

7.0 SPRINGS:**7.1 General:****7.1.1 Environment Condition:**

Range of environmental temperature:	-10 °C to + 50 °C (average + 35 °C)
Parking temperature:	70 °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

7.1.1.1 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/m³.

7.1.1.2 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.

7.1.1.3 The coil springs shall function in accordance with this specification when subjected to high wind in certain areas with wind pressure reaching 150 kg/m².

7.1.1.4 The coil springs shall function in accordance with this specification when exposed to solar radiation in the range from 0 Kw/m² to 1 Kw/m².

7.1.1.5 Special care shall be taken to ensure no damage to coil springs due to deposition of atmospheric salts and industrial pollutants. Supplier shall enclose the details of specific measures adopted to ensure the satisfactory working of coil springs against the deposition of salts & industrial pollution.

7.1.2 Manufacturing Sequence of Springs:


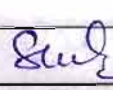
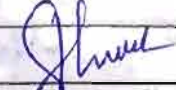
Manufacturing sequence shall include the following operations, in order given below:

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

*** Formation of ends & Stamping:**

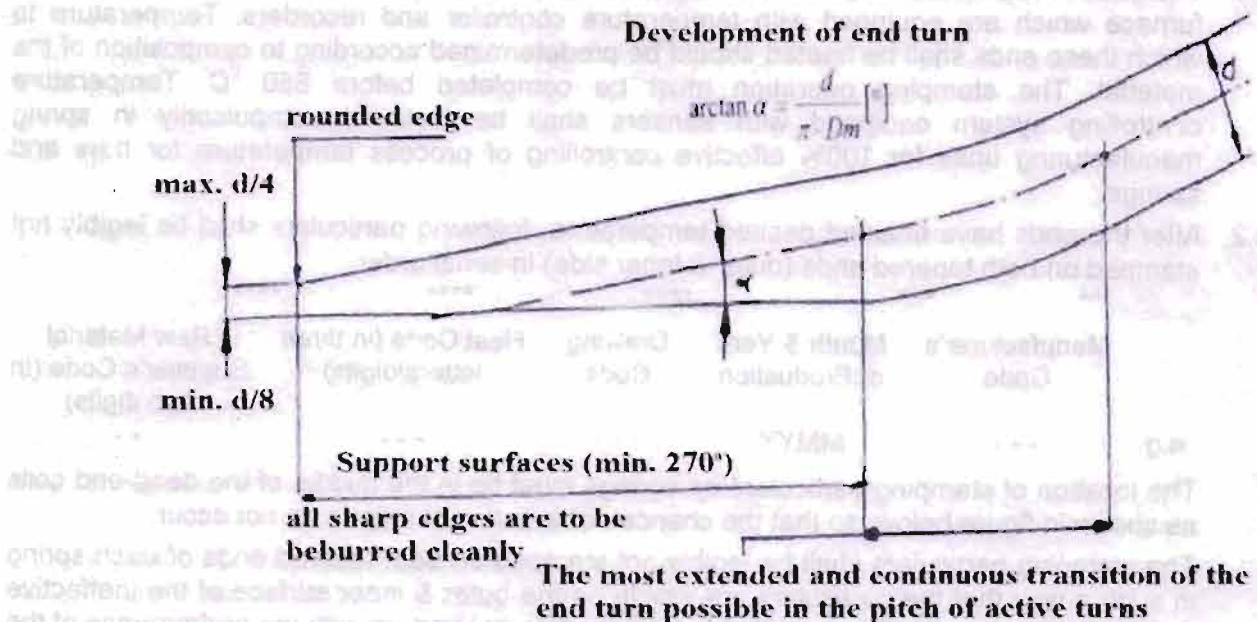
Alternate method apart from mentioned in the specification for end formation & marking/stamping may also be accepted subject to prior approval of Carriage Directorate, RDSO.

7.1.2 The surface of the springs shall not have any defects (lamination, grooves, machining marks, cracks, crevices etc.) which may be detrimental to spring performance or life. Any surface and sub-surface defects identified during the electromagnetic crack detection test shall not be permitted.

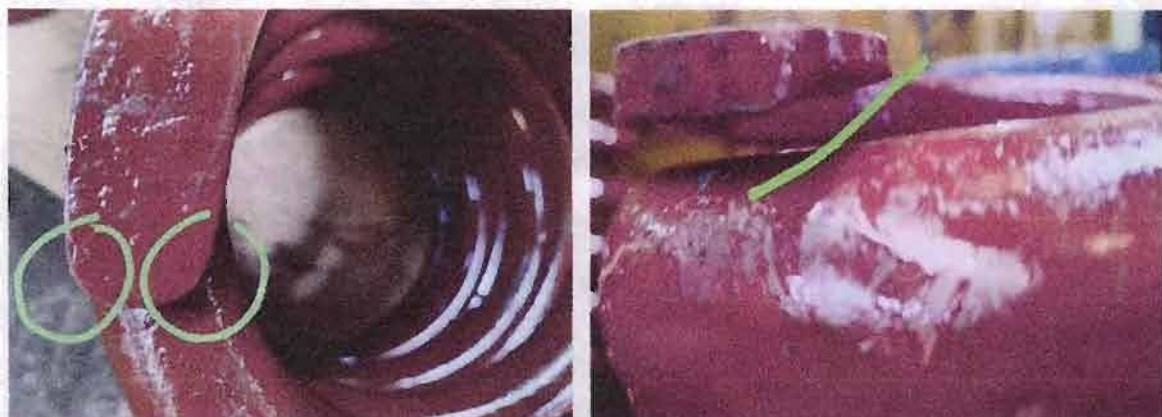
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7.2 Formation of Ends:

- 7.2.1 Both the ends of the rod shall be tapered by Taper rolling to a length which shall be equivalent to an arc angle of 270° (minimum) formed by end coils of the spring. This is meant to ensure a firm bearing of about 75% of the mean coil circumference at support surfaces of the finished springs. Formation of ends by hammering is totally unacceptable. The tapered faces should not have steps, pits or crack. The rod should be heated up to 910°C to 920°C during end tapering operation and the stamping operation must be completed before 850°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.
- 7.2.2 End taper the rod in such way that tip thickness is normally $d/3$ mm and then making coil spring perfectly to achieve its tip thickness of specified range of $d/4$ to $d/8$ after coiling and end grinding operations. Alternatively, spring manufacturers may opt different end taper thickness (other than $d/3$ mm) as per their process requirements and same should be clearly mentioned in the QAP. In both the cases, tip thickness of finished coil springs should be in the range of minimum $d/8$ to maximum $d/4$ as shown in figure below subject to the condition that it shall not be less than 3 mm in any case.



- 7.2.3 Proper care should be taken during the formation of ends of the springs. Correct ends formation shall be ensured as shown in Figure below:



- 7.2.4 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:

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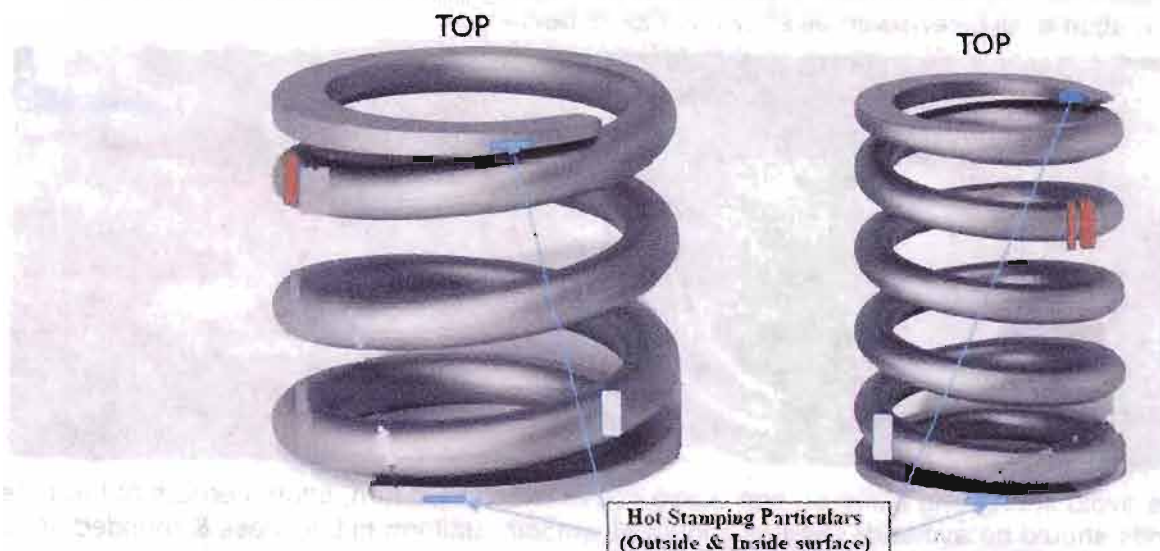





- 7.3.1 The ends of rods (Para 7.2) shall be heated in an electric, oiled or LPG fired indirect heating furnace which are equipped with temperature controller and recorders. Temperature to which these ends shall be heated should be predetermined according to composition of the material. The stamping operation must be completed before 850 °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.
- 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)
---	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.



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Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and traceability.

- 7.3.3 Stamping shall be done on the outer & inner surface of the ends in the tapered end area.
- 7.3.4 The stamping depth must be adequate to ensure that the stamping particulars remain legible even after grinding and finish coating/painting of the springs.
- 7.3.5 Tool used for stamping must be rounded.
- 7.3.6 Size of letters of stamping shall be 5 mm on rods having diameter above 20 mm and 3 mm for bars having diameter 20 mm or less. No marking shall be done on springs made from rods of diameter of 9.5 mm and below.

7.4 Hot Coiling:

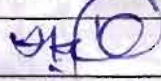
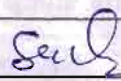
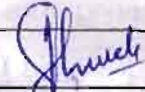
- 7.4.1 Rods with tapered ends shall be heated in electric, oil or LPG fired indirect heating furnace of minimum 10 metres, equipped with automatic temperature indicators, controllers and recorders and soaked sufficiently at that temperature in a controlled atmosphere (Soaking/Heating time = approximately $0.83 \times \text{Bar Dia. minute}$).

After clamping of rod for coiling, the formation of adjacent active coil should be formed very smoothly by controlling at least 10 different points on coiling machine by experimenting and putting different values. After getting perfection, these values should be stored for future usage and references.

- 7.4.2 With minimum time lag, rod shall be removed from the heating furnace and coiling end pitching done in a high speed automatic coiling and pitching machine. Bar temperature before coiling operation should be $890-920^{\circ}\text{C}$. 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.
- 7.4.3 Pre heated mandrel to minimum temperature of 80°C shall be used for coiling and water shall not be allowed to come in contact with heated rod. 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.
- 7.4.4 Coiling machine used for the purpose shall have in-built features to maintain uniformity of pitch and gap between end coil and adjacent coil without the need for any manual adjustment. The coiling machine shall be CNC/Computer/ PLC or PIV controlled.
- 7.4.5 Development of end turn of spring shall be as per Para 7.2.2 figure. Transition from the end turn to the active turn shall be in a most extended and continuous manner possible i.e. the gap between inactive coil and first active coil should gradually increase.
- 7.4.6 It shall be ensured at the time of end closing of the spring that the end gap between the tip and the adjacent effective coil is such that the tip does not bite the effective coil under load as well as under no load conditions. Closing of the end coil should be in built feature of coiling machine and no manual adjustment should be required.
- 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.

7.5 Heat Treatment:

- 7.5.1 Temperature of the coiled spring just after coiling and before quenching should be $830^{\circ}\text{C} - 860^{\circ}\text{C}$. 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 $40^{\circ}\text{C} - 70^{\circ}\text{C}$ 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.

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7.5.2 The quenching oil shall be kept at constant temperature range of 40 °C - 70 °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.

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 °C – 120 °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.

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 °C. The tempering should be done in temperature range of 400 °C - 500 °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/zones and soaking time of coil spring in tempering furnace shall be digitally displayed on display panel of furnace along-with rod diameter automatically.

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.**

7.5.6 Springs should be water cooled after tempering to approximately 100 °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.

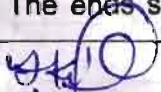

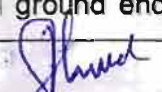
7.6 Scragging:

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 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 °C. After hot scragging process, the scragged spring should normally not show further permanent set on subsequent loading.

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. After long duration scragging, 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.

7.7 End Grinding:

7.7.1 Both the end surfaces of the spring should be ground to ensure square seating of the spring. The ends should not have any sharp edge/burrs. The actual ground end surface

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shall be atleast 75% of the mean coil circumference of the spring. The end faces of the spring should not have blue marks due to end grinding as the same leads to temper brittleness.

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.

7.7.3 The grinding angles at the ends of the springs shall be $270^{\circ} + 15^{\circ} - 0^{\circ}$. For grinding angles measurement, calibrated gauges should be available with the spring manufacturers.

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.

7.8 CRACK DETECTION:

100% of the springs shall be tested for crack detection (Magnetic Particle Test) in accordance with Annexure E of EN13298 for both longitudinal and transverse cracks. Additionally, the Standards/ Specifications DIN EN ISO 9934-1, DIN EN ISO 9934-2, DIN EN ISO 9934-3, DIN EN ISO 3059 & DIN EN ISO 9712 shall be followed for various requirements associated with magnetic particle testing.

7.9 SURFACE TREATMENT AND PROTECTION:

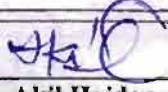
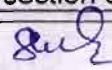
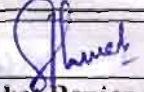
7.9.1 Shot Peening:

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.

7.9.1.1 The characteristics of the Almen test samples shall comply the Table C.1 of Annex C of EN 13298 (latest).

7.9.1.2 The number of samples to be mounted on the "sample carrying spring" depends on the free length (L_0) of the spring and shall be as follows:

Free length (L_0) of the Spring	Nos. of Almen test samples & Locations
$L_0 \geq 500$ mm	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.
$500 > L_0 \geq 300$	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.
$L_0 < 300$ mm	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.

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7.9.1.3 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 inactive coil and first active coil at approx. 0.1 turn from the end tip of the spring.

7.9.1.4 Ensure use of rounded jet grains for effective shot peening. Rounded jet grains of size 0.45 -1.0 mm as per IS: 4606 shall be used.

7.9.1.5 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.

7.9.2 **Phosphatizing:**

All the springs shall be phosphated by using zinc phosphate within 30 minutes. after shot peening. The thickness coat shall be more than 5 µm of fine crystalline nature and it can be evaluated as per method given in IS: 3618 (latest). The class of phosphate coating shall be Class C, as per IS: 3618 (latest).

7.9.3 **Final Painting:**

7.9.3.1 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).

7.9.3.2 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:

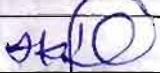


S. No.	Tests	Requirements
1.	Resistance to Salt Spray Test (minimum 1000 hours) according to EN ISO 9227	No rusting, cracking, flaking, blistering & corrosion
2.	Evaluation of Degree of Rusting according to EN ISO 4628-3	Ri1 or better
3.	Evaluation of Degree of Cracking according to EN ISO 4628-4	1(S3) or better
4.	Evaluation of Degree of Flaking according to DIN EN ISO4628-5	0(S0) or better
5.	Evaluation of Degree of Blistering according to EN ISO 4628-2	2(S2) or better
6.	Evaluation of Detachment and corrosion around the scratch according to EN ISO 4628-8	≤ 3 mm, no delamination
7.	Evaluation of Adhesion according to EN ISO 2409	Cross-cut Rating (GT): ≤ GT0-1
8.	Fire Protection according to EN 45545-2	Hazard level- HL3 R9

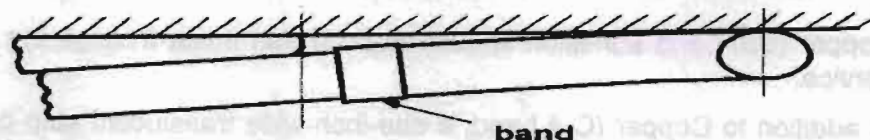
7.9.3.3 The Type and Acceptance Test Reports of brand and make of paint, which are applied on springs shall be kept ready during Inspections. As quality control measure, type tests of brand and make of paint which is used for applications on springs, shall be conducted once in a year from NABL certified Lab and report of the same shall be kept ready during Inspections.

7.9.4 **Special Spring Marking (Besides Stamping) on FIAT Coil Springs:**

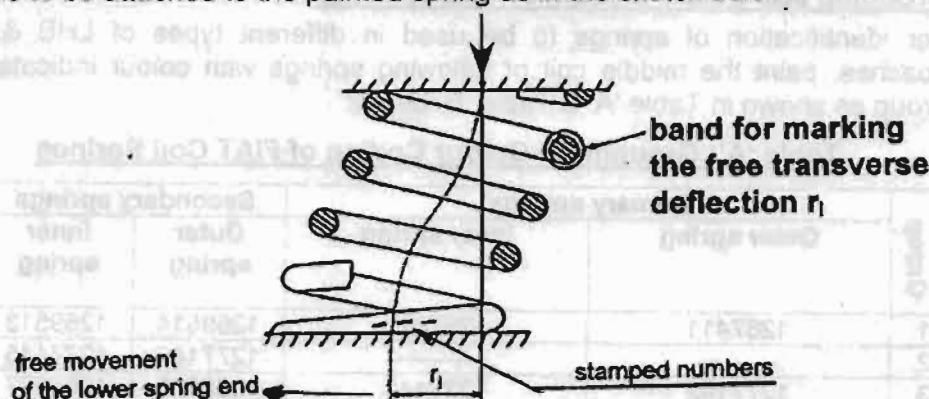
7.9.4.1 In addition to the stamping at end coil of the spring (Para 7.3), each spring is to be marked with a band of bronze, copper or brass. The band is secured with a cyanogen acrylate adhesive (e.g. Loctite Js 496), or with a compression joint. The following are to be stamped on the band:

- Spring length under test load corresponding to tare condition in mm
- Value "r₁" of the free transverse deflection in (mm) under test load corresponding to tare condition (only for category 'A' Springs).

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Further, the direction of free transverse deflection " r " 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:



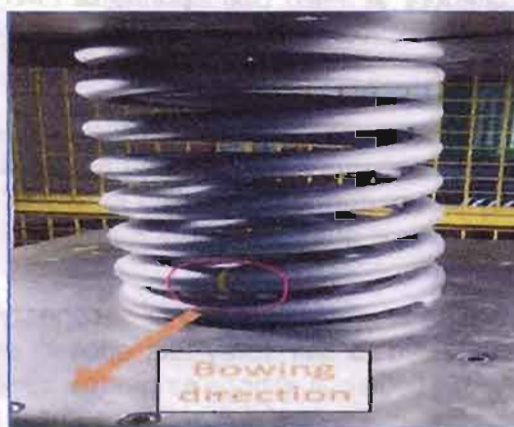
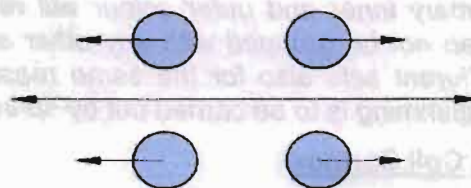
7.9.5 Marking (Besides Stamping) on Coil Springs of Vande Bharat Coaches:

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_i corresponding to a functioning mode of the vehicle which it belongs) on the other hand shall be $\leq 30^\circ$.

Bowing (angle, force, direction) for primary outer & inner springs shall be as per Cause 9 of EN 13298:2003.

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.



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7.9.5.3 Copper (Cu) band adhesion should be such that it last through the life of coil spring in service.

7.9.5.4 In addition to Copper (Cu) band, a one-inch-wide translucent strip of yellow colour over the entire height of coil spring & a band of aluminum adhesive tape (e.g. Tesaflex 171) shall also be provided to indicate bowing direction.

7.9.6 **Grouping and Colour Coding of Coil Springs:**

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:

Table 'A': Grouping & Colour Coding of FIAT Coil Springs

Group	Primary springs		Secondary springs		Colour to be done on the middle coil
	Outer spring	Inner spring	Outer spring	Inner spring	
1.	1267411	1267412	1269514	1269513	Green
2.	-----	-----	1277146	1277145	Blue
3.	1277142	1277143	1268836	1268837	Yellow
4.	LG01100	LG01101	LG05101	LG05100	Black

Table 'B': Grouping & Colour Coding of Vande Bharat Coil Springs

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

Note: 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.


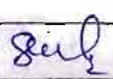
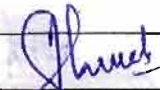
7.9.7 **Coupling of FIAT Coil Springs:**

- 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.

7.9.8 **Salt Spray Test:**

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.







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

7.10 Properties:**7.10.1 General:**

The shape dimensions and direction of coiling should conform to the drawing. When it is not specified in the drawing, direction of coiling shall be to the 'right'.

7.10.2 Dimensional Accuracy of Springs (before painting):

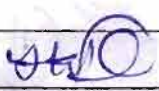
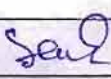
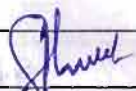
It should conform to the following tolerances:

S. No.	Parameter	Tolerance								
1.	Free height (L_0)	According to drawing. In case not specified in drawing, it shall be as per Clause 7.1 of DIN 2096 Part 1 (latest).								
2.	Height of Spring (L_1) at Tare Load (F_1)	According to drawing. In case not specified in drawings then $\pm 1\%$ of the nominal value of (L_1).								
3.	Axial static forces (F_1, F_2, \dots) applied on the spring	According to drawing. In case not specified in drawings then $\pm 1\%$ with reference to the nominal value.								
4.	Perpendicularity (e_1) or Squareness	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 $\leq 1.5\%$ of (L_0). ii. For Springs with a free length of (L_0) ≤ 150 mm, should be $\leq 2\%$ of (L_0).								
5.	Parallelism (e_2)	As per drawings. In case not specified in drawing, it shall be: $\pm 1.5\%$ of D_{outer}								
6.	Wire Diameter)	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>	Dia. of rods (mm)	Tolerance (mm)	18-30	± 0.105	30-50	± 0.125	50-80	± 0.150
Dia. of rods (mm)	Tolerance (mm)									
18-30	± 0.105									
30-50	± 0.125									
50-80	± 0.150									
7.	External coil diameter, D_{outer}	According to drawing. In case not specified in drawings then $\pm 1.5\%$ of D_{outer}								
8.	Internal coil diameter, D_{inner}	According to drawing. In case not specified in drawings then $\pm 1.5\%$ of D_{inner}								
9.	Concentricity of wound rods: <table><tr><td>Rod $\varnothing \leq 30$</td><td>O</td><td>0.2</td></tr><tr><td>Rod $\varnothing > 30$</td><td>O</td><td>0.4</td></tr></table>	Rod $\varnothing \leq 30$	O	0.2	Rod $\varnothing > 30$	O	0.4			
Rod $\varnothing \leq 30$	O	0.2								
Rod $\varnothing > 30$	O	0.4								
10.	Planeness of the support (End) surface: <table><tr><td>Turn Diameter $D_m \leq 250$ mm</td><td>0.5</td><td></td></tr><tr><td>Turn Diameter $D_m > 250$ mm</td><td>1.0</td><td></td></tr></table>	Turn Diameter $D_m \leq 250$ mm	0.5		Turn Diameter $D_m > 250$ mm	1.0				
Turn Diameter $D_m \leq 250$ mm	0.5									
Turn Diameter $D_m > 250$ mm	1.0									

7.10.3 Behaviour of Spring under Load:

7.10.3.1 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.

7.10.3.2 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'.

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