

mandrel, to provide accurate control of pitches and bar positioning. The coiling machine shall be CNC /computer / PLC or PIV controlled, and shall be able to produce springs with uniform pitches and end coils as per the specification/drawing. The coiling machine shall be so located that the time lag between heating in the furnace to coiling is very small, so that the red hot bar does not remain in contact with air for long, and the temperature drop from furnace to the coiling machine is not more than 50 °C. Further functional details, of coiling machine shall be as given below:



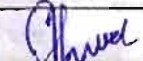
- (i) Bars shall be clamped by clamping jaw (preferably hydraulically operated) with appropriate force to ensure that no any mark is left on the bar. The clamping arrangement shall be able to prevent slippage of bars during coiling.
- (ii) Complete coiling operation till closure of the second end of the bar shall be automatic once coiling is initiated by the operator.
- (iii) The closing mechanism shall ensure that the end of the tapered bar does not protrude outside the coil diameter.
- (iv) The spring shall be automatically released from the mandrel after the second end is closed. The released spring shall land softly into the chute leading to the quenching tank without any impact.
- (v) There shall be a proper mechanism to ensure that the coiled spring is quenched before the spring temperature drops below a certain temperature.
- (vi) The Machine shall be provided with a temperature sensing device to sense the temperature of bar coming to the coiling machine, and there shall be a full proof system to ensure that coiling is carried out at appropriate temperature only within a certain range.
- (vii) The coiling machine shall have plane mandrel.
- (viii) Closing of end coils shall be an inbuilt feature of the coiling machine.

- (12) At least a Quenching Tank with minimum 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 °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 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 °C to 70 °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.

- (13) At least one Indirect Convective Heating Continuous Type Tempering Furnace equipped with variable speed conveyor, temperature controllers, recorders and indicators. There shall be no flame impeachment on the springs. The tempering furnace shall be in line with quenching tank conveyor. The furnace shall have multiple thermocouples to facilitate measurement of temperature in the furnace at different locations. The temperature in the furnace shall be uniform with temperature

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variation in different zones not more than 15 °C. The temperature of different zones of the furnace shall be recorded. At least three thermocouples shall be provided to sense temperatures of different zones of the furnace, and the same shall be recorded. The furnace shall be covered by non-conducting material at entry and exit location of springs. The springs shall enter into the furnace and come out from it following first-in-first-out principle to ensure proper heat treatment time for each spring. There shall be an arrangement in the furnace, to ensure the required soaking time for each type of spring depending on the bar diameter.

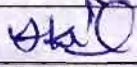

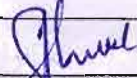
- (14) Facility for water cooling after tempering of springs.
- (15) At least a Continuous/Batch Type Shot peening machine equipped with automatic spring transportation system and rotation during shot peening to achieve the required Almen intensity as per the specification and to ensure that the springs are shot peened uniformly over the entire area of the springs. Blasting medium as per Annexure 'C' of EN 13298 shall be used. Shot peening machine shall have self-sieving arrangement to ensure that the shots of only the required size remains in operation and remaining shots or powders are removed from the machine.
- (16) At least One End Grinding Machine equipped with adequate coolant facility, controlled speed, feed rate etc. to prevent burning of end coils during grinding.
- (17) At least One Magnetic Particle Testing Machine with adjustable current to cater to the requirements for different diameters of springs having a provision for detection of cracks in longitudinal as well as in transverse directions. Provision for automatic loading / unloading of springs shall be preferred. The test facility shall have a suitable automatic device for rotation of the spring in position to facilitate testing of entire surface of the spring in one setting. The facility shall also have provision for demagnetization of springs after crack detection. The effectiveness of demagnetization shall be verified by checking that the spring exerts no attraction on a non-magnetized piece of ferro-magnetic steel, or with the aid of a device such as a field strength meter as per UIC Code 822.
- (18) At least one Scragging Machine capable of scragging the springs in quick succession. The capacity of the machine shall be sufficient to scrag the springs to solid height and shall be capable of applying the load for long duration of 48 hours as described in UIC-822.
- (19) Adequate setup for painting of springs to suit the surface protection requirements as per the specification.
- (20) Adequate number of pallets for storing / handling of springs at various intermediate stages of manufacturing. The springs shall be transported using pallet type trolleys.

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.

17.0 INSPECTION & TESTING FACILITIES:

The firm shall have at-least the following inspection & testing facilities:

- (1) A chemical laboratory to conduct Wet Analysis of all types of alloy steels required as per this specification. Emission Spectrometer along with printer for analysis and recording of chemical composition of spring steel rounds / bars and finished springs shall be also available.
- (2) The facilities for preparation of Metallographic specimen as per IS: 7739 (latest).
- (3) One Metallographic Microscope with image analyzer with minimum magnification of 1000X and photographic attachment to meet requirements of IS: 4163 and IS: 6396.
- (4) Two Brinell Hardness Testers, one in the laboratory and other in the shop floor.
- (5) Three Eye pieces / low power microscopes.

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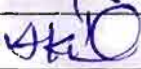


- (6) One computerized load-deflection testing machine of minimum 20t capacity with a least-count of 5 kg and accuracy of $\pm 1\%$ on load measurement which is calibrated against standard proving ring. Apart from facility to measure the deflection of the springs using digital meter, the machine shall also have an inbuilt arrangement for drawing the load-deflection characteristics graphs for the springs. It must be suitable for flexi-coil springs having lateral stiffness as well.
- (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.
- (8) Fatigue Testing machine for carrying out the fatigue testing of springs as per the relevant test scheme.
- (9) A surface table of size at least 1200 mm x 1800 mm and one set of gauges (Vernier Caliper, Micrometer, Scale, Square, Feeler Gauges, etc.) duly calibrated for purchase inspection.
- (10) At least three sets of gauges for checking of the following parameters of springs:
 - Steel Bar Diameter (peeled & ground bar)
 - Outer Diameter of spring
 - Inner Diameter of spring
 - Free Height
 - End Taper
 - Out-of-squareness
 - Parallelism

Two sets of gauges shall be available at the work place for carrying out necessary checks at various stages during manufacturing and one set of gauges shall be available in the Inspection Section for carrying out checks on finished springs by the internal inspecting officials & Authorized Inspecting Agency.
- (11) Any other measuring instrument/gauge/testing machine if required for testing springs/raw material as per specification but not covered/mentioned in any clause of this specification shall also be provided.

18.0 QUALITY CONTROL REQUIREMENTS:

The Quality Control Systems given below shall exist and shall be strictly followed:

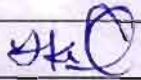
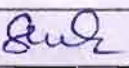
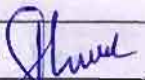
- (1) Measurement of straightness, surface finish and dimensions of the peeled & ground bars and maintenance of their records.
- (2) Measurement and recording of as-quenched hardness of the springs.
- (3) Magnetic Particle Testing Machine for crack detection of springs shall be calibrated in accordance 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.
- (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

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- as tempering operations shall also be mentioned in QAP, and displayed at the work place.
- (5) Checking of oil in Quenching Tank and topping up / replenishment as required shall be done compulsorily at pre-decided periodic intervals, and the records for the same shall be available.
 - (6) The traceability of the product from raw material stage to finished product stage shall be maintained. The system shall help in identifying the raw material details – Heat No., Supplier, Inspection details from the finished product stage.
 - (7) There shall be proper stacking of raw material heat wise and the record detailing Dispatch Memo No., Quantity, Heat No., Inspection, the Purchase Order details of the products against which the raw material has been procured shall be available.
 - (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.
 - (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.
 - (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.
 - (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. coaches having FIAT Design Bogies.
 - (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.
 - (13) Proper record of complaints received from users (Railways) and corrective and preventive actions taken, shall be maintained.
 - (14) The latest versions of EN/ASTM / IS / UIC Specifications given in the specification shall be available with the firm.

19.0 QUALITY ASSURANCE PLAN:

- (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.

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- (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

(vii) Policy of disposal of rejected product

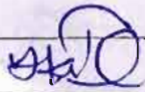
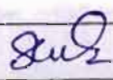
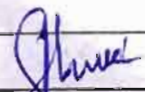
- (2) The manufacturer shall proceed for manufacturing of Hot Coiled Cylindrical Springs only after approval of QAP. The firm shall strictly follow the stipulations of QAP.

The firm shall maintain a record of QAP implementation for documentary evidence.

- (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.

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.

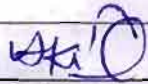
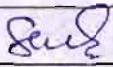
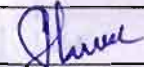
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ANNEXURE- I**A) LIST OF FIAT SPRINGS DRAWINGS:**

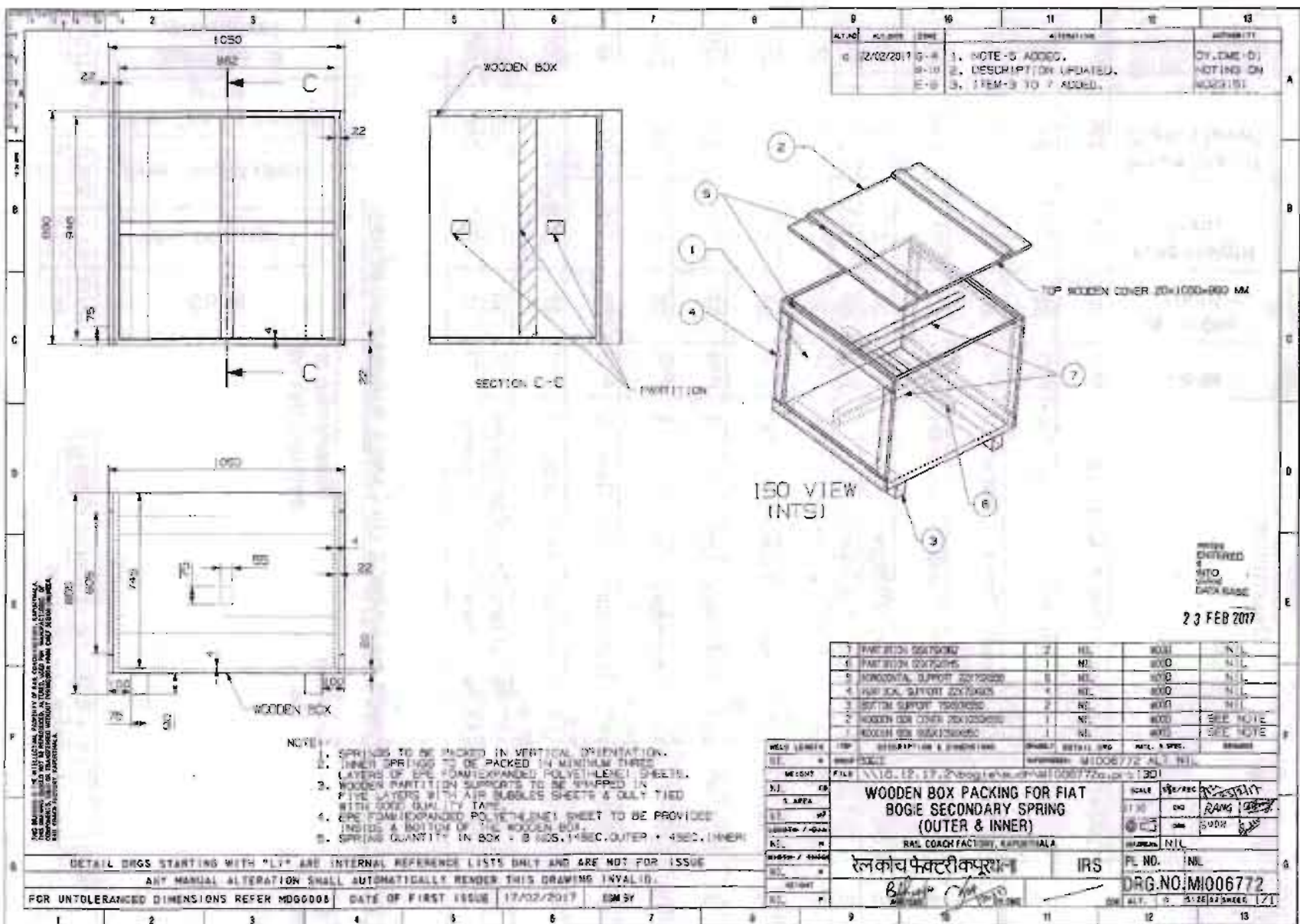
S. No.	Drawing No.	Description	Code	Wire Dia. (mm)	Free Height (mm)	Mean Dia. of Spring (mm)	Outer Dia. of Spring (mm)
1.	1267412	FIAT Coach Primary Chair Car (Inner)	F02	26	324.5	138	164
2.	1267411	FIAT Coach Primary Chair Car (Outer)	F03	38	324.5	219	257
3.	1277143	FIAT Coach Primary Generator Car (Inner)	F04	27	337	138	165
4.	1277142	FIAT Coach Primary Generator Car (Outer)	F05	40	337	219	259
5.	LG01101	FIAT Primary GS (Inner)	F06	27	313	138	165
6.	LG01100	FIAT Primary GS (Outer)	F07	40	313	219	259
7.	LG05100	FIAT Coach Secondary GS (Inner)	F08	36	593	245	281
8.	LG05101	FIAT Coach Secondary GS (Outer)	F09	55	637	376	431
9.	1277146	FIAT Secondary Gen Side -1 (Outer)	F14	57	708	372	429
10.	1277145	FIAT Secondary Gen Side -1 (Inner)	F15	38	664	243	281
11.	1268836	FIAT Secondary Gen Side -2 (Outer)	F16	55	702	372	427
12.	1268837	FIAT Secondary Gen Side -2 (Inner)	F17	37	658	243	280
13.	1269514	FIAT Secondary Chair Car (Outer)	F18	50	707	368	418
14.	1269513	FIAT Secondary Chair Car (Inner)	F19	34	663	246	280


B) LIST OF COIL SPRINGS DRAWINGS OF VANDE BHARAT COACHES:

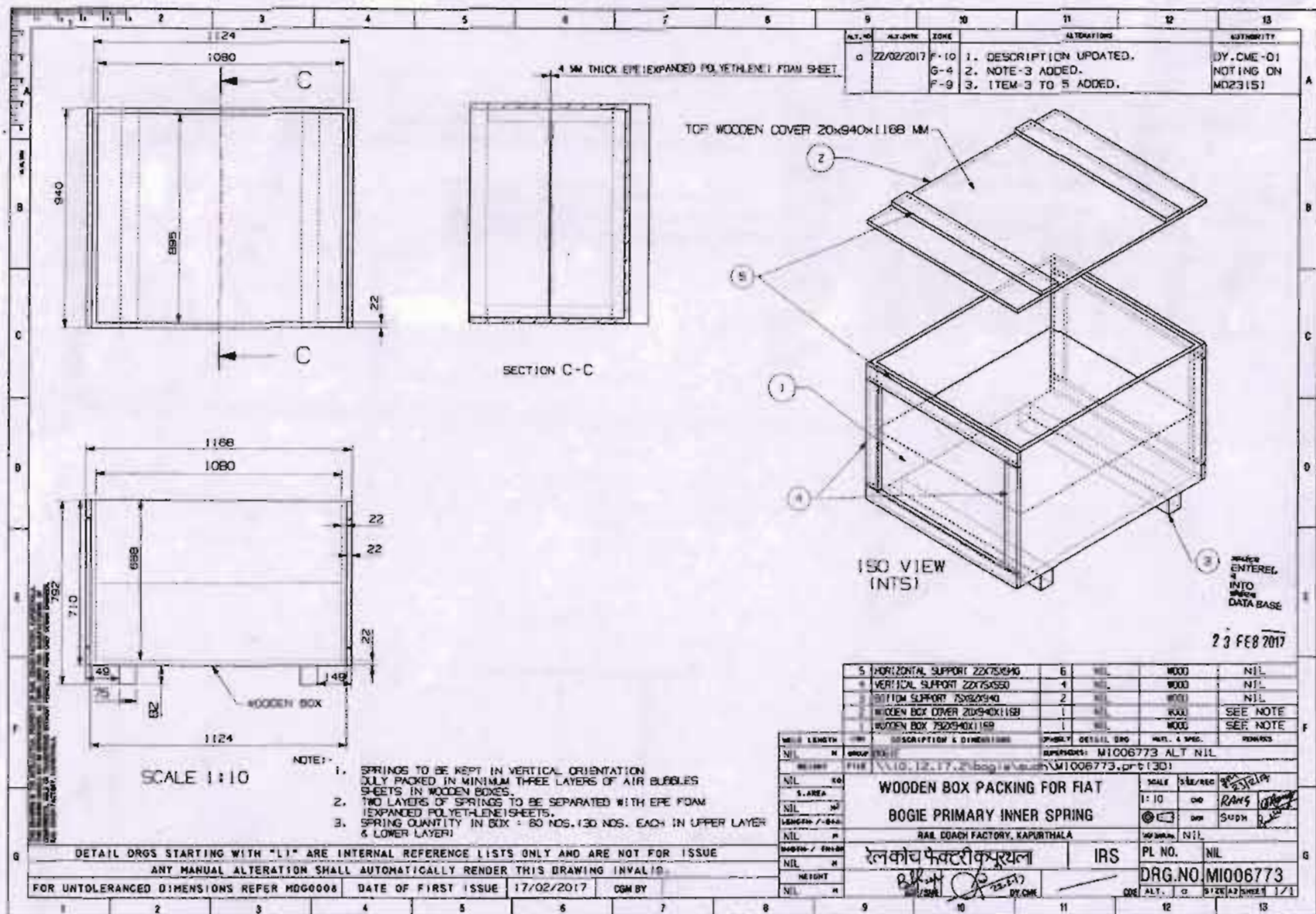
S. No.	Drawing No.	Description of Primary Spring	Code	Wire Dia. (mm)	Free Height (mm)	Mean Dia. of Spring (mm)	Outer Dia. of Spring (mm)
1.	MT18Br2001449-8 (Alt. 08 or Latest)	Spring Outer	VB01	41.4	335.6	237	278.4
2.	MT18Br2001448-8 (Alt.08 or Latest)	Spring Inner	VB02	29.6	335.6	148	177.6

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ANNEXURE - II

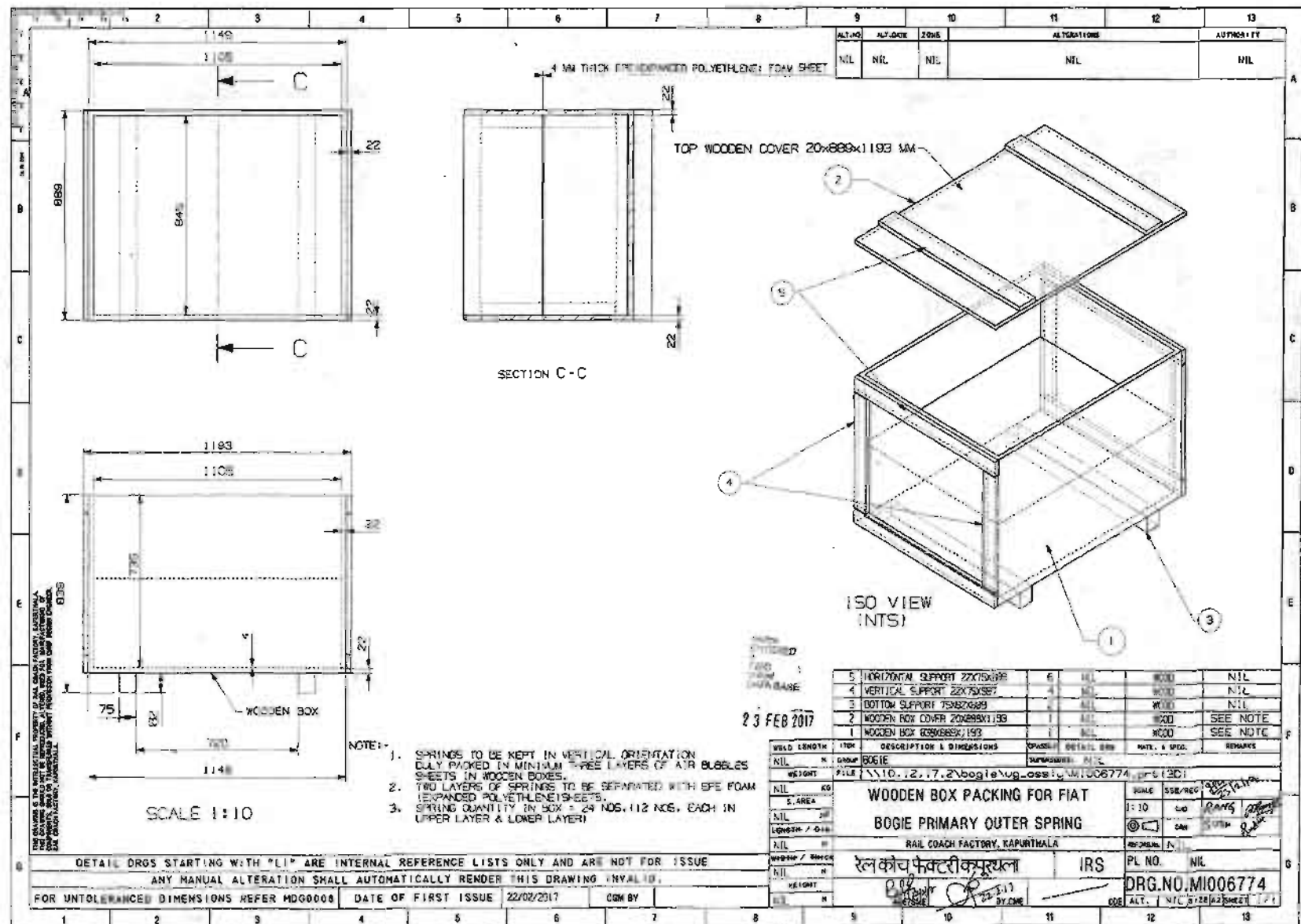


Signature				
Name & designation	Akil Haider, SSE/Design/Carriage	Sayendra Kumar, ADE/VDG/ Carriage	Prabhat Ranjan Shukla, Director/VDG/Carriage	
Prepared by:				
Checked by:				
Approved by:				



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ANNEXURE-IV



Signature	<i>Akil Haider</i>		
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Prepared by:		Checked by:	
Approved by:			

PROFORMA FOR FIELD TRIAL SCHEME OF HOT COILED CYLINDRICAL SPRINGS USED IN FIAT & TRAINSET DESIGN BOGIES:

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Signature			
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