<tr>
<td>7.9.7</td>
<td><u>Coupling of FIAT Coil Springs</u>:

• Coupling for Category ‘A’ Flexi Coil Springs of FIAT Bogies will be carried out as per FIAT Technical Specification No. 17.471.101 Version 01 or latest.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.9.8</td>
<td><u>Salt Spray Test:</u>

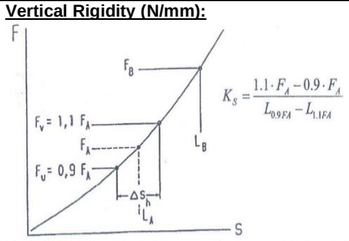
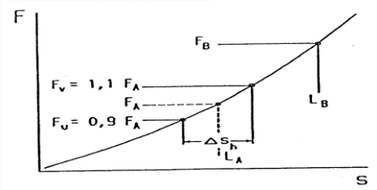
A salt spray test shall be carried out to verify the quality of paint system. For springs fully painted as per painting scheme permitted with approval by RDSO, the test piece shall be passed in salt spray test performed according to ISO 9227 for minimum 1000 hours and shall not indicate any sign of corrosion & deterioration up to duration indicated in the specification.

One sample of any type of spring (primary or secondary), randomly selected by Inspecting official, shall be subjected to salt spray test once in every year or after supply of every cumulative quantity of 25000 coil springs as per this specification, whichever is later. It shall be process check point. In event of failure any sample in salt spray test, process shall be considered as failed.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td></td>
<td>The para has been re-viewed and slightly revised as follows:

“A salt spray test shall be carried out to verify the quality of paint system. For springs fully painted as per painting scheme permitted with approval by RDSO, the test piece shall be passed in salt spray test performed according to ISO 9227 for minimum 1000 hours as per applicable specification and shall not indicate any sign of corrosion & deterioration up to duration indicated in the specification.

One sample of any type of spring (primary or secondary), randomly selected by Inspecting official, shall be subjected to salt spray test once in every year or after supply of every cumulative quantity of 25000 coil springs as per this specification, whichever is later. It shall be process check point. In event of failure any sample in salt spray test, process shall be considered as failed.”</td>
</tr>
</table>

<table>
<tr>
<td>7.10.2</td>
<td><u>Dimensional Accuracy of Springs (before painting):</u>
It should conform to the following tolerances:
<table>
<tr><th>S. No.</th><th>Parameter</th><th>Tolerance</th></tr>
<tr><td>1.</td><td>Free height (L_0)</td><td>According to drawing. In case not specified in drawing, it shall be as per Clause 7.1 of DIN 2096 Part 1 (latest).</td></tr>
<tr><td>2.</td><td>Height of Spring (L_1) at Tare Load (F_1)</td><td>According to drawing. In case not specified in drawings then ± 1% of the nominal value of (L_1).</td></tr>
<tr><td>3.</td><td>Axial static forces (F_1, F_2, …) applied on the spring</td><td>According to drawing. In case not specified in drawings then ± 1% with reference to the nominal value.</td></tr>
<tr><td>4.</td><td>Perpendicularity (e_1) or Squareness</td><td>As per drawings. In case not specified in drawing, it shall be:
i. For Springs with a free length of (L_0) > 150 mm, should be ≤ 1.5% of (L_0).
ii. ii.For Springs with a free length of (L_0) ≤ 150 mm, should be ≤ 2% of (L_0).</td></tr>
<tr><td>5.</td><td>Parallelism (e_2)</td><td>As per drawings. In case not specified in drawing, it shall be: ±1.5% of D_{outer}</td></tr>
<tr><td>6.</td><td>Wire Diameter (d)</td><td>The diameters of the straightened rods must be within following limits:
<table>
<tr><th>Dia. of rods (mm)</th><th>Tolerance (mm)</th></tr>
<tr><td>18-30</td><td>± 0.105</td></tr>
<tr><td>30-50</td><td>± 0.125</td></tr>
<tr><td>50-80</td><td>± 0.150</td></tr>
</table></td></tr>
<tr><td>7.</td><td>External coil diameter, D_{outer}</td><td>According to drawing. In case not specified in drawings then ±1.5% of D_{outer}</td></tr>
<tr><td>8.</td><td>Internal coil diameter, D_{inner}</td><td>According to drawing. In case not specified in drawings then ±1.5% of D_{inner}</td></tr>
<tr><td>9.</td><td colspan="2">Concentricity of wound rods
<table>
<tr><td>Rod Ø≤30</td><td>O</td><td>0.2</td></tr>
<tr><td>Rod Ø>30</td><td>O</td><td>0.4</td></tr>
</table></td></tr>
<tr><td>10.</td><td colspan="2">Planeness of the support (End) surface
<table>
<tr><td>Turn Diameter Dm ≤ 250 mm</td><td>0.5</td></tr>
<tr><td>Turn Diameter Dm > 250 mm</td><td>1.0</td></tr>
</table></td></tr>
</table></td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.10.3.1</td>
<td>The Pitch of the coils shall be sufficiently uniform so that when the spring is compressed to a height representing a deflection of 85% of nominal free to solid deflection, none of the coils shall be in contact with one another, excluding the inactive end coils.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.10.3.2</td>
<td>In the remaining vertical load zone i.e. upto about 85% of the block length load (Para 7.10.4.2), the contact between end coil and first active coil at both the ends must follow in a continuously rolling manner and may not be toppling over support points and no ‘kinks’.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.10.3.3</td>
<td>The turn interval is to be held so exactly that no additional contact at any other point on the spring upto load given in Para 7.10.3.2 occurs.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.10.3.4</td>
<td>Under 85% of nominal free to solid deflection, the maximum spacing between any two adjacent active coils shall not exceed 40% of the nominal free coil spacing. The nominal</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it..</td>
</tr>
</table>

	free coil spacing is equivalent to the specified total travel divided by the number of active turns.										
7.10.3.5	The length of contact line during testing at load as per A.4 of Annexure 'A' of EN 13298 shall be equal to or more than 20% of mean coil diameter but not less than 20 mm for both primary and secondary outer & inner coil springs. The beginning of the line of contact may not be further than 60^0 from the end at load F_A (minimum operational force).			The condition "not less than 20 mm" implies that minimum contact line of 20 mm is acceptable. Lowering of contact line will lead to concentration of contact pressure which will nucleate the cracks at the contact area. Since contact line of 20 mm is very less when compared to 20% of mean coil dia., the condition **"not less than 20mm" may be dispensed** with to avoid on-line failures due to stress concentration.						Not applicable	The comments of Southern Railway are acceptable as OEMs of FIAT & VB Coil Springs (M/s Grueber & M/s Axtone) have reviewed the matter of contact length of springs. They have recommended that the contact length of 0.2*D is a good compromise between a sufficient contact line length and an acceptable spring curve over the spring travel. The contact line length criteria "not less than 20 mm" is being followed in coil springs of Vande Bharat Version 2.0. Hence, para is retained as it.
7.10.3.6	The measurement of the contact length must be carried out on a spring testing machine, dully calibrated according to the relevant standards by an independent institute. For the measurement of the contact length between first active and the end coil, 02 thickness gauges with thickness 0.10 mm shall be used..									Not applicable	In view of no comments received, para is retained as it..
7.10.4.1	**Vertical height at loads (mm):** Tare: As per the relevant drawings at this load. Other loads: Nominal $\pm^{6\%}_{4\%}$ of nominal deflection at this load.									Not applicable	In view of no comments received, para is retained as it..
7.10.4.2	**Solid/Block length in mm (as per Annexure A.6.2 of EN 13298):** $L_c \leq d \times (N_t - 0.3)$, Where N_t = Total no. of coils, L_c = Solid/Block length (in mm), d = Diameter of rod in mm.									Not applicable	In view of no comments received, para is retained as it...
7.10.4.3	**Vertical Rigidity (N/mm):**  The lengths for the vertical stiffness are to be measured in the relief phase between two horizontal plates. The axial stiffness (vertical rigidity) shall be within ±5% of nominal value.									Not applicable	The para is reviewed in the light of para 5.2.3.1 & 7.2.2 of EN 13298 & tolerances primary coil springs of Vande Bharat coaches and revised as follows: **Vertical Rigidity (N/mm):**  7.10.4.3.1 For Axial stiffness test of FIAT Coil Springs, the following formula may be used with their usual notations: $K_S = \frac{1.1 \cdot F_A - 0.9 \cdot F_A}{L_{0.9FA} - L_{1.1FA}}$ 7.10.4.3.2 For Axial stiffness test of Vande Bharat Coil Springs, the following formula may be used with their usual notations: $K_S = \frac{F_B - 0.9 \cdot F_A}{L_{0.9 \cdot F_A} - L_{F_B}}$ 7.10.4.3.3 The tolerance on the axial stiffness (vertical rigidity) shall be according to drawings. In case not specified in the drawings, the axial stiffness (vertical rigidity) shall be within ±5% of nominal value.

<table>
<tr>
<td>7.10.4.4</td>
<td><u>Lateral Rigidity (N/mm) (for Springs Classified as ‘A’)</u>:

<u>Tare</u> ±15% of nominal value

Gross ±15% of nominal value

Max. load ±15% of nominal value</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it..</td>
</tr>
<tr>
<td>7.10.4.5</td>
<td><u>Chasse Value (For Springs Classified as ‘A’):</u>

Chasse value at normal gross load condition must not exceed the following limit:
C= 0.018L+ 0.0072 L^2/D Where,
L = Nominal free length of spring in mm
D = Nominal mean coil dia. in mm
C = Chasse in mm</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.10.5</td>
<td><u>Mechanical Characteristics</u>:
The mechanical characteristics such as yield point, breaking strength, elongation, hardness and through hardening capacity must be guaranteed according to following norms (valid for tempered state):

<u>Material</u> <u>Norm</u>

52CrMoV4 ISO 683-14
or EN10089</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>7.10.6</td>
<td><u>Shot Peening</u>:

Following values must be guaranteed after shot-peening operation of springs.

Almen value (mm): 0.40 - 0.60 mm on A-Stripe
Blasting medium Ø (mm): According to EN13298 Annex C. Rounded jet grains of size 0.45 -1.0 as per IS:4606 shall be used.</td>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>In view of no comments received, para is retained as it.</td>
</tr>
<tr>
<td>8.1</td>
<td>Tests for ascertaining various requirements as stipulated on this specification shall be done as per relevant specifications/standards in the table below:
<table>
<tr><th>S. No.</th><th>Test</th><th>Relevant Specification/Method to be followed</th></tr>
<tr><td>1.</td><td>Chemical composition of raw material and products i.e. bars & rods</td><td>EN10089 or ISO 683-14</td></tr>
<tr><td>2.</td><td>Hardness of surface</td><td>ISO/TR 10108/ EN ISO 18265</td></tr>
<tr><td>3.</td><td>Inclusion contents</td><td>EN13298 Annex D/ ASTM E45/IS: 4163</td></tr>
<tr><td>4.</td><td>Depth of decarburization & structure</td><td>EURONORM 104//ASTM E-1077/ IS:6396</td></tr>
<tr><td>5.</td><td>Grain size</td><td>EURONORM 103/ASTM E-112</td></tr>
<tr><td>6.</td><td>Visual checks for defects</td><td>EN13298</td></tr>
<tr><td>7.</td><td>Macro-examination</td><td>EURONORM 103/ASTM E-381/IS:7739</td></tr>
<tr><td>8.</td><td>Magnaflux testing</td><td>EN 10228-1/ASTM E 709. Alternatively, DIN EN ISO 9934-1, DIN EN ISO 9934-2, DIN EN ISO 9934-3, DIN EN ISO 3059 & DIN EN ISO 9712.</td></tr>
<tr><td>9.</td><td>Surface finish of rods</td><td>EN ISO 4298</td></tr>
<tr><td>10.</td><td>Dimensional and other checks of finished spring</td><td>EN13298 or as defined in this specification.</td></tr>
<tr><td>11.</td><td>Vertical stiffness tests</td><td>The stiffness value is obtained from the load difference and the length difference by increasing the load from F_u to F_v and recording the respective length L_u and L_v. (As defined in EN 13298).
$Ks = (F_v-F_u)/(L_u-L_v)$</td></tr>
<tr><td>12.</td><td>Transverse</td><td>The transverse static</td></tr>
</table>
</td>
<td></td><td></td><td></td>
<td><u>S. No. 29 Fatigue Test</u>:

Fatigue test during approval must be done at RDSO Fatigue Lab. Subsequently one alternate year can be done at firm’s premises.</td>
<td></td><td></td><td></td><td>.</td>
<td>S. No. 8 Magnaflux testing:

Agreed.</td>
<td>The comments of Frontier Springs are not acceptable and para is retained as it.</td>
</tr>
</table>

		stiffness test (for group 'A' classification spring only, and chasse evaluation (See Para 7.2 & 7.3)	stiffness is calculated by following formula. Kt=1/2[{(Q_{B1}-Q_{A1})/(r_{B1}-r_{A1})} +{(Q_{B2}-Q_{A2})/(r_{B2}-r_{A2})}], refer EN13298									
		13.	Tests to verify quality of shot peening (Almen test)	EN13298 Annex C									
		14.	Tests to verify quality of phosphatizing	AS per clause 7.9.2 of this specification.									
		15.	Breaking strength	EN 10083-1									
		16.	Elongation at breaking load	EN 10002-1									
		17.	Creep Test	Para 7.2.3 of EN 13298									
		18.	Fatigue Testing	As per Para 8.4									
		Note: *(i) Hardness of surface of springs shall be in accordance to EN 13298 and this specification.* *(ii) Inclusion contents, Grain size, Macro examination, Breaking strength and Elongation at breaking load of material shall be verified at raw material stage only. These tests shall be verified on black bars/bright bars. For the test for breaking strength & elongation, EN 10089 (latest) shall be referred.* *(iii) The total depth of decarburization, partial plus complete on the finished spring in the quenched and tempered condition shall not exceed 0.5% of the bar diameter.* *(iv) During macro-examination, surfaces of the springs shall be free from harmful defects namely seams, cracks and non-metallic inclusions..*											
8.2	Special test for measurement of lateral rigidity (for group 'A' classification springs) and Chasse evaluation according to the EN13298 and Para 7.10.4.5 of this specification.									Not applicable	In view of no comments received, para is retained as it.	
8.3	Special test for evaluation of chasse value, direction and rotation etc. according to the EN13298/Para 7.10.4.5 of this specification.									Not applicable	For clarity between testing of FIAT coil & Vande Bharat springs, para is elaborated as follows: "Special test for evaluation of chasse value, direction and rotation etc. of FIAT Coil Springs (Group 'A') shall be according to the EN13298/Para 7.10.4.5 of this specification."	
8.5	**FATIGUE TEST:** The purpose of fatigue testing of hot coiled helical spring is to ascertain that the springs meet the expected life during service. Fatigue testing of the spring shall be done during the initial approval of a manufacturer for the spring by RDSO. It shall subsequently be done on any one spring randomly selected from first lot of any type of spring in every alternate year. In case of new spring manufacturer not registered in RDSO Vendor Directory, fatigue testing during the initial approval shall be carried out at RDSO on any one spring randomly selected from first lot of any type of spring.									Not applicable	In view of no comments received, para is retained as it.	
8.5.1.1	All spring samples should be marked before commencing the fatigue test.									Not applicable	In view of no comments received, para is retained as it.	
8.5.1.2	The following parameters of the springs are to be measured before and after the fatigue test. a) Free height of spring as specified in drawings/specification. b) Actual height at the gross load specified in the drawing. c) Actual load for the gross height specified in the drawing. **d)** Load verses height graph from free height to gross height and free height to solid height.									Not applicable		
8.5.1.3	The fatigue test is to be displacement controlled from the height under gross load of the spring. The alternating displacement of the test is ± 30% of the static deflection (Free height – height under gross load) of the spring or as specified in the drawings.									Not applicable		
8.5.1.4	In case the minimum height due to stroke is less than solid									Not		

	height of the spring, the range of deflection for the springs should be limited to [Height under tare load ± Deflection amplitude specified in the drawing]. In case deflection amplitude is not specified in drawing, the range of deflection for the springs should be limited to [Height under tare load ± 30% of the static deflection] i.e. [Height under tare load ± 30% of (Free height – height under gross load)].									applicable	
8.5.1.5	The frequency of the test should be maximum obtainable safely as per actual displacement and fatigue test machine capability, (But not less than 1.5 H_2). The frequency at which spring is fatigue tested should be recorded.									Not applicable	
8.5.1.6	The springs shall be fatigue tested for two million cycles. Test set up should be monitored at least once a day to ensure the setup is performing well. Actual height of spring at static load should be recorded at every 2.5 lakh cycles.									Not applicable	
8.5.1.7	After completion of fatigue testing, spring shall be checked by magnaflux testing for any crack/indication of cracks. The spring shall not develop any crack for the performance to be considered satisfactory.									Not applicable	
8.6	**METALLURGICAL & CHEMICAL TEST:** For new spring manufacturer not registered in RDSO Vendor Directory, metallurgical & chemical testing during the initial approval shall be carried out at RDSO on any one spring randomly selected from first lot of any type of spring.									Not applicable	In view of no comments received, para is retained as it.
9.1.1	The material to be used in the manufacture of Spring Steel (SS) Rounds and the finished springs shall be subjected to inspection by the RDSO Inspector to ascertain the quality of the material and the characteristics of the finished springs. He shall be permitted to carry out all the checks necessary to ensure that all the conditions specified for the manufacture of the material and of the springs are adhered to. In case of foreign manufacturer of springs, not having any RDSO approved vendor for raw materials (Spring Steel Rounds) in the country in which springs are being manufactured, raw material shall be sourced from the sources approved in QAP only. Moreover, as Railway officials posted in foreign countries can also conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Not applicable	In view of no comments received, para is retained as it.
9.1.3	The manufacture shall afford the Inspecting official, free of charge, all reasonable facilities, by way of labour appliances and necessary assistance for such test as may be carried out on his premises in accordance with this specification. Where facilities are not available at manufacturer's works, the manufacturer shall bear the cost of carrying out such tests elsewhere.									Not applicable	In view of no comments received, para is retained as it.
9.1.4	The finished spring shall be presented for inspection in batches of 1000 or Part thereof. The springs shall be presented for inspection after the application of the protective coating against corrosion. The Inspecting official is free to have the sample springs shot peened for various tests.									Not applicable	In view of no comments received, para is retained as it.
9.1.1	**Raw material Traceability:** Material consumed in offered lot to be mentioned on original invoice by IE conducting inspection. Ledger for ensuring accountal of raw material showing co-relation between raw material received and consumption for each lot of inspection must be maintained by the supplier which will be endorsed by IE and record kept of inspection documents.									Not applicable	In view of no comments received, para is retained as it.
9.1.2	In case of foreign manufacturer of springs, not having any RDSO approved vendor for raw material (Spring Steel Rounds) in the country in which springs are being manufactured, raw material shall be sourced from the sources approved in QAP only. Moreover, as Railway officials posted in foreign countries can also conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Not applicable	In view of no comments received, para is retained as it.
9.2.1	The steel and rolled bar manufacturer shall submit to the spring manufacturer necessary test certificates of the following tests, carried out by him apart from the documents pertaining to the steel manufacture and refining details, ingot shape and size of the rolled product, cropping yield etc.									Agreed.	The para is re-examined and revised as follows: The steel and rolled bar manufacturer shall submit to the spring manufacturer necessary test certificates of the following tests, carried out by him apart from the documents pertaining to the

	a) Chemical composition of the ladle analysis and product analysis. b) Inclusion contents in bars c) Reduction Ratio. d) Depth of decarburization e) Surface hardness f) Grain size g) Dimensions h) End quench hardenability test for each heat/lot (As per ISO 683-14 & EN 10089) In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.										steel manufacture and refining details, ingot shape and size of the rolled product, cropping yield etc. a) Chemical composition of the ladle analysis and product analysis. b) Inclusion contents in bars c) Reduction Ratio. d) Depth of decarburization e) Surface hardness f) Grain size g) Dimensions h) End quench hardenability test for each heat/lot (As per ISO 683-14 & EN 10089) i) Surface Integrity (Auto MFL & Auto UT) In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.
9.2.2	While carrying out the inspection of rolled bars at spring steel manufacturer's premises, the Inspecting official would pay special attention to the following: - a) Size of ingots/billets used as verified from the records of the steel manufacturer. b) Dressing of complete billet by general surface grinding and freedom from surface defects. c) Discarding of end portions at both ends of each billet and freedom from piping. d) The size of ingot used shall be checked, recorded and verified that minimum reduction ratio of 16:1 is ensured for the rolled bars offered for inspection. In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Agreed	In view of comments received, para is retained as it.
9.2.3	The Inspecting official shall examine various registers and records maintained by the spring steel manufacturer to verify heatwise checks carried out by them on various parameters and manufacturing practice like production of ingots with wide end up and hot top cropping of each ingot/primary rolled billet etc. In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Not applicable	In view of no comments received, para is retained as it.
9.2.4	The Inspecting official shall carry out the following minimum checks as per sampling given in Para 9.2.5 and maintain records. Testing method as per Para 8.1 shall be followed. He may draw any additional number of samples and carry out tests at his discretion. He shall also have the right to cross check any of the above parameters by actual tests at his discretion and at the cost of the spring steel manufacturer. In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Agreed	In view of comments received, para is retained as it.

9.2.5	**Sampling (Random):** **S. No. / Test / Sampling** 1. Chemical analysis — 2 samples per heat per section. 2. Hardness — 10 bars per heat. 3. Macro-examination — 0.5% subject to min. of 5 bars per heat. 4. Depth of decarburization — 3 bars per heat per section. 5. Inclusion content — 3 samples per heat per section. 6. Grain size — 3 bars per heat per section. 7. Visual checks for defects — 2% of bars per heat per section. 8. Verification of dimensional tolerances — 5 samples per heat per section. In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Agreed	In view of comments received, para is retained as it.
9.2.6	Records for all the above tests shall be made available for scrutiny of inspector. Sample and records of the above tests shall be preserved for atleast three months for counter check by Inspector, if he so desires. In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Agreed	In view of comments received, para is retained as it.
9.2.7	Inspecting official may pick up two samples per 1000 tonnes of material offered and send the same to approved agency for confirmatory test for chemical and metallurgical properties at Spring Steel Manufacturer's expense. This test should not form part of purchase acceptance test but will only serve as a counter check on Spring Steel Manufacturer's quality control practice. In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.									Agreed	In view of comments received, para is retained as it..
9.3.1	During manufacture, records pertaining to checking of 100% of the rods for minimum material removal, surface finish, dimensional checks and cracks and crack detection by magnaflux testing shall be kept by the spring manufacturer.									Agreed	In view of comments received, para is retained as it..
9.3.2	The Inspecting official shall be allowed to examine various records and registers maintained by the spring manufacturer to verify checks carried out by them in respect to clause 9.3.1.										In view of comments received, para is retained as it.
9.3.3	In addition, spring manufacturer should submit a certificate certifying that "Magna-flux test & Ultrasonic Test (UT) with automation method as per clause 6.2.1.2 & 6.2.1.3 has been carried out on full length of 100% of the centreless ground/polished bars against particular purchase order. This certificate should be submitted to the Inspecting Authority as well as consignee railway.								`		The para is re-examined and revised as follows: In addition, spring manufacturer should submit a certificate certifying that "Magna-flux test & Ultrasonic Test (UT) method as per clause 6.2.1.2 & 6.2.1.3 has been carried out on full length of 100% of the centerless ground /polished bars against particular purchase order". This certificate should be submitted to the Inspecting Authority as well as consignee railway.
9.4.1	For each batch of finished springs or part thereof presented for inspection, tests as per Para 9.4.2 shall be carried out on springs randomly selected by the purchaser's inspector.									Not applicable	In view of no comments received, para is retained as it.

<table>
<tr>
<td>9.4.2</td>
<td>Sampling from the batch of finished springs:
<table>
<tr><th>S. No.</th><th>Description of check</th><th>Sample size</th><th>Equipment used</th></tr>
<tr><td>1.</td><td>Spring surface</td><td>As per Table 6 of EN 13298</td><td>Visual as finished
Visual after shot peening</td></tr>
<tr><td>2.</td><td>Stamping</td><td>As per Table 6 of EN 13298</td><td>Visual</td></tr>
<tr><td>3.</td><td>Free height measurement</td><td>As per Table 6 of EN 13298</td><td>Gauge/Vernier calipers (Digital type)</td></tr>
<tr><td>4.</td><td>Perpendicularity/Squareness</td><td>As per Table 6 of EN 13298</td><td>Surface Table, Try Square & Filler Gauge</td></tr>
<tr><td>5.</td><td>Parallelism</td><td>As per Table 6 of EN 13298</td><td>Parallelism Gauge</td></tr>
<tr><td>6.</td><td>End preparation</td><td>As per Table 6 of EN 13298</td><td>Visual</td></tr>
<tr><td>7.</td><td>Tip thickness</td><td>As per Table 6 of EN 13298</td><td>Vernier caliper</td></tr>
<tr><td>8.</td><td>Scragging</td><td>As per Table 6 of EN 13298</td><td>Scragging machine</td></tr>
<tr><td>9.</td><td>Static load test-stiffness</td><td>As per Table 6 of EN 13298</td><td>Spring testing machine</td></tr>
<tr><td>10.</td><td>Static load test-working height</td><td>As per Table 6 of EN 13298</td><td>Spring testing machine</td></tr>
<tr><td>11.</td><td>**Transverse Stiffness</td><td>As per Table 6 of EN 13298</td><td>Spring testing machine</td></tr>
<tr><td>12.</td><td>Maximum spacing between two active coils under 85% deflection</td><td>As per Table 6 of EN 13298</td><td>Spring testing machine</td></tr>
<tr><td>13.</td><td>Uniformity of pitch</td><td>As per Table 6 of EN 13298</td><td>Spring testing machine</td></tr>
<tr><td>14.</td><td>Crack detection</td><td>As per Table 6 of EN 13298</td><td>MPI Machine</td></tr>
<tr><td>15.</td><td>Shot peening/Almen Test</td><td>Internal test records. But, Almen gauge to clamped on 01 spring and reading to be noted.</td><td>Shot peening machine</td></tr>
<tr><td>16.</td><td>Core hardness</td><td>1 Sample per heat</td><td>BHN hardness tester</td></tr>
<tr><td>17.</td><td>Surface hardness</td><td>As per Table 6 of EN 13298</td><td></td></tr>
<tr><td>18.</td><td>Chemical composition</td><td>1 Sample per heat</td><td>Spectrometer/chemical testing equipment</td></tr>
<tr><td>19.</td><td>Depth of decarburization</td><td>1 Sample per heat</td><td>Photo Microscope & Computer Analyzer</td></tr>
<tr><td>20.</td><td>*Grain Structure</td><td>1 Sample per heat</td><td>Photo microscope</td></tr>
<tr><td>21.</td><td>*Inclusion Rating</td><td>1 Sample per heat</td><td>Photo microscope</td></tr>
<tr><td>22.</td><td>Macro etching</td><td>1 Sample per heat</td><td>Photo microscope</td></tr>
<tr><td>23.</td><td>Paint</td><td>As per</td><td>There should be no</td></tr>
</table>
</td>
<td></td><td></td><td></td>
<td>Sr. no.22 • Macro elchlng:
• Verified at raw material stage only.
(as per Final Draft of RDS0/2017/CG-01 (Rev.-03) Para no. 8.1 note (i), Page No. 22, Inclusion contents, Grain size, Macro examination, Breaking strength and Elongation at breaking load of material shall be verified at raw material stage only.)</td>
<td></td><td></td><td></td><td></td>
<td>Not applicable</td>
<td>The comments of Frontier Springs are not acceptable as Breaking strength and Elongation at breaking load of material shall be verified on Test bar of 1 – 1.5 meter length as stipulated in Para 9.4.2 (S. No. 30 & 31). Hence, para is retained as it.</td>
</tr>
</table>

	quality	Table 6 of EN 13298	sign of any sagging, blistering, checking, chalking, flaking, spotting, peeling and mechanical damage when checked on finished coated spring.
24.	Grouping and colour coding	As per Table 6 of EN 13298	Spring testing machine
25.	Dimensional Checks & **Chasse check (loaded)`	As per Table 6 of EN 13298	Spring testing machine
26.	Length of contact line	As per Table 6 of EN 13298	Spring testing machine
27.	Salt Spray Test	One sample of any type of spring (primary or secondary), randomly selected by Inspecting official, shall be subjected to salt spray test once in every year or after supply of every cumulative quantity of 25000 coil springs as per this specification, whichever is later.	Internal test reports to be reviewed.
28.	Creep Test	At any one spring randomly selected from first lot of any type of spring in every six months.	Creep Test Fixture. Internal test reports to be reviewed.
29.	Fatigue Test	During the initial approval and subsequently on any one spring randomly selected from first lot of any type of spring in every alternate year.	Fatigue Testing machine. Internal test reports to be reviewed.
30.	***Tensile strength of springs	1 sample per heat	As per EN 13298 (latest). The Test bar of 1 - 1.5 meter length shall be given same heat treatment as to springs of the lot which will be

				certified by the firm.								
	31..	***Ductility of springs	1 sample per heat	As per EN 13298 (latest). The Test bar of 1 - 1.5 meter length shall be given same heat treatment as to springs of the lot which will be certified by the firm.								
	******* *Verified at raw material stage only.* ******** *For spring of Group 'A' & Vande Bharat coaches only.* ********* *The test pieces shall be taken from the bar, utilized for the manufacture of the spring and heat treated according to the identical process as the spring.* In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis.											
9.4.3	Records of individual test results as above will be kept by the spring manufacturer for a period of 5 years following delivery and can be viewed upon demand. The cut samples used for the destructive tests shall also be preserved for one year for counter check along with the records.										Agreed	In view of comments received, para is retained as it.
9.5.1	During the sampling inspection, if any spring is found to be defective, another sample of twice the size of the earlier sample should be selected for inspection. If there is any rejection in the sample, the whole batch stands rejected. After inspection, the inspecting officer shall affix his stamp/seal on each spring as token of the spring having been passed by him.										Agreed	In view of comments received, para is retained as it.
9.5.2	The rejected springs shall be either gas cut or cross marked on one of the effective coils with the help of grinding cutter so that the rejected springs do not get mixed up with good springs at any stage. This should be done in the presence of the inspecting officer immediately after the spring has been rejected.										Agreed	In view of comments received, para is retained as it.
10.0	**<u>QUALITY RECORDS</u>:** The recorded individual test result will be kept by the manufacturer for a period of 5 years following delivery and can be viewed upon demand.										Agreed	In view of comments received, para is retained as it.
11.0	**GUARANTEE:** The springs shall be guaranteed for a period of six years against any defect imputable to manufacture from the date of delivery of the spring as stamped on end coil or for a period of five years from date of actual fitment whichever is earlier. Springs that show, during the guarantee period, defects making them either unfit for service or reduce the effectiveness of the life and which defects may be imputable to manufacture shall be replaced free of cost by the manufacturer.				**Guarantee:** (i) As per IRS The spring shall be guaranteed for a period of 30 months against any defect imputable to manufacture from the date of delivery of the spring as stamped on end coil or for a period of 24 month from date of actual filment. ii) Another condition may be considered as 300000 km or 24 months from the date of actual filment **whichever is earlier.** iii)) Another condition 24 months from the date of actual filment due to Spring is subjected to the vibrate above 2 Hz frequency so that's reason Springs life is reduce due to increase strain & shear stress. Please analysis strain & shear stress of spring in running condition in	Warranty can be defined in terms of running kms or 5 years whichever happen earlier				Agreed	Comments of firms are not acceptable. As per Railway Board directives, guarantee clause has been revised as below: The springs shall be guaranteed for a period of six years against any defect imputable to manufacture from the date of delivery of the spring as stamped on end coil or for a period of five years from date of actual fitment whichever is earlier. Springs that show during the guarantee period, defects making them either unfit for service or reduce the effectiveness of the life and which defects may be imputable to manufacture shall be replaced free of cost by the manufacturer. Hence, para is retained as it.

					train. so please decide guarantee of spring as per absorb strain ,shear stress & frequency in running condition.						
12.0	**FINAL ACCEPTANCE OF SPRINGS:** Final acceptance of the springs is reserved exclusively to RDSO or any other agency nominated for the purpose.									Not applicable	In view of no comments received, para is retained as it.
13.0	**PACKING & TRANSPORTATION:** Spring is to be placed first in "Ethylene Vinyl Acetate" Sheet of 1.5 mm thick bag or bubble sheets. The open end of the bag shall be sealed and folded in the spring ensuring that no portion of the spring remains exposed or likely to get exposed during handling. The inner and outer springs each should be suitably wrapped with bubble sheet and suitable separator shall be inserted between inner and outer springs placed concentric. Suitable separators shall also be used between each outer springs. The springs must be packed and transported in such a way that the coating lacquer is protected from any damage. Transportation of spring shall be done in wooden pallets /boxes. Any other precaution in packing as may be deemed fit for safe transportation shall be taken by the spring manufacturer to avoid damage during transportation. The general arrangement of wooden boxes shall be as per Annexure-II, III & IV. Arrangement may be modified as per requirement after taking approval from RDSO. The packing should be as per with the one provided by overseas suppliers. Any other packing arrangement better than above may be approved by RDSO depending on case to case basis.									Not applicable	In view of no comments received, para is retained as it.
14.0	**VENDOR CHANGES IN APPROVED STATUS:** For considering a new vendor for registration as a vendor for developmental order, field trial shall be done in minimum 50 coach sets. Approval may be considered after fitment and satisfactory field performance of the springs on LHB & Vande Bharat coaches separately for 06 months as per guideline. Field performance shall be monitored as per format at Annexure- V. One outer and one inner spring shall be removed from coach after 06 months from fitment and subjected to tests as per specification for functionality.									Agreed	In view of comments received, para is retained as it.
15.0	**VENDOR CHANGES IN APPROVED STATUS:** A vendor shall be considered eligible for up-gradation as "Approved Vendor" on completing successful supply of a minimum of 250 coach sets of the particular type of spring along-with the fulfillment of conditions mentioned in latest apex ISO document of RDSO for "Vendor changes in approved status" (document no. QO-D-8.1-11 Version No. latest.				VENDOR CHANGES IN APPROVED STATUS: A vendor shall be considered eligible for up- gradation as "Approved Vendor" on completing successful supply of a minimum of 100 coach sets of the particular type of spring along-with the fulfilment of conditions mentioned in latest apex ISO document of RDSO for 'Vendor changes in approved status" (document no. QO-D-81-11 Version No. latest Yours Faithfully.					Agreed	i. The comments of Frontier Springs are not acceptable as trials of 100 coach sets will take comparatively more time and will restrict the new vendors. Hence, para is retained as it. ii. The para is re-examined and revised as follows: "A vendor shall be considered eligible for up-gradation as "Approved Vendor" on completing successful supply of a minimum of 250 coach sets of the particular type of spring along-with the fulfillment of conditions mentioned in latest apex ISO document of RDSO for "Vendor changes in approved status" (document no. QO-D-8.1-11 Version No. 2.7 (or latest)."
16.0	**MANUFACTURING FACILITIES (MINIMUM):**									Not applicable	In view of no comments received, para is retained as it.
16.0 (12)	At least a Quenching Tank with minimum ~~10,000~~ 20,000 liters of quenching oil equipped with temperature indicator and provision of strainer / filters, agitation pumps, heat exchangers and cooling towers etc. to prevent oil temperature going beyond 70 ^{0}C at any time. The quenching tank shall be located adjacent to the coiling machine so that the movement of springs after coiling to the quenching tank is minimum. The quenching tank with ample volume of oil having a conveyor system with variable speed settings shall be provided so that the springs once taken out									Not applicable	In view of no comments received, para is retained as it.

	from the coiling machine are placed directly in the tank and then conveyed immediately through the conveyor to the tempering furnace. There shall be an appropriate arrangement to ensure proper maintenance of temperature of the oil bath in the range 40 ^{0}C to 70 ^{0}C. The quenching tank shall have the following features: • Suitable agitating mechanism shall be provided in the tank to ensure uniform temperature of the quenchant. • A suitably designed chute to receive spring coils from coiling machine w/o shock or impact. • Temperature indicator to indicate temp. of quenching oil, along with alarm in case the quenched temperature goes beyond set values; to be provided at prominent location..										
16.0 (19)	Adequate setup for painting of springs to suit the surface protection requirements as per the specification.									Not applicable	In view of no comments received, para is retained as it.
16.1	Proper preventive maintenance of different machines used in manufacturing process is essential for ensuring its reliable outputs. For this purpose, machine-wise maintenance schedule to be defined and displayed at machines with done & due date.									Not applicable	In view of no comments received, para is retained as it.
17.0 (7)	Adequate setup for checking the painting as per specification of springs to suit the painting requirements as per the stipulations in relevant RDSO drawing including Elcometer for measuring Dry Film Thickness (DFT) shall be available. The facility shall be periodically checked at monthly intervals for Gun characteristics, DFT and paint quality to suit the requirements.									Not applicable	In view of no comments received, para is retained as it.
18.0 (3)	Magnetic Particle Testing Machine for crack detection of springs shall be calibrated in accordance with IS: 3703/ASTM E 709 (latest) or any other relevant ASTM specification to ensure correct level of Ultra Violet illumination and appropriate wavelength, sensitivity level of penetrant and magnetizing current. The calibration frequency shall be decided and undertaken by the manufacturer which shall in no case be more than a year and a proper record thereof shall be maintained. The calibration results shall be in conformity with the permissible limits. ASNT/ISNT Level II certified operator for Magnetic Particle Testing shall be deployed. Alternatively, magnetic particle testing of the springs for crack detection may be carried out in accordance with DIN EN ISO 9934-1, DIN EN ISO 9934-2, DIN EN ISO 9934-3, DIN EN ISO 3059 & DIN EN ISO 9712.									Not applicable	In view of no comments received, para is retained as it.
18.0 (4)	The Pre-determined temperatures at which the ends of the ground bars of various springs are to be heated, along with their heating/soaking times shall be clearly mentioned in the QAP, and also displayed at the work place. Similarly, the temperatures and soaking times for different types of springs for bar heating, as well as tempering operations shall also be mentioned in QAP, and displayed at the work place.									Not applicable	In view of no comments received, para is retained as it.
18.0 (8)	A Quality Assurance Plan for the product detailing various aspects shall be available: • Organization Chart • Flow Process Chart • Stage Inspection details • Various parameters and to ensure control over it.									Agreed	In view of comments received, para is retained as it.
18.0 (9)	There shall be at least one full time technical expert having a minimum bachelor's degree in relevant field with 5 years' experience or a person with diploma in relevant field with 12 years' experience. He shall be free from day-to-day production, testing & quality control responsibility. He shall be mainly responsible for development for product, analysis of products, analysis of stage rejections, failure analysis, planning corrective and preventive action, control over raw material, devising actions in case of difficulties in achieving the parameters etc.									Agreed	In view of comments received, para is retained as it.
18.0 (10)	The in-charge of the Quality Control Section shall have a minimum bachelor's degree in the relevant field & have minimum 5 years' experience or a diploma holder with minimum 12 years' experience. He shall be actively involved in day-to-day activities of quality control / stage inspection / compliance of QAP etc.									Not applicable	In view of comments received, para is retained as it.
18.0 (11)	The Quality Manual of the firm shall clearly indicate at any stage the control over manufacturing and testing of Hot Coiled Cylindrical Springs for use in suspension of I.R.									Agreed	In view of comments received, para is retained as it.

	coaches having FIAT Design Bogies.										
18.0 (12)	There shall be a system of statistical quality control. There shall be a system of monitoring of rejections at various stages of manufacture, and corrective and preventive actions for containing those rejections, and redressal of customer complaints.									Agreed	In view of comments received, para is retained as it.
19.0 (1)	The firm shall submit two copies of Quality Assurance Plan (QAP) for manufacture of Hot Coiled Cylindrical Springs to RDSO for approval. The QAP shall include the following: (i) Organization Chart emphasizing Quality Control Setup. (ii) Qualification of key personnel and the officials deployed in Quality Control Cell. (iii) Calibration Policy for Testing Equipments, Gauges, Measuring Devices etc. (iv) Process Flow Chart indicating process of manufacture for an individual product or for a family of products if the process is same. (v) Stage wise details of spring Manufacture, Testing & Inspection. (vi) Record of finished product as per Identification Markings & Quality Assurance System - Inspection & Testing Plan. • This shall cover the following: • Incoming material • Process control • Product control • System control (vi) Policy of disposal of rejected product									Agreed	In view of comments received, para is retained as it.
19.0 (2)	The manufacturer shall proceed for manufacturing of Hot Coiled Cylindrical Springs only after approval of QAP. The firm shall strictly follow the stipulations of QAP. The firm shall maintain a record of QAP implementation for documentary evidence.									Agreed	In view of comments received, para is retained as it.
19.0 (3)	Renewal of QAP shall be required after three years. Any changes in the manufacturing procedure/Machinery and Plants associated with the manufacture of Hot Coiled Cylindrical Springs shall be duly incorporated in QAP and approved by RDSO.									Agreed	In view of comments received, para is retained as it.
20.0	**PROFORMA FOR FIELD TRIAL SCHEME:** Field performance of hot coiled helical spring used in FIAT Bogies of LHB & Vande Bharat Coaches shall be monitored for 06 months as per proforma at Annexure –V.									Not applicable	In view of no comments received, para is retained as it.
Annexure – 'I';	**ICF letter No. MD/D/Bog/41 dated 07.02.2024.** **Sub:** Specification for Vande Bharat (Ver.-1), EMU/US and MEMU/US bogie components: **Ref:** 1. MoM-RB letter No. 2023/M(W)II/509/3 dated 07.08.2023. 2. This office letter of even no. dated 19.10.2023. 3. RDSO Draft Specification for metal bonded rubber items- RDSO/CG/S/23004. 4. RDSO Draft Specification for CTRB- RDSO/2014/CG-02 (Rev.1). 5. RDSO Draft Specification for Wheels- IRS R-19/93 Part II (Rev.6). 6. RDSO Draft Specification for hot coiled cylindrical springs- RDSO/2017/CG-01 (Rev.3). 7. RDSO Darft Specification for damper- RDSO/CG-18005 (Rev.2).	In draft specifications uploaded in RDSO website for wheels, CTRB, helical springs, dampers, metal bonded rubber items, etc. vide Ref-3, 4, 5, 6 & 7 details for VB (Ver.-1), EMU/US and MEMU/US bogies have not been included. In view of above, RDSO is requested again for including/incorporating all the above components for Vande Bharat (Ver.1), EMU/US and MEMU/US bogies in relevant STRs/specifications suitably.								Not applicable	The comments of ICF have been noted. For the inclusion of same in Specification, the Grouping & Colour coding details of VB helical springs (Version-1) is required from ICF for examination at RDSO. Hence, Annexure – 'I' is retained as it as this stage.