सत्यमेव जयते

भारतसरकार–रेलमंत्रालय

Government of India- Ministry of Railways

केवल कार्यालय उपयोग के लिए
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SPECIFICATION FOR HOT COILED/COLD COILED HELICAL SPRINGS

USED ON

MAINLINE COACHES, EMU AND FREIGHT STOCK

No. WD-01-HLS-94 (Rev.5)

Issued by:

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PREFACE

The specification No.WD-01-HLS-94 (Latest) is applicable for Hot coiled helical springs used in suspension system of Mainline coaches, EMU and Freight stock working over Indian Railways and Cold coiled helical springs for Freight stocks only. Therefore, the specification has been distributed into two parts i.e. Part-A & Part-B. Part-A of the specification shall be applicable for Hot coiled helical springs of mainline coaches, EMU and Freight stock and Part-B of the specification shall be applicable for Freight stocks only.

Contents

PART-A

TECHNICAL SPECIFICATION FOR HOT COILED HELICAL SPRINGS USED ON MAINLINE COACHES,EMU STOCK AND FREIGHT STOCK

1.0 SCOPE

1.1 This Specification is applicable for high performance helical springs used in the suspension system of Main line Coaches, EMU Stock and Freight Stock on the Indian Railways. This standard covers springs which are to be manufactured out of circular section bars.

1.2 This specification is intended to cover general requirements of heavy duty helical springs of Coaching Stock, EMU Stock and Freight Stock which call for stricter control in raw material quality, manufacturing processes and testing standards to improve the reliability and life of springs.

1.3 It also applies to all springs which are comble to the above by virtue of their functional or dimensional characteristics.

1.4 Inspecting authority shall mean RDSO or any other agency decided by the Purchaser in accordance with the requirements of this schedule, approved drawings and relevant IS specification.

1.5 Firm shall generally follow the infrastructure, manufacturing, testing and quality control requirement mentioned in this specification. However, the supplier can also offer alternate process infrastructure, manufacturing, testing facilities etc. Firm shall submit the detailed test report, documentary evidences, and the justification/ evidence to establish that the same can provide consistent output to desired level of output/ accuracy/ performance of the offered solution vis-à-vis specified in the specification to the Director General (Wagon)/RDSO, Lucknow for obtaining approval before use.

2.0 REFERENCE DOCUMENTS AND STANDARDS

2.1 The manufacture of springs covered by this specification is to be entrusted only to spring Manufacturers approved by RDSO.

For infrastructure manufacturing, testing and quality control requirements for hot coiled helical springs, the suppliers should comply with latest IL-17-2000 issued by QA/Mech. Directorate of RDSO.

All the provisions contained in RDSO's ISO procedures laid down in document No. QO-D-8.1-11 Latest (titled "Vendor-Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the registered vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

2.2 Procurement of spring steel shall be done only from reputed manufacturers approved by RDSO. Only spring steel bars duly inspected and passed by RDSO shall be used for manufacture of springs.
For infrastructure manufacturing, testing and quality control requirements for spring steel rounds to RDSO Specification No. WD-01-HLS-94 (Latest), the suppliers should comply latest IL-16-2000 issued by RDSO.

2.3 This part of the Specification requires references to the following ASTM/IS/UIC Specifications. The latest amendment/revision/corrigendum of the specifications shall be referred wherever applicable: -

SrNo	Standards	Descriptions
i.	IS: 4748	Standard Test Method for determining average grain size
ii.	IS: 11371	Standard Method of Macroetch Testing, Inspection and Rating Steel Products, Comprising Bars, Billets, Blooms and Forgings
iii.	IS:228	Methods of Chemical Analysis of the steel
iv.	IS:1500	Methods for Brinell Hardness Test for steel
v.	IS:2074	Ready mixed paint air drying red oxide zinc chrome priming.
vi.	IS:2932	Specification for Enamel Synthetic exterior type Iundercoating (b) finishing colour as required.
vii.	IS:3073	Assessment of Surface Roughness
viii.	IS:3195	Specification for steel for the manufacture of volute and helical springs (for freight, coaching, EMUs and Locomotive Stock).
ix.	IS:3703	Code of practice for Magnetic particle Flaw Detection.
x.	3848-1981	Method of End Quench Tests for Hardenability.
xi.	IS:4163	Methods for determination of inclusion content in steel by Microscopic Method.
xii.	IS:6396	Methods of measuring decarburized depth of steel.
xiii.	IS:7001	Methods for shot peening and test for shot- peened ferrous metal parts.
xiv.	IS:7739	Code of practice for pretion of Metallographic Specimens.
xv.	IS:7906	
	(Part v)	Specification for hot coiled springs made from circular section bars.
	(Part vii)	Quality requirements for cylindrical coil compression springs used mainly as Vehicle Suspension Springs.
	(Part viii)	Method of Inspection of Hot Coiled Compression Springs made from circular section bars.
xvi.	UIC-822	Technical Specification for the supply of Helical Compression Springs, hot coiled, for tractive and trailing stock.
xvii.	ASTM A 304-90	Specification for hardenability Band(Fig. 71 of 92060 H)

2.4 Specific provisions in this Specification will over ride those in the above ASTM/IS/UIC Specifications where these are not in conformity with one another.

2.5 Any special requirements given in the drawings will over ride this specification.

3.0 RAW MATERIAL

3.1 General

Unless otherwise specified in the drawings, the material of the springs as applicable to different rolling stocks are:-

Table 1: Material of Springs

Finished Bar Dia. 'd' (mm)	Grade of Steel as per IS:3195-92 (Amendment No. 2 of Sept. 2000 or Latest)*	
	Mainline Coach/ EMU	Freight Stock
d ≤ 30	60 Si 7	60 Si 7 52 Cr4Mo2V
30 < d ≤ 60	52 Cr4Mo2V	-

* The contents of Sulphur, Phosphorus and tramp elements shall be maintained as under for all the above grades:-

S	:	0.025% (maximum)
P	:	0.025% (maximum)
S & P together	:	0.040% (maximum)
Sn + Pb + As	:	0.1% (maximum)

3.1.1 ~~Steel making through basic oxygen, electric arc process shall be employed and steel made through open hearth route shall not be used. The steel shall be refined in the laddle furnace and vacuum degassed before using continuous cast/ Ingot. Permissible limit of hydrogen and nitrogen contents in liquid steel shall be 2.0 ppm (Max) and 0.007% (Max) respectively. In Ingot casting electromagnetic stirrer is not necessary; however, continuous casting machine should have the facility of electromagnetic stirring.~~

Steel shall be manufactured by electric, duplex or a combination of these processes routed through secondary refining furnace. The routing of the steel through vacuum de-gassing plant is essential as an additional requirement. The permissible limit of hydrogen and nitrogen contents in liquid steel shall be 2.0 ppm (Max.) and 0.007% (Max.) respectively. In Ingot casting electromagnetic stirrer is not necessary. However, continuous casting machine should have the facility of electromagnetic stirring.

3.1.2 The size of ingots, billets or continuous cast billets for any given size of finished steel product 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.

3.1.3 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).

3.1.4 While ordering the raw material suitable allowance in the bar diameter shall be made for loss of material in peeling/centreless grinding and scaling during heat treatment.

3.1.5 Marking on each bar over 15 mm diameter or of equivalent cross-section shall be stamped with the name or trade mark of the manufacturer, grade and the cast number or identification mark by which the steel may be traced to the cast from which it has been made. Such marking shall be made at the extreme ends of each bar. Firm can also follow any alternate method of marking to ensure proper traceability of the bar with prior approval of DG (Carriage)/RDSO.

3.1.6 The manufacture and supply of spring steel rounds with a diameter of less than 16 mm shall involve the following processes: hot rolling into wire rod (coil form), followed by annealing, and then drawing to achieve the required diameter for straight bars.

3.2 Quality of Spring Steel Rounds

3.2.1 The hot rolled material shall be reasonably smooth and be free from distortion, twist, kinks and shall be straight. The hot rolled bars shall also be free from harmful defects namely seams, folds, laps, cracks, deep rooted seams, holes, deep pits, grooves, excessive scaling and non-metallic inclusion which may lead to cracking during hardening or impair the serviceability of the material. The material shall also be free from harmful internal defects such as piping and segregations.

3.2.2 The hardness of the spring steel round material when tested in accordance with the IS:1500 shall be as given below:-

Table 2: Spring Steel Round Material

Grade	Hardness HB Max	
	Untreated condition*	Annealed condition (Max.)
60 Si 7	255	245
52 Cr 4 Mo 2V	310	255

Any deviation in the hardness value shall require prior approval of DG (Wagon)/RDSO before use. This shall be specified in the QAP.

3.2.3 Macro etching shall be used for evaluating the heterogeneity of the steel and to ensure freedom from harmful internal defects. The macro etching test sample shall be prepared as per IS: 7739. Macro etch level shall not be worse than C2, R2, S2 of ASTM 381 Plate 1 for blooms and billets.

3.2.4 Microscopic examination shall be conducted on a longitudinal section for evaluation of non-metallic inclusion content. Method of sampling and the magnified photo micrographs for evaluation shall be as per IS: 4163. The inclusion rating shall be 1.5 ABCD for thin series and 1.0 ABCD for thick series when compared to the chart for determining the inclusion content of secondary refined steels (Fig.2) of IS:4163-1982.

3.2.5 Average grain size of the bar shall be to ASTM No.6 or finer when checked as per ASTM/E-112.

3.2.6 Permissible depth of seam and lap in the rolled bar shall be d/100 or 0.4 mm whichever is less (d is bar diameter). The test procedure for detecting surface seams shall be as per IS: 3703.

3.2.7 Tolerance on diameters of hot rolled bars shall be within +1.0%- 0.8%.Ovality of the bars to be checked so as to ensure minimum removal of the material on minor diameter as specified in clause 3.3.1.

3.2.8 The material shall be supplied in straightened condition and the limit for out of straightness shall be as given below-
Hot rolled bars 1.5 mm/meter length Max.

3.2.9 All other conditions shall be as per IS 3195-92.

3.3 Inspection of Spring Steel Rounds

The Steel Manufacturer shall submit 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.

a) Chemical composition of ladle analysis and product analysis determined as per IS:228.
b) Inclusion contents of rounds
c) Reduction ratio.
d) Depth of decarburisation on rounds.
e) Surface hardness.
f) Grain Size.
g) Dimensions
h) Other
    (i) Test results of End Quench Hardenability (Jominy band) for each heat/ cast are Compulsorily required to be submitted by the manufacturer. IS:3848- 1981 is the Specification for `Method of End Quench Hardenability' of steel for this purpose:-
        a) Specification for Hardenability Band- ASTM A 304-90 (Fig 71 of 9260 H) material may be referred to as guidance as it is the nearest equivalent.
        b) Distance from quench end-4 (in terms of 1/16 of an inch).

c) Hardness value range- Min. 53 HRc and Max. 64 HRc.

(ii) Submission of test certificate for chemical composition including the contents of Tramp elements in the ladle and product analysis shall be mandatory.

3.3.1 While carrying out inspection of rolled bars the RDSO Inspector/authorized inspecting agency would pay special attention to:

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 16:1 is ensured for the rolled bars offered for inspection.

3.3.2 The RDSO Inspector/authorized inspecting agency shall carry out the following minimum checks as per sampling given in Clauses 3.3.2.1, 3.3.2.2 and 3.4 and maintain records. The inspector may draw any additional number of samples and carry- out tests at his/her discretion. The inspector shall also have the right to cross check any of the above meters by actual tests at his discretion and at the cost of the spring manufacturer.

3.3.2.1 Examine various registers and records maintained by the steel manufacture to verify heat wise checks carried out on various meters and manufacturing practices like production of ingots with wide end up and hot top cropping of each ingot/primary rolled billet etc.

3.3.2.2 All other aspects specified in Clause 3.0 and 3.2(i.e. from Clause 3.2.1 to 3.2.9) shall also be checked.

3.3.3 The Inspecting officials shall also conduct Process/Stage inspection on monthly basis or as decided by DG/wagon, of different Process/Stages of production as included in the approved QAP.

3.4 Sampling (Random) of Spring Steel Rounds

No.	Atributes	Relevant Spec.	Sampling
a)	Chemical Analysis	IS:228	2 Samples per heat per section.
b)	Hardness	IS:1500	10 Bars per heat.
c)	Macro Examination	IS:7739	0.5% subject to min. of 5 bars per heat.
d)	Depth of Decarburisation	IS:6396	3 bars per heat per section
e)	Inclusion Content.	IS:4163	3 samples per heat per section
f)	Grain size.	ASTM-E112	3 bars per heat per section
g)	Visual checks for defects.	IS:3195	2% of black bars per heat per section.
h)	Verification of dimensional tolerance	-do-	5 samples per heat per section.

3.4.1 Records for all the above tests shall be made available for scrutiny of Inspector. Samples of the above test shall be preserved for atleast 3 months for counter check by Inspector, if he so desires.

3.4.2 RDSO Inspector/authorized inspecting agency 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.

3.5 Rejection

3.5.1 In case the material offered for inspection fails in one or more of the criteria in 3.1, 3.2 & 3.3 or any other meter specified in this specification (Part-A), "double" the samples will be drawn and tested against the criteria in which the failure had occurred. If the "double" samples pass, the lot shall be accepted. Failure of the "double" sample will, however, result in the rejection of the complete lot. No further inspection shall be carried out until the firm has investigated and come up with satisfactory reason for the failure as well as the remedial action to improve the quality of material and also implemented the same.

3.5.2 In the event of rejection, the entire lot offered for inspection shall be made unusable for Railway application in the presence of the inspecting /purchasing authority.

4.0 MANUFACTURE OF HELICAL SPRINGS

4.1 General

Springs shall be made of bars of fine grained special quality spring steel to IS: 3195. The spring manufacturer before taking up manufacturing of springs shall inspect and check all steel rounds for conformance with the requirements for the raw material as given in this specification. Only when the raw material is found to be within the specific standards, it will be used to manufacture the springs. It will be the responsibility of the spring manufacturer to ensure quality of spring steel rounds.

4.1.1 Generally the steel manufacturers supply the spring steel rounds to the specified lengths ordered by the Spring Manufacturers, hence, no cropping of the rounds is necessary at this stage. In case of multiple lengths/excess lengths, rods may be cut to length by shearing/cutting carefully so as to prevent cracking at the ends. **Flame (Gas) cutting is prohibited.**

4.2 Straightening

The bars shall be straightened in the bar straightening machine.

4.3 Peeling and Centreless Grinding

4.3.1 The straightened bar should be peeled and centreless ground. Centreless grinding of peeled bars before coiling is mandatory and the surface finish of the ground bar shall be 5 microns(μm) Ra values in terms of IS: 3073 or better. The reduction in the bar diameter after peeling and centreless grinding shall be 3% of nominal bar diameter or 1mm, whichever is higher.
The tolerances on centreless ground bars diameter shall be within ± 0.05 mm. The limit for out of straightness for peeled and centreless ground bars shall be 1 mm/metre length max.

4.3.2 Centreless ground bars having tool marks, grooves either shallow or deep, dent marks or black spots due to non-uniform grinding shall be rejected.

4.3.3 100% of the peeled and ground bars shall be subjected to Magnetic particle testing by fluorescent wet method. The test procedure for detecting surface and sub surface defects should be as per IS:3703. Open seams are not acceptable and sub surface seams i.e. closed seams upto a depth of 1.0 mm from the surface are not acceptable. Eddy current testing method, as an alternative is not permitted.

4.3.4 Magnetic particle testing facilities should be such that complete length of spring bars can be accommodated for testing in one setting and the bars can be rotated with a suitable device in position to facilitate testing of entire surface of the bars in one setting. Magnetic particle Testing Machine should be calibrated before testing of spring bars with standard blocks for comparing the depth of sub-surface defects.

4.3.5 No trace of arc burns or spots on the centreless ground bars due to the passage of electric current following Magnetic particle testing shall be permitted.

4.4 End Tapering

4.4.1 Both ~~the ends of the ground bar shall be tapered by taper rolling machine to give the finished spring about 75% firm bearing. The tapered faces are to be grounded & grinding operation shall be performed perpendicular to the axis of the spring helix in such a way that microscopic cracks or blue burn marks are not formed during this operation. It must be ensured that the tip thickness is maintained within the prescribed limit and the grinding coverage is uniform in the spring. The tapered faces should not have steps/pits or cracks due to hammer blows, as line contact with the effective coils is required under load.~~

Both the ends of the rod shall be tapered by Taper rolling machine to a length which shall be equivalent to an arc angle of 270° (minimum) formed by end coils at 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 strictly prohibited. The tapered faces should not have steps, pits or crack. The rod should be heated up to 910 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

4.4.2 The dimensions of the spring tip thickness shall be maintained as tabulated below:

Sr. No.	Nominal Bar Diameter(d) (mm)	Variation in Tip Thickness over the Cross Section of Spring End (mm)		Permissible Value of tabs (mm) i.e tmax - tmin
		Minimum (t min)	Maximum (t max)	
1.	d≤20	0.5 x d	(0.5 x d) + 5	5
2.	20<d ≤33	0.25 x d	(0.25 x d) + 5	5
3.	33<d≤60	0.20 x d	(0.25 x d) +5	(0.05x d) +5

It is to be ensured that the tip thickness of the finished spring does not in any way affect the load test requirement given in the drawing.

4.4.3 The ends of the peeled and centreless ground bars shall be heated in electric or oil or gas fired indirectly heating furnace equipped with temperature controllers and recorders. ~~The temperature to which the ends of the ground bars be heated should be pre-determined according to chemical composition of the material.~~

4.4.4 The complete End Tapering process shall be the part of the QAP.

4.5 Stamping

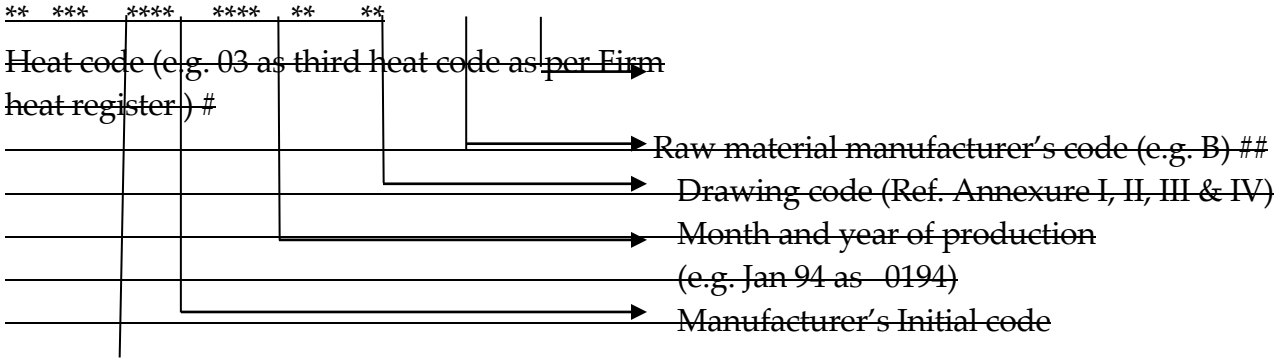
~~3.5.1 The following material code shall be followed for stamping:-~~

~~CM:- Chrome Moly~~

~~SM:- Silico Manganese~~

~~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 surface of the ineffective coils and they do not get erased during end grinding or interfere with the performance of the spring. The size of letters shall be 5mm. on bars having wire dia. above 20 mm and 3 mm for bars having wire dia. 20 mm or less.~~

~~3.5.2 The serial order in which the particulars are to be stamped on the ineffective coils on each spring shall be as given below:-~~



~~Material Code~~

~~e.g. CM CSN 0194 A01 B 05~~

~~# Heat code should be taken from 01 to 99, thereafter start from 01.~~

~~## For raw material manufacturer's codes, annexure VI is to be referred.~~

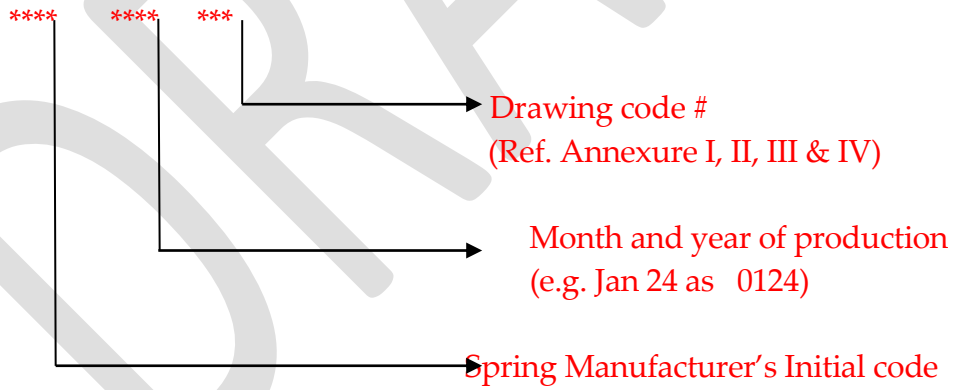
~~For drawing codes of springs for Main line coaches, Milk Vans, EMU and freight stock annexures I,II,III &IV are to be referred.~~

~~3.5.3 No marking shall be done on springs made from bar dia. of 9.5 mm and below.~~

4.5.1 The following material code shall be followed for stamping:-

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 surface of the ineffective coils and they do not get erased during end grinding or interfere with the performance of the spring. For bar with a diameter above 15 mm, the size and depth of the letters shall be minimum 5 mm and 1.0 mm, respectively. For bar with a diameter of 15 mm and less, the size and depth of the letters shall be minimum 3 mm and 0.5 mm respectively. Alternatively, bar with a dia. of 15 mm and less can also be marked by metal laser engraving with a minimum size of 3 mm and depth of 0.3 mm.

4.5.2 The serial order in which the particulars are to be stamped on the ineffective coils on each spring shall be as given below:-



e.g. CSN 0124 A01

'#' For drawing codes of springs for Main line coaches, Milk Vans, EMU and freight stock annexures I,II,III&IV are to be referred.

4.5.3 Firm shall ensure that the marking is legible and remain till the life of the component.

4.5.4 Any spring found having illegible markings at the time of fitment in Railway Workshops, Maintenance Depot or at Wagon Builder premises, shall be treated as rejected and shall be replace by the manufacturers free of cost. The cost of transportation shall also be borne by manufacturer.

3.6 Coiling and Heat Treatment:

3.6.1 The spring steel bars with tapered ends shall be heated in electric or oil or gas fired indirectly heating walking beam furnace with variable speeds and soaked sufficiently at that temperature in a controlled atmosphere so that excessive scaling and decarburisation do not take place.

3.6.2 The furnace in which the bars are heated for coiling and heat treatment should be equipped with automatic temperature indicators, controllers and recorders.

3.6.3 Coiling and pitching should be carried out on a high speed automatic coiling and pitching machine, taking specific care to ensure minimum time lag between heating, coiling and starting of quenching operation.

Use of high speed automatic coiling machine is necessary to ensure that the heated material remains in contact with air for minimum possible time so as to avoid oxidation. Bars shall be coiled on a preheated mandrel. No water shall be allowed to come in contact with the heated bar at any time. It should 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. The gap between inactive coil and first active coil should gradually increase (the gap at 25 mm from tip should be more than at the tip, similarly, gap at 50 mm from tip should be more than at 25 mm from the tip). Closing of end coils should be inbuilt feature of the coiling machine and manual adjustment should not be done. End gap between the tip of the last coil and adjacent active coil shall not in any way affect the load test requirement given in the drawing and uniformity of pitch as specified.

3.6.4 For heat treatment, the springs should be quenched in an ample volume of circulating or agitated oil or other suitable quenching medium, conforming to standard specification, the temperature of which is maintained within the predetermined limit in order to ensure optimum quenching conditions.

3.6.5 After quenching, the springs shall be conveyed immediately through a continuous conveyrised tempering furnace. During Tempering the springs shall be heated to desired pre-determined temperature range and for a sufficient length of time to produce the required spring hardness throughout the section. The furnace shall be heated in electric or oil or gas fired indirect heating with automatic temperature controller and recorder.

3.6.6 In order to ensure the uniform heating of spring steel bars, it is recommended that each zone of the furnace should be provided with independent pyrometer for temperature control. The temperature shall be controlled within ±10 ^{0}C in each zone of the furnace. The temperature of the tempering furnace should also be maintained within this range of variation.

In order to ensure the proper heat treatment of spring steel bars the following table shall be used for guidance:

Table 3 : Temperatures for the heat treatment of steels

Grade of steel	**Hardening in oil ^{0}C**	**Tempering ^{0}C**
60 Si7	830-860	350-450
52 Cr4 Mo2V	830-860	350-450

3.6.7 The heat treatment should be carried out with the aim to achieve a homogenous structure of the spring.

The tempered martensitic distribution across the complete cross section of the active coil of the Chrome Moly spring steel and Silico Manganese spring steel should be 90% martensite minimum in the core (upto 70% of radius). On the surface and sub-surface region, the martensite may vary between 90-100%.

3.6.8 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. The amount of decarburization shall be examined at 100 X magnification on a test specimen covering at least 25mm length of original circumference and cut from a full cross section of the spring.

3.6.9 To check the quality of heat treatment, the following meters of the spring shall be checked by spring manufacturers

i) The hardness of the spring should be in the range of 380 to 440 BHN for silicomagnese steel and 415 to 460 BHN for chrome moly spring steels.

ii) The difference in hardness between the surface and core as well as across the cross

~~section should not be more than 20 BHN. Surface hardness should be more than core hardness.~~

~~iii) Depth. of decarb shall not exceed 0.5% of the nominal bar dia.~~

~~iv) The martenstic distribution shall not be less than as specified in Clause 3.6.7.~~

~~3.6.10. The hardness shall be measured on the surface of the spring on inactive coils after removal of the decarburised material. The hardness of the springs shall be measured at least at two places.~~

~~3.6.11 Hardness at core and periphery and depth of decarb shall be checked by cutting and preparing suitable samples from the active coil of the spring.~~

4.6 Hot Coiling

4.6.1 The spring steel bars with tapered ends shall be heated in Electric, Oil or Gas fired indirectly heating walking beam furnace with variable speeds and soaked sufficiently at that temperature in a controlled atmosphere so that excessive scaling and decarburization do not take place.

4.6.2 The furnace in which the bars are heated for coiling and heat treatment should be equipped with automatic temperature indicators, controllers and recorders and soaked sufficiently at that temperature in a controlled atmosphere (Soaking/Heating time = approximately 0.83 x 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 perfect coil, these values should be stored for future usage and references.

4.6.3 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 920-890°C or as approved by DG(Wagon)/RDSO. 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.

4.6.4 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.

4.6.5 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.

4.6.6 Development of end turn of spring shall be as per 4.4.1. 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 (the gap at 25 mm from tip should be more than at the tip, similarly, gap at 50 mm from tip should be more than at 25 mm from the tip).

4.6.7 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.

4.6.8 The complete Hot coiling process shall be the part of QAP duly incorporating each process indicated above.

4.7 Heat Treatment

4.7.1 Temperature of the coiled spring just after coiling and before quenching should be 830°C - 860 °C with minimum time lag, coiled rods (called springs) as mentioned in this specification shall be oil quenched in a suitable quenching medium.

4.7.2 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 sufficient capacity 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.

4.7.3 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 springs.

4.7.4 Furnace used for tempering shall be electric, oil or Gas fired indirect heating type equipped with independent temperature sensors for each zone to control temperature within ± 10°C. The tempering should be done in temperature range of 350°C - 450°C. Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for springs

4.7.5 Springs should be 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 springs.

4.7.6 The heat treatment should be carried out with the aim to achieve a homogenous structure

of the spring.

4.7.7 The tempered martensitic distribution across the complete cross section of the active coil of the Chrome Moly spring steel and Silico Manganese spring steel should be 90% martensite minimum in the core (upto 70% of radius). On the surface and sub-surface region, the martensite may vary between 90-100%.

4.7.8 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. The amount of decarburization shall be examined at 100 X magnification on a test specimen covering at least 25mm length of original circumference and cut from a full cross section of the spring.

4.7.9 To check the quality of heat treatment, the following meters of the spring shall be checked by spring manufacturers-

i) The hardness of the spring should be in the range of 380 to 440 BHN for Silico-magnese steel and 415 to 460 BHN for chrome moly spring steels.

ii) The difference in hardness between the surface and core as well as across the cross section should not be more than 20 BHN. Surface hardness should be more than core hardness.

iii) Depth. of decarb shall not exceed 0.5% of the nominal bar dia.

iv) The martenstic distribution shall not be less than as specified in this specification.

4.7.10 The hardness shall be measured on the surface of the spring on inactive coils after removal of the decarburised material. The hardness of the springs shall be measured at least at two places.

4.7.11 Hardness at core and periphery and depth of decarb shall be checked by cutting and preparing suitable samples from the active coil of the spring.

4.7.12 The complete Heat Treatment process shall be the part of QAP duly incorporating each process indicated above.

4.8 End Grinding

Both the end faces of the spring should be ground to ensure square seating of the spring. The sharp edges of the ends should be ground and have no burrs. The actual ground end surface shall be at least 75% of the mean coil circumference of the spring and the ends should not bite the effective coil. The end faces of the spring should not have blue marks due to end grinding as the same leads to temper brittleness.

4.9 Scragging

Each and every spring should be scragged 3 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 spring should be scragged home. The scragging load in such cases should not exceed 1.5 times the theoretical axial load, corresponding to block length.

4.9.1 Long duration scragging is to be introduced as a process check at regular intervals and necessary documentation 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 2 minutes in the first two strokes and for 48 hours at the last stroke.

4.9.2 The scragged spring should not show further permanent set on subsequent loading.

4.9.3 Type testing of newly designed springs (Fatigue Testing) shall be done if mentioned on drawing. The test scheme shall be provided by the concerned Design Directorate.

4.10 Crack Detection

100% of the springs shall be tested for crack detection in accordance with Appendix 'B' of Specification UIC-822, for both longitudinal and transverse crack. After crack detection, the spring shall suitably be demagnetized.

4.11 Shot Peening

All the springs shall be shot peened in a continuous type shot peening machine, preferably with self- sieving arrangement in accordance with IS:7001 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 IS: 7001. 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 IS: 7001 should be minimum 0.40 mm (0.016").

4.12 Grouping and Colour Coding:

100% of the springs shall be compressed with specified working load and the loaded height of the individual springs shall be measured in spring testing machine. The working height of the spring shall be within the tolerances specified in the drawing. The springs shall be grouped and painted with suitable colour code for identification as specified in the drawing/tender document. Any spring which is found to be defective or which does not confirm to the test and other requirements of the specification should be rejected.

5.0 GEOMETRICAL CHARACTERISTICS

5.1 General:

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

5.2 Dimensional Accuracy

The dimensional accuracy of the springs shall conform to the tolerances given in the Table-4 below:-

Table 4

S.No.	Parameters	Tolerances
1.	Free Height a) Coaching & EMU Stock b) Freight Stock	 +1.5-0.5% of free height ± 3mm
2.	End Squareness	1.0 mm per 100 mm free height
3.	Wire Diameter	± 0.5 % of wire dia. or 0.1 mm whichever is less
4.	Outer Coil Diameter	± 1.5% of outer dia.
5.	Inner Coil Diameter	± 1.5% of inner dia.
6.	Parallelism	1.5 mm per 100 mm outer dia.

N.B. These are to be checked as per IS: 7906 Part-VIII.

5.3 Squareness

All springs shall not deviate from perpendicular at any point on its outer circumference.

(a)	At effective coil	by more than 1% of the nominal free height.
(b)	At ineffective coil (over a Circumferential length from its free end equal to 3.5 times the wire dia.)	by more than 1% of the nominal free height plus 3 mm OR 2% of the nominal free height. (whichever is less)

The deviation shall be determined by standing the spring on its base and measuring the same along the outer circumference from a perpendicular to the surface plate on which spring is standing with the help of a set/try square and a suitable measuring device.

5.3.1 The solid height (LB) of the spring made from centre- less ground steel bar should be:
LB ≤ (Total No. of coils - 0.4) x d max. (Where Total No. of coil = No. of active coils + 1.5)
As given in IS: 7906 Part V. It should be measure when the spring is completely compressed.

5.4 Pitching

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. It should be ensured that as and when contact between the ineffective coils and the adjacent effective coils is made, it should occur over a minimum length of 1/3rd of the mean coil dia. of the spring.

Under 85% deflection the maximum spacing between any two adjacent active coils shall not exceed 40% of the nominal free coil spacing. The nominal free coil spacing is equivalent to the specified total travel divided by the number of active turns. When the spring is designed to provide lateral stiffness also, the above requirement of not exceeding 40% do not apply.

5.5 Lateral Deflection

When prescribed on the drawing, the lateral deflection characteristics shall be checked by means of suitable device approved by the Purchaser.

6.0 LOAD TESTING

6.1 The spring shall be tested on a spring testing machine, as per load chart of the drawing. Each load is maintained till the load is stabilized after which the corresponding height of the spring (under load) is determined. The tolerance on the height of the spring under static load shall be as indicated on the drawing or in the absence thereof, should not be more than ±3% design deflection value at nominal working load and + 6% / -4% of design deflection value at other loads.

6.2 The spring stiffness shall be within ± 3.4% upto bar dia.18 mm and ±5% beyond 18 mm of the design value. It should be determined by dividing the difference of load between 70% and 30% of the designed home load by the difference of measured deflection between these two loads.

7.0 FATIGUE TESTING

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 springs shall be done during the initial approval of a manufacturer for the spring by RDSO. It shall subsequently be done in first lot of each type of spring supplied in every alternate year.

7.1 Test Setup

The test setup primarily consists of a fatigue test machine and spring fixture. The machine should have the facility to record deflection as well as load simultaneously. The springs can be tested as a single spring or together with other spring in the fixture. The fixture should be designed in such a way that both the ends of the spring remain parallel and perpendicular to the loading direction. The end plates of the fixture should not allow spring to move sideways.

7.2 Test and Measurements

7.2.1 All spring samples should be marked before commencing the fatigue test.

7.2.2 The following meters of the springs are to be measured before and after the fatigue test.

a) Free height of spring.
b) Actual load at static (working) height as per RDSO drawing.
c) Load verses height graph from free height to static height and free height to solid height.

7.2.3 The fatigue test is to be displacement controlled from the static height of the spring. The displacement of the test is ± 30% of the static deflection of the spring.

7.2.4 The frequency of the test should be maximum obtainable safely as per actual displacement and fatigue test machine capability. (But not less than 2Hz). The frequency at which spring is fatigue tested should be recorded.

7.2.5 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 and arrangement should be in place to video record the testing at suitable interval during the test period. Actual height of spring at static load should be recorded at every 2.5 lakh cycles.

7.2.6 After completion of fatigue testing, spring shall be checked by magnaflux testing for any crack/indication of cracks.

7.3 Test Report

The test report shall be furnished that includes the data of spring before fatigue test, during fatigue test and after the fatigue test. It should also include the failure analysis of the spring failed during fatigue test.

8.0 HANDLING OF SPRINGS

The springs should be properly handled during manufacture. Springs should not be thrown on floor or roll at any stage of manufacture to avoid any damage to the springs.

9.0 INSPECTION OF HELICAL SPRINGS

9.1 General

The material to be used in the manufacture of springs and the finished springs shall be subjected to inspection by the Purchaser's 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.

9.1.1 The Inspecting Officer or the Purchaser shall have free access to the works of the manufacturer at all reasonable times. He shall be at liberty to inspect the manufacture of the springs at any stage and to reject any material that does not conform to the Specification.

9.1.2 The manufacturer shall provide the Inspecting Officer, free of charge, all reasonable facilities by way of labour, appliances and necessary assistance for such tests 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.

9.1.3 The finished spring shall be presented for inspection in batches of not more than 1000. The springs shall be presented for inspection after the application of the protective coating against corrosion. The Inspector is free to have the sample springs shot peened for various tests.

9.2 Stage-I (Raw Material)

Shall be done as per Clauses 3.3, 3.4 and 3.5 of this Specification.

9.3 Stage-II (During Manufacture)

9.3.1 The manufacturer shall carryout all necessary checking of all the centreless ground bars for minimum material removal surface finish, crack detection, the depth of decarburization of springs during the heat treatment, surface hardness etc. and maintain records for each tests as per QAP.

9.3.2 The Inspecting officials shall also conduct Process/Stage inspection on monthly basis or as decided by DG/wagon, of different Process/Stages of production as included in the approved QAP.

9.4 Stage-III (Finished Spring)

For each batch of finished springs or part thereof presented for inspection the following tests shall be made out of springs selected at random by the Inspecting official:-

9.4.1 Checking of records for quality verification of raw materials used by the firm.

The inspecting official shall check the records and ensure that verification has been done by the firm on the spring material used before commencing the manufacture of springs as per checks specified in this specification.

9.4.2 The inspecting official shall carryout following checks on the finished springs:

S. No.	Description of check	Sample Size	Equipment used	Acceptance Limits	Specification Used
1.	Spring surface	100% springs	Visual as finished	Crocodile skin on spring is not acceptable	---
		2% springs	Visual after shot peening		
2.	Stamping	5% or 20 springs whichever is less	Visual	As per clause 4.5	---
3.	Free height measurement	5% or 20 springs whichever is less	Gauge	As per RDSO drawing	---
4.	Squareness	5% or 20 springs whichever is less	---	As per clause 5.3	IS:7906 Part8
5.	Pallelism	5% or 20 springs whichever is less	---	As per clause 5.2	IS:7906 Part8
6.	End Preparation	5% or 20 springs whichever is less	Visual	Tapered face should not have steps/pits/burrs or cracks	
7.	Tip thickness	5% or 20 springs whichever is less	Vernier caliper	As per clause 4.4.2	
8.	Scragging	5% or 20 springs whichever is less	Spring testing machine	As per clause 4.9	
9.	Static load test-stiffness	5% or 20 springs whichever is less	Spring testing machine	As per clause 6.1	
10.	Static load test-working height	5% or 20 springs whichever is less	Spring testing machine	As per clause 6.2	
11.	Minimum spacing between two active coils under 85% deflection	5% or 20 springs whichever is less	Spring testing machine	As per clause 5.4	
12.	Uniformity of pitch	5% or 20 springs whichever is less	Spring testing machine	As per clause 5.4	
13.	Crack detection	5% or 20 springs whichever is less	---	As Per Clause 4.10	Appendix-B of UIC- 822
14.	Shot peening	Internal test	---	As per clause	IS:7001

		records		4.11	
15.	Core Hardness	1% or 3 Springs whichever is less	BHN hardness tester	As per clause 4.7.9	IS:1500
16.	Surface Hardness	5% or 20 springs whichever is less			
17.	Chemical Composition.	1% or 3 Springs whichever is less	Spectrometer/ chemical testing equipment	As per RDSO drawing	IS:228
18.	Depth of Decarburizatio n.	1% or 3 Springs whichever is less	3 Springs	As per clause 4.7.9	IS:6396
19.	Grain Structure	1% or 3 Springs whichever is less	Photo microscope	Average grain size No.6 or finer.	ASTM E-112
20.	Inclusion Rating	1% or 3 Springs whichever is less	Photo microscope	As per clause 3.2.4	IS:4163
21.	Macro etching	1% or 3 Springs whichever is less	Photo microscope	As per clause 3.2.3	IS:7739
22.	Paint quality	5% springs	---	As per clause 11.0	IS:2074 & IS2932
23.	Grouping and colour coding	5% springs	Spring testing machine	As per clause 4.12 or RDSO drawing	---

Removal of paint by caustic soda wash or any other effective method is required before the crack detection test. Shot peening may be avoided.

9.4.3 Records for all the above tests shall be preserved for at least 5 years and samples one year for counter check if so desired.

9.4.4 The Spring Manufacturer should submit certificate certifying that:" Magnetic Particle Test as per Clause 4.3.3 has been carried out on full length of 100% of the centreless ground bars against particular Purchase Order". This Certificate should be submitted to the Inspecting Authorities as well as to Consignee Railways.

9.4.5 The spring manufacturer should submit a certificate to the effect that spring steel rounds purchased by the firm against specific purchase order from RDSO approved source and inspected as per corresponding Dispatch Memo No. has been used for manufacturing a particular batch of springs against particular purchase order and no other material has been used.

10.0 REJECTION

10.1 During the sampling inspection if any spring fails in one or more of the criteria specified in this specification (Part-A), "double" the samples will be drawn after removing the defective sample and tested against the criteria in which the failure had occurred. If the "double" samples pass, the lot shall be accepted. Failure of the "double" sample will, however, result in the rejection of the complete lot. No further inspection shall be carried out until the firm has investigated and come up with satisfactory reason for the failure as well as the remedial action to improve the quality of material and also implemented the same.

10.2 In the event of rejection, the entire lot offered for inspection shall be made unusable for Railway application in the presence of the inspecting /purchasing authority. 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 stages. This should be done in the presence of the Inspecting Officer immediately after the spring batch has been rejected.

11.0 PROTECTION AGAINST CORROSION

~~Finished springs shall be given one coat of zinc chromate primer to IS:2074 followed by one coat of Black Synthetic Enamel to IS:2932 or Powder coating or as specified in the drawing, for protection against corrosion.~~

11.1 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).

11.2 Final Painting :

Powder coating as per IS:13871 shall be done on the springs for protection of corrosionsand thickness shall be minimum 80 microns both inside and outside springs. Powder coating film thickness layer shall be checked by Elcometer.

12.0 PACKING OF SPRINGS FOR TRANSPORTATION

~~The springs are one of the most stressed components of the vehicle suspension. Hence, they should be suitably packed to ensure their safe transportation.~~

~~For packing the springs, a seamless polythene sleeve of minimum 500 micron thickness and appropriate diameter (matching the finished spring bar diameter) should be slide on the finished spring wire/bar and sealed from both the ends. The whole spring bar should then be wrapped with a thick jute strip such that no portion of the spring is exposed open. Precaution shall be taken in packing as may be deemed fit for safe~~

~~transportation should be taken by the spring manufacturer to avoid damage during transportation.~~

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13.0 GUARANTEE FOR SPRINGS

The spring shall be guaranteed for a period of five years against any defect imputable to manufacture from the date of manufacture of the spring, as indicated by stamping of month and year of manufacture on the tapered ends of the spring vide 4.5 of this Specification. 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.

14.0 FIELD TRIAL:

14.1 To consider a new vendor for registration for developmental orders, a field trial must be conducted for Casnub bogie's and LWLH bogie's springs. (approximately 1000 springs total in even mix as per requirement of particular bogie design) in minimum 10 wagons (CC Rake).

14.2 The firm shall submit all copies of the purchase order (issued by the purchaser) to RDSO. The wagon depots(s) where the spring shall be supplied and fitted will be nominated by RDSO (Wagon Directorate) in order to monitor their field performance.

14.3 Wagon directorate shall monitor all springs manufactured by the firm for field performance on CC rakes. Firm shall be permitted to supply maximum 20000 nos. springs during the trials duly inspected by inspecting agency for ascertaining performance & reliability evaluation.

14.4 The Vendor shall also ensure that they do not secure total order quantity more than the limited quantity mentioned in the Vendor Directory.

14.5 Failure criteria shall be as follows:-

14.5.1 During field performance monitoring, Railways shall maintain and provide Quarterly

performance details of springs to Wagon Directorate.

14.5.2 The performance details shall include Monthly fitment details (Month & Year of Manufacturing, Month & Year of Fitment and Fitment Quantity), Monthly failure details (Month & Year of Manufacturing, Month & Year of Failure and Failure Quantity).

14.5.3 During field performance monitoring, failure of springs shall not be more than 1 % of spring fitted during the entire trial period.

If the spring failure is more than 1% of total spring under field performance monitoring period (six months), the field trials may be extended for another six months again. However, the failure upto the extended period should not be more than 1.5%. Springs not meeting this extended field trial criteria shall investigate the cause/s and the firm's application for registration of it's name for the subject item may be considered failed and a fresh application shall be made for.

14.6 During field performance monitoring, detailed field performance of spring shall also be monitored. For this, 1000 springs shall be fitted in nominated wagons in presence of Wagon Directorate Officials. Firm shall provide a unique serial number to each of these 1000 springs. After completion of six months, 10 springs of each type out of these 1000 springs shall be randomly picked from the field for detailed testing. These springs shall be checked as per Annexure-F1. The spring shall be considered as "failed" if the permanent set of spring has crossed the specified limit or any cracks appeared on springs.

14.7 After successful field trial, firm shall be registered as 'RDSO Vendor for Developmental Orders'. Final approval shall be accorded as per existing procedure prevailing at that time.

15.0 QUALITY AUDIT

15.1 The quality audit of the firm shall be carried out to ensure the adherence to its quality assurance plan and its general quality consciousness as per extant RDSO ISO procedures. This quality audit may also be carried out on the need basis in case of reports of severe premature failures of the product are received from Railways. For establishing this, the samples shall be collected from Railways and sent to RDSO, Lucknow as and when required for carrying out the tests mentioned in this Specification.

16.0 QUALITY ASSURANCE PLAN (QAP)

16.1 The manufacturer shall prepare a quality assurance program (QAP) as per the relevant ISO Document i.e. QO-F-8.1-7 (latest) of Annexure-A7 and submit it for approval to the DG/Wagon/RDSO and shall obtain his approval before commencing the manufacture of the spring. Besides other aspects, the following salient points shall be taken into consideration for the pretion of QAP to be submitted to the Approving Authority.

16.1.1 There should be at least one full time metallurgist 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 should be free from day-to-day production, testing & quality control responsibility. He should be mainly responsible for development for product, analysis of products, control over raw material and corrective action in case of difficulties in achieving the meters.

16.1.2 The in-charge of the Quality Control Section should 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 should be actively involved in day-to-day activities of quality control / stage inspection / compliance of QAP etc.

16.1.3 There should be a system to ensure use of correct raw material and traceability of the product from raw material stage to finished product stage. This system should also facilitate to identity the raw material composition from the finished product stage.

16.1.4 Ensure that there is a system to identify defective components at various stages of manufacture, the reasons for occurrence of defects and also a system for disposal of those defective rejected components.

16.1.5 Ensure that proper analysis is being done on monthly basis to study the rejection/defect at various in internal stages, and to take corrective action thereafter.

16.1.6 Ensure that a proper documentation of all the above steps is there, which is to be presented on demand inspecting agency/RDSO officials.

16.1.7 Ensure the proper record of complaints received from customers and corrective action take thereof, is maintained.

16.1.8 Following parameters to be included in QAP, Section- (E)

(i) Details of Incoming Raw Materials: Details that includes Grade of the material, Supplier Certificate including test meters, meters for Inspection, Mode of Inspection, Equipment used for testing, Acceptable Limit, National/International Standards if any of following raw material shall be incorporated.

a) Spring Steel Round
b) Quench oil
c) Phosphatizer and Powder Coating Paints
d) Steel Ball for Shot Peening
e) Any Others

(ii) Details of In-process Inspection: Details that includes manufacturing Process meters to be controlled and checked, Quality Check Points, Characteristics of Product meters, Characteristics of Process meters, Mode of Inspection, Equipment used for testing, Acceptable Limit, National/International Standards if any of following major process shall be incorporated.

a) Straightening
b) Peeling and centre-less grinding
c) Magnetic Particle testing
d) End tapering
e) Stamping
f) Heating
g) Coiling
h) Quenching
i) Tempering
j) Testings of Tempered spring
k) End surface grinding
l) Scragging
m) Shot Peening
n) Crack detection of finished spring
o) Load testing
p) Protection against corrosion

17.0 PROCESS FOR VENDOR REGISTRATION AND PROTOTYPE TESTING

All manufactures seeking approval for supply of Hot coiled helical springs covered under this specification, to Indian Railways shall follow the procedure outlined below:

17.1 RDSO document 'Vendor application processing' ISO QO-D-8.1-6 (latest) shall be followed for the registration and approval of the firm. For document scrutiny the firm shall refer the ISO document No QO-F-8.1-1 and No QO-F-8.1-7. For Capability assessment the firm shall refer the ISO document No ISO QO-F-8.1-8, RDSO Document No STR (QMS-17:2000 latest), this specification and QAP.

17.2 Based on successful completion of above, prototype testing shall be undertaken. For this purpose, manufacturer shall manufacture 50 nos. of each. type of spring for prototype testing of Springs following this specification along with provisionally approved QAP.

17.3 On receipt of permission for prototype manufacturing, the manufacturer shall then give 15 days' notice to DG (Wagon)/RDSO for witnessing complete manufacturing and testing process as per specified in this Specification and provisionally approved QAP for process inspection of prototypes manufacturing. Besides witness by RDSO complete process shall be video graphed and submitted to RDSO in a hard drive duly labeled.

17.4 After successful completion of above, confirmatory testing as mentioned in this specification (Part-A) shall be carried out at RDSO or any other lab approved by DG (Wagon)/RDSO for which firms shall submit samples to Director General (Wagon), RDSO, and necessary charges shall be paid by firm in advance as applicable. Five samples each shall be submitted, which shall be drawn by the Inspecting Officer or as nominated by DG (Wagon)/RDSO from a minimum lot of 50 numbers.

17.5 The manufacturing of proto samples of springs shall be done strictly as per relevant drawings, specification and provisionally approved QAP. Quality conformance shall be checked with respect to the requirements of this specification. All tests listed in this specification shall be done.

17.6 During prototype testing if any sample fails/not meeting requirements, the manufacturer has to review the process and report has to be submitted to the approving authority i.e. DG(Wagon)/RDSO for consideration. Sample type testing will be carried out as per RDSO's ISO document no. QO-D-8.1-10 (latest) & other related documents that are applicable.

17.7 Based on the satisfactory prototype test results, manufacturing facilities found to be meeting the requirements in respect of infrastructure and field trial as mentioned above other requirements as covered in specification, the firm shall be considered for approval as a RDSO vendor for Developmental Orders for the manufacture and supply of Hot coiled helical springs as per the relevant and applicable RDSO procedure (s) for the same.

17.8 A manufacturer shall be considered from "RDSO approved vendor for Developmental order" to "approved" for manufacture and supply of coiled helical springs after satisfactory field performance of 6 month and supply for a minimum quantity as specified in item master on UVAM or as specified in the relevant RDSO document, in accordance to RDSO document no. QO-D-8.1-11 (latest).

17.9 The firm has to apply to RDSO for up gradation of their status from "RDSO vendor for developmental order" to "approved" and the same shall be processed as per relevant procedures applicable time to time.

17.10 All the provisions contained in RDSO's ISO procedures laid down in document No. QO-D-8.1-11 (Latest version) (titled "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.

17.11 All terms and conditions for vendor registration/approval of foreign firms shall be applicable as stipulated in RDSO ISO document QO-D-8.1-5 (latest version) title "Application for registration of vendor". In case of any contradiction between the clauses of this specification and ISO document QO-D-8.1-5 regarding the vendor registration/approval of foreign firms, the clauses of ISO document shall prevail.

17.12 Vendor-Changes in Approved status: All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 version No:1.7 date effective 22.01.2021 (titled "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.

ANNEXURE-I

DRAWING CODE OF SPRINGS FOR MAIN LINE COACHES

BOGIE	TYPE OF SPRING	ICF DRG. NO.	DRG. CODE NO.
ICF (BG)	AXLE BOX	F-0-1-006	A01
		WTAC-0-1-202	A03
		WLRRM 2-0-1-202	A04
		DD-0-1-001	A06
		WLRRM8-0-1-802	A09
		RDS0/SK-98017	A10
		RDS0/SK-K1038	A11
	BOLSTER	F-0-5-002	B01
		WTAC-0-5-202	B03
		WLRRM 2-0-5-202	B04
		DD-0-5-003	B06
		WLRRM8-0-5-802(OUTER)	B11
		WLRRM 8-0-5-802 (INNER)	B13
		RDS0/SK-98018	B16
		RDSO/SK-K1039	B17
		WGACCN3-0-5-302 (OUTER)	B18
		WGACCN3-0-5-302 (INNER)	B19
ICF (MG)	AXLE BOX	MG/T-0-1-029 or MG/T-0-1-002	C01
		MG/PLV-0-1-001	C02
		MG/AC-9-0-001	C03
		MG/AC-9-0-005	C04
	BOLSTER	MG/T-0-5-002	C50
		MG/PLV-0-5-001	C51
		MG/AC-9-0-001	C52
		MG/AC-9-0-005	C53
		MG/AC-9-0-005	C54
BEML (BG)	AXLE BOX	RDSO/SK-84259	D01
		RDSO/SK-84262	D02
	BOLSTER	RDSO/SK-84260(OUTER)	D50
		RDSO/SK-84260 (INNER)	D51
		RDSO/SK-84261(OUTER)	D52
		RDSO/SK-84261 (INNER)	D53
		RDSO/SK-84263	D54

ANNEXURE-II

CODE OF SPRING FOR MILK VAN

	TYPE OF SPRING	DRG. No.	DRG. Code No.
MILK VAN (BG)	AXLE BOX	RDSO/SK-65233	A51
	BOLSTER (FOR 100 KMPH)	RDSO/SK-76159 (OUTER)	B51
		RDSO/SK-76159 (INNER)	B52
	BOLSTER (FOR 110 KMPH)	CONTR-9013-S/2 (OUTER)	B53
		CONTR-9013-S/2 (INNER)	B54
		Item 1 of RITES DRG. No. RSD-6410-80 (OUTER)	B55
		Item 2 of RITES DRG. No. RSD-6410-80 (INNER)	B56
MILK VAN (MG)	AXLE BOX	MG/MV-1-0-002	C25
	BOLSTER	MG/MV-0-5-009 (OUTER)	C75
		MG/MV-0-5-009 (INNER)	C76

ANNEXURE-III

DRAWING CODE OF SPRING FOR EMU COACHES

S.No.	Drg. No.	Stock	Type	No. of/ coach	Code
1	DC/EMU-0-1-002	DC/EMU/TC, EMU/TC, DMU/TC & DTC, MEMU/TC	Primary	16	H25
2	DC/EMU/M-0-1-002	DC/EMU/M	Primary	16	H06
3	DC/EMU-0-5-005/2	DC/EMU/TC, EMU/TC	Secondary (outer)	8	H60
4	DC/EMU-0-5-005/1	DC/EMU/TC, EMU/TC	Secondary (inner)	8	H61
5	DC/EMU/M-0-5-008/1	DC/EMU/M	Secondary (outer)	8	K46
6	DC/EMU/M-0-5-008/2	DC/EMU/M	Secondary (inner)	8	K45
7	DC/EMU/H_2-0-5-202/1	DC/EMU/TC (HCC)	Secondary (outer)	8	H66
8	DC/EMU/H_2-0-5-202/2	DC/EMU/TC (HCC)	Secondary (inner)	8	H65
9	DC/EMU-0-5-008/2	DC/EMU/TC	Secondary (outer)	8	H67
10	DC/EMU-0-5-008/1	DC/EMU/TC	Secondary (Inner)	8	H68
11	DC/EMU$_2$-0-1-203	DC/EMU/T/ASR, AC/EMU/C/ASR, AC EMU/D/ASR	Primary	16	H26
12	DC/EMU/M_2-0-1-203	DC/EMU/M_2, AC/ EMU /M/ASR, AC/DC EMU/M_2, AC/DC EMU/C_2, AC/DC EMU/D_2, AC/DC EMU/D_2/HC, DC/EMU/M, DC/EMU M/ASR	Primary	16	H07
13	EMU/M-0-5-049/1	EMU/M	Secondary (outer)	8	K41
14	EMU/M-0-5-049/2	EMU/M	Secondary (inner)	8	K40
15	EMU/M-0-1-024	EMU/M, DHMU/DPC, DHTC/SAN, ARTV	Primary	16	K01
16	EMU/M-0-5-050/1	EMU/M	Secondary (outer)	8	K42
17	EMU/M-0-5-050/2	EMU/M	Secondary (inner)	8	K43
18	EMU/M-0-5-004/1	EMU/M, DD	Secondary (outer)	8	K48
19	EMU/M-0-5-004/2	EMU/M, DD	Secondary (inner)	8	K47
20	J9A/B 2446	Jessop/EMU/TC	Primary	16	J25

21	J7A/B 1923/A	Jessop/EMU/TC	Secondary (outer)	8	J66
22	J7A/B 1923/B	Jessop/EMU/TC	Secondary (inner)	8	J65
23	J7B/B 1981A	Jessop/EMU/MC	Secondary (outer)	8	J46
24	J7B/B 1981/B	Jessop/EMU/MC	Secondary (inner)	8	J45
25	J9B/B 2498	Jessop/EMU/MC	Primary	16	J06
26	MEMU/TC-0-5-006/1	MEMU/TC & DTC & DMU/TC & DTC	Secondary (outer)	8	G57
27	MEMU/TC-0-5-006/2	MEMU/TC & DTC & DMU/TC & DTC	Secondary (inner)	8	G58
28	MEMU/DMC-0-1-002, RDSO/SK-92006	MEMU/DMC	Primary	16	G01
29	MEMU/DMC-0-5-02/1, RDSO SK-92007	MEMU/DMC	Secondary (outer)	8	G51
30	MEMU/DMC-0-5-002/2 RDSO/SK-92007	MEMU/DMC	Secondary (inner)	8	G52
31	MEMU/TC2-0-1-201	MEMU/TC	Primary	16	G07
32	MEMU/TC2-0-5-201/1	MEMU/TC	Secondary (outer)	8	G60
33	MEMU/TC2-0-5-201/2	MEMU/TC	Secondary (inner)	8	G59
34	MEMU/DMC-0-1-001	MEMU/DMC	Primary	16	G02
35	DMU/DPC-0-1-001	DMU/DPC (700hp)	Primary	16	G13
36	DMU/DPC-0-5-004/1	DMU/DPC (700hp)	Secondary (inner)	8	G63
37	DMU/DPC-0-5-004/2	DMU/DPC (700hp)	Secondary (outer)	8	G64
38	DMU/DPC5-0-1-501	HP DMU/DPC	Primary	16	G14
39	DETC-0-5-001/1	DETC, DHMU/DPC	Secondary (inner)	8	G87
40	DETC-0-5-001/2	DETC, DHMU/DPC	Secondary (outer)	8	G88
41	MG/EMU-0-1-005	MG/EMU/TC	Primary	16	L25
42	MG/EMU/M-0-1-002	MG/EMU/M	Primary	16	L06
43	MG/EMU/M2-0-1-203	MG/EMU/M	Primary	16	L07
44	MG/EMU-0-5-002	MG/EMU/TC	Secondary	8	L65
45	MG/EMU/M-0-5-002	MG/EMU/M_2	Secondary	8	L45
46	MG/EMU/M_2-0-5-203	MG/EMU/M	Secondary	8	L46
47	MG/EMU/M_2-0-5-204/1	MG/EMU/M_2	Secondary(outer)	8	L48
48	MG/EMU/M_2-0-5-204/2	MG/EMU/M_2	Secondary(inner)	8	L47

ANNEXURE-IV

DRAWINGS CODES OF SPRINGS FOR CONTAINER FLATS

S.N.	Type of Bogie	Location of Spring	Type	Drg. No.	Code
1	LCCF-20(C)	Bolster	Outer	CONTR-9404/S-7 ITEM-1	CF01
2	LCCF-20(C)	Bolster	Inner	CONTR-9404/S-7 ITEM-2	CF02
3	LCCF-20(C)	Bolster	Snubber	CONTR-9404/S-7 ITEM-3	CF03
4	LCCF-20(C)	Side Bearer		CONTR-9404/S-15 ITEM-3	CF04

ANNEXURE-V

BG, MG & NG FREIGHT STOCK COIL SPRINGS DRAWING CODES

B.G.

S.N.	Type of Bogie /Assembly	Location of Spring	Type	Drg. No.	Code
1	CASNUB BOGIE (NLB,W(M))	Bolster	Outer	WD-83069-S/1 ITEM-1	X01
2			Inner	WD-83069-S/1 ITEM-2	X02
3			Snubber	WD-83069-S/1 ITEM-3	X03
4	Cast Steel/ Diamond Frame Bogie (16.25t)	Bolster	Outer	W/BE-606 ITEM-1	X04
5			Inner	W/BE-607 ITEM-2	X05
6	Draft Buffer Spring	Draft Buffer Spring	Outer	W/BD-357	R01
7			Inner	W/BD-365	R02
8			Outer	W/BD-366	R03
9			Inner	W/BD-373	R04
10			LH	W/BD-409	R05
11			RH	W/BD-457	R06
12			Recoil Spring	W/BD-430	R07
13			Outer	W/BD-372	R08
14			Outer	W/BD-375	R09
15			Inner	W/BD-377	R10
16			Outer	W/BD-376	R11
17			Friction Draft Spg.	W/BD-463	R12
18				W/BD-464	R13
19	CASNUB HS BOGIE	Bolster	Outer	WD-92058-S/5 ITEM-1	X06
20			Inner	WD-92058-S/5 ITEM-2	X07
21			Snubber	WD-92058-S/5 ITEM-3	X08
22	IRF-106 HS BOGIE	Bolster	Outer	WD-97030-S/8 ITEM-1	X17
23			Snubber	WD-97030-S/8 ITEM-2	X18
24	IRF-108 HS BOGIE	Bolster	Outer	WD-98014-S/3 ITEM-1	X19
25			Inner	WD-98014-S/3 ITEM-2	X20
26			Snubber	WD-98014-S/3 ITEM-3	X21
27	BVZI	Bolster	-	WD-00039-S/11 ITEM-5	X24
28		Axle Box	-	WD-00039-S/11 ITEM -4	T01
29	CASNUB HS (MOD-I) BOGIE	Bolster	Outer	WD-04017-S/4 ITEM-1	X25
30			Inner	WD-04017-S/4 ITEM-2	X26
31			Snubber	WD-04017-S/4 ITEM-3	X27
32	CASNUB HS (MOD-II) BOGIE	Bolster	Outer	WD-08026-S/3 ITEM-1	X28
33			Inner	WD--08026-S/3 ITEM-2	X29

34			Snubber	WD--08026-S/3 ITEM-3	X30
35	IRF 108 HS BOGIE	Side Bearer	Outer	WD-98014-S/5 ITEM-10	X31
36			Inner	WD-98014-S/5 ITEM -11	X32
37	LWLH25 Bogie.	Bolster	Outer	WD-98014-S/3 ITEM -1	X19
38			Inner	WD-98014-S/3 ITEM -2	X20
39			Snubber(Outer)	WD-13012-S/7 ITEM -1	X33
40			Snubber(Inner)	WD-13012-S/7 ITEM -2	X34
41	Spring Loaded Side Bearer	Spring Loaded Side Bearer	Outer	WD-12007-S/1 ITEM-3	X35
42			Inner	WD-12007-S/1 ITEM-4	X36
43			Outer	WD-12008-S/1 ITEM-3	X37
44			Inner	WD-12008-S/1 ITEM-4	X38
45			Outer	WD-17025-S/1 ITEM-3	X39
46			Inner	WD-17025-S/1 ITEM-4	X40
47	RFT Bogie	Bolster	Outer	WD-22055-S/1	X41
48			Inner	WD-22055-S/2	X42
49			Snubber (Outer)	WD-22055-S/3	X43
50			Snubber (Inner)	WD-22055-S/4	X44

BG, MG & NG FREIGHT STOCK COIL SPRINGS DRAWING CODES

M.G.

S.N.	Type of Bogie	Location of Spring	Type	Drg. No.	Code
1	12.2t CAST STEEL BOGIE	Bolster	Inner	W/BE-761	Y01
2			Outer	W/BE-816	Y02
3	12.2t CS BOGIE MOD-1	Bolster	Outer	WD-86044-S/1 ITEM-1	Y03
4			Inner	WD-86044-S/1 ITEM-2	Y04
5			Snubber	WD-86044-S/1 ITEM-3	Y05
6		Coupler Spring	Yoke End Hook End	W/BD-653	S01
7				W/BD-667	S02
8				DRG. NO. 3470/68/5	S03
9				DRG. NO. 3470/68/6	S04
10	14t HIGH SPEED BOGIE	Bolster	Load Bearing	WD-89065-S/5 ITEM-1	Y06
11			Snubber	WD-89065-S/5 ITEM-3	Y07
12	14t CS FRICON BOGIE	Saddle (Axle Box)	Inner/Snubber	WD-90119-S/7 ITEM-1	U01
13			Outer	WD-90119-S/7 ITEM-2	U02

N.G.

S.N.	Type of Bogie	Location of Spring	Type	Drg. No.	Code
1	8.1t CAST STEEL BOGIE	Bolster	Outer	SK-58363/M ITEM-1	Z01
2			Inner	SK-58363/M ITEM-2	Z02
3		Coupler Spring	Yoke End Hook End	W/BD-3118	Q01

NOTE:-

Following codes have been allotted for freight stock springs

X-01 T0 X-99	Bolster Coil Springs	B.G.
Y-01 TO Y-99		M.G.
Z-01 TO Z-99		N.G.
T-01 TO T-99	Axle Box Springs	B.G.
U-01 TO U-99		M.G.
V-01 TO V-99		N.G.
R-01 TO R-99	Draft Gear Springs	B.G.
S-01 TO S-99		M.G.
Q-01 TO Q-99		N.G.

ANNEXURE-VI

RAW MATERIAL, MANUFACTURER'S CODE

S. No.	Manufacture of Spring Steel Round	Manufacturer's code as per Vendor Directory	Code to be stamped on spring
1.	AdhunikMetaliks Ltd	AML	A
2.	Bhushan Power & Steel Ltd	BPSL	B
3.	JayaswalNeco industries Ltd	JNIL	JN
4.	JSW Steel Limited	JSW	J
5.	Modern Steels Limited	MSL	M
6.	R.L. Steels & Energy Ltd	RLS	R
7.	Sunflag Iron & Steel Co. Ltd	SF	S
8.	Surya Alloy Industries Limited	SA	SA
9.	Upper India Steel manufacturing and Engg. Co. Ltd.	UIS	U
10.	Usha Martin (Usha Alloy & Steel Division)	UMI	UM
11.	Vardhman Special Steels Ltd	VSSL	VM
12.	VISA Steel Limited	VSL	VS
13.	Vishvesvaraya Iron & Steel	VISP	V

***

Annexure-F 1

Proforma for Field Trial Scheme of Hot Coiled Helical Spring used in Wagon

Spring Manufacturer Name-

Date of Fitment- Type of Bogie (Casnub/LWLH)-

Place of Fitment-

SN	Check During Fitment				Check After 6 month					
	Wagon no.	Spring Type/Drawing no.	Marking Details	Free Height of Spring(mm)	Free Height of Spring(mm)	Permanent Set (mm)	Permanent Set within Limit (Yes/No)	Date of failure (if any)	Type of Failure	Remark

RDSO Representative Sign. SSE/Incharge Sign. Firm Representative Sign.

PART-B

TECHNICAL SPECIFICATION FOR COLD COILED HELICAL SPRINGS USED ON FREIGHT STOCK

1.0 SCOPE

1.1 This Specification is applicable for high performance cold coil helical springs used in the suspension system of Freight Stock on the Indian Railways. This standard covers springs which are to be manufactured out of circular section bars.

1.2 This specification is intended to cover general requirements of heavy duty helical springs of Freight Stock which call for stricter control in raw material quality, manufacturing processes and testing standards to improve the reliability and life of springs. Firm may offer alternate process, infrastructure with justification/ evidence and with the approval of RDSO to establish that the same can provide consistent output to desired level.

1.3 This Part of the Specification requires references to the following ASTM/IS/UIC Specifications. The latest amendment/revision/corrigendum of the specifications shall be referred wherever applicable.

i.	IS: 4748	Standard Test Method for determining average grain size.
ii.	IS: 11371	Standard Method of Macrotech Testing, Inspection and Rating Steel Products, Comprising Bars, Billets, Blooms and Forgings
iii.	IS:228	Methods of Chemical Analysis of the steel.
iv.	IS:1500	Methods for Brinell Hardness Test for steel.
v.	IS:2074	Ready mixed paint air drying red oxide zinc chrome priming.
vi.	IS:2932	Specification for Enamel Synthetic exterior type I undercoating (b) finishing colour as required.
vii.	IS: 3073	Assessment of Surface Roughness.
viii.	IS: 4454	
	(Part-I)	Steel Wire for Mechanical Springs- Specifications (Cold Drawn unalloyed steel wire .
	(Part-II)	Steel Wire for Mechanical Springs- Specifications (Oil Hardened and tempered steel wire)
ix.	IS: 3703	Code of practice for Magnetic particle Flaw Detection.
x.	IS:3848-1981	Method of End Quench Tests for Hardenability
xi.	IS: 4163	Methods for determination of inclusion content in steel by

		Microscopic Method.
xii.	IS: 6396	Methods of measuring decarburized depth of steel.
xiii.	IS: 7001	Methods for shot peening and test for shot peened ferrous metal parts.
xiv.	IS: 7739	Code of practice for pretion of Metallographic Specimens.
xv.	IS: 7906	
	(Part i)	Helical Compression Springs (Design and Calculations forsprings made from circular section wire or bar)
	(Part ii)	Helical Compression Springs (Specification for cold coiled springs made from circular section wire or bar)
xvi.	UIC 822	Technical Specification for the supply of Helical Compression Springs, hot coiled, for tractive and trailing stock.
xvii.	ASTM A 304-90	Specification for hardenability Band (Fig. 71 of 92060 H)
xviii.	IS:1608	Metallic Materials- Tensile Testing at ambient Temperature.

1.4 Specific provisions in this Specification will over ride those in the above ASTM/IS/UIC Specifications where these are not in conformity with one another.

1.5 Any special requirements given in the drawings will over ride this specification.

1.6 Inspecting authority shall mean RDSO or any other agency decided by the Purchaser in accordance with the requirements of this schedule, approved drawings and relevant IS specification.

1.7 Firm shall generally follow the infrastructure, manufacturing, testing and quality control requirement mentioned in this specification. However, the supplier can also offer alternate process infrastructure, manufacturing, testing facilities etc. Firm shall submit the detailed test report, documentary evidences, and the justification/ evidence to establish that the same can provide consistent output to desired level of output/ accuracy/ performance of the offered solution vis-à-vis specified in the specification to the Director General (Wagon)/RDSO, Lucknow for obtaining approval before use.

2.0 RAW MATERIAL

2.1 Manufacturing of Steel Wire

Unless otherwise specified on the drawings the material of the springs as applicable to different rolling stocks are: -

Table 1: Material of springs

Finished Wire Dia. 'd' (mm)	**Grade of Steel as per IS:4454(Part-2)**
	Freight Stock
d ≤ 12	**54SiCr6(FDSiCr)***

Note*

i) The contents of Sulphur, Phosphorus and tramp elements shall be maintained as under.

S	-	0.025% (maximum)
P	-	0.025% (maximum)
Sn+ Pb+As	-	0.1% (maximum)

~~2.1.1 Steel making through basic oxygen, electric arc process shall be employed and steel made through open hearth route shall not be used. The steel shall be refined in the ladle furnace and vacuum degassed before using continuous process. The continuous casting machine should have the facility of electromagnetic stirring.~~

Steel shall be manufactured by electric, duplex or a combination of these processes routed through secondary refining furnace. The routing of the steel through vacuum de-gassing plant is essential as an additional requirement. The permissible limit of hydrogen and nitrogen contents in liquid steel shall be 2.0 ppm (Max.) and 0.007% (Max.) respectively. In Ingot casting electromagnetic stirrer is not necessary. However, continuous casting machine should have the facility of electromagnetic stirring.

2.1.2 The size of ingots, billets or continuous cast billets for any given size of finished steel product shall be such that a minimum 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.

2.1.3 While ordering the raw material suitable allowance in the bar diameter shall be made for loss of material in peeling/center-less grinding and scaling during heat treatment.

2.1.4 Each coil of Wire Bundle shall consist of one single length of wire originating from one Heat only. Welding within coil shall not be allowed. The weight of the coils should be mutually agreed to between the purchaser and the manufacturer. Each coil of wire shall be legibly marked / Tagged with the following information:

(i) Name of Supplier
(ii) Wire Grade
(iii) Diameter of Wire
(iv) Weight of the coil
(v) Batch/ Heat No. Date of Supply
(vi) Quality Status

2.1.5 Firms supplying raw material for hot coiled helical springs as per Part-A of this specification shall also be eligible for the supply of raw material for cold rolled spring as per Part-B of this specification.

2.2 Quality of Spring Steel Wire

2.2.1 The spring steel wire shall also be free from harmful defects namely seams, folds, laps, cracks, deep rooted seams, holes, deep pits, grooves, excessive scaling and non-metallic inclusion which may lead to cracking during hardening or impair the serviceability of the material. The material shall also be free from harmful internal defects such as piping and segregations.

2.2.2 Macro etching shall be used for evaluating the heterogeneity of the steel and to ensure freedom from harmful internal defects. The macro etching test sample shall be prepared as per IS: 7739. Macro etch level shall not be worse than C2,R2,S2 of ASTM 381 Plate 1 for blooms and billets.

2.2.3 Microscopic examination shall be conducted on a longitudinal section for evaluation of non-metallic inclusion content. Method of sampling and the magnified photo micrographs for evaluation shall be as per IS: 4163. The inclusion rating shall be 1.5 ABCD for thin series and 1.0 ABCD for thick series when compared to the chart for determining the inclusion content of secondary refined steels (Fig.2) of IS:4163-1982.

2.2.4 Average grain size of the bar shall be to ASTM No.6 or finer when checked as per ASTM/E 112.

2.2.5 Permissible depth of seam and lap in the rolled bar shall be d/100 or 0.4 mm whichever is less (d is wire diameter). The test procedure for detecting surface seams shall be as per IS:3703.

2.2.6 The material shall be supplied in the form of Coils (Bundles) with proper identification as described in # 2.1.4.

2.2.7 All other conditions shall be as per IS: 4454.

2.3 Inspection of Spring Steel Wire

The Steel Manufacturer shall submit 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.

a) Chemical composition
b) Inclusion contents of rounds
c) Reduction ratio.
d) Depth of decarburization on rounds.
e) Dimensions

f) Other meters

2.3.1 While carrying out inspection of wire, the RDSO Inspector/authorized inspecting agency would pay special attention to:

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 16:1 is ensured for the rolled bars offered for inspection.

2.3.2 The RDSO Inspector/authorized inspecting agency shall carry out the following minimum checks as per sampling given in Clauses 2.3.2.1, 2.3.2.2,2.4 and 2.5 and maintain records. 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 meters by actual tests at his discretion and at the cost of the spring manufacturer.

2.3.2.1 Examine various registers and records maintained by the steel manufacture to verify heat wise checks carried out on various meters and manufacturing practices like production of ingots with wide end up and hot top cropping of each ingot/primary rolled billet etc.

2.3.2.2 All other aspects specified in Clause 2.0 shall also be checked.

2.3.3 The Inspecting officials shall also conduct Process/Stage inspection on monthly basis or as decided by DG/wagon, of different Process/Stages of production as included in the approved QAP.

2.4 Manufacturing & Inspection of Oil Hardened and Tempered Wire

2.4.1 Oil-tempered spring steel wires shall be manufactured in multi-strand type furnace. Firm can adopt any other proven technology with prior approval of DG/Wagon, RDSO. The Oil Hardened and tempered wires shall have almost no variation of quality in each whole length of wire.

2.4.2 Manufacturing of oil hardened and tempered wires shall be generally consisting of wire-drawing process and hardening-tempering process. Wire-drawing may be carried out through several dies in a continuous wire-drawing machine to produce desired diameters. Suitable coating shall be applied, in-line, which carries the lubricant powder into wire drawing dies.

2.4.3 Before starting wire heat treatment, the wire surface shall be cleaned through a mechanical process such as shot blasting which removes surface coat particles as well as surface defects. Heat-treatment furnaces shall be generally multi-strand-type furnaces, in which wires are laid in parallel for the heating process. Pipes shall be used in furnaces to hold inert atmosphere

through indirect heating of the wire. The hot wires shall be quenched with oil or any other suitable quench media and then tempered in furnaces such as molten lead furnaces.

2.4.4 State-of-the-art heat treatment furnaces shall be employed and must be capable of maintaining an even heat distribution within +/- 10°C throughout. To ensure uniform heating of the spring steel drawn wire, it is desirable that independent thermocouples and temperature controllers are provided in each area of the furnace. The established temperature and wire feed speed are ensured to achieve the required tensile strength and cross section reduction area. The temperature shall be controlled within +/- 10°C in each zone of the furnace. The temperature of the tempering furnace should also be maintained within +/- 10°C range of variation. Proper records of the feed speed & temperature of each zone shall be maintained for each coil in order to ensure the proper heat treatment of spring steel Wire.

2.4.5 All the stages of heat treatment with various temperature ranges of processes shall be clearly brought out in QAP. Inspecting Authority shall examine it with actual heat treatment process being followed during quality audit.

2.4.6 The manufacturer is required to develop and document heat-treating standards that describe the processes, process control, procedures, and record keeping requirements.

2.4.7 Heat Treatment Process is intended to ensure that products are properly heat treated. Furnace temperatures for heat treatment shall be controlled by pyrometers having associated recording equipment that produce time-temperature record charts that are identified by date and furnace number. A log sheet for each load of castings heat treated (batch) should show all information pertinent to each heat-treat load including the following:

a) Type of casting
b) Prescribed heat treatment
c) Serial numbers and the heat numbers of the castings
d) Actual time of heat treatment.

2.4.8 Pyrometers shall be calibrated every 3 months. Records of time-temperature charts, furnace log sheets, and pyrometer calibrations will be maintained for 3 years and available to the purchaser upon request.

2.4.9 To check the quality of Hardened and tempered spring steel wire, the following meters of the spring shall be checked:

i) Ultimate tensile Strength = 1910 Mpa -2060 Mpa
ii) Reduction Area ≥ 30%
iii) Microstructure=Tempered martensite structure

2.4.10 The Hardened and tempered spring steel wire shall be protected against corrosion and mechanical damage. Unless specified otherwise, the wire may have an oiled surface for all surface finish. The packing of material shall be done in such a way that corrosion does not

attack the material during transit. Each coil of hardened and tempered wire shall be legibly marked with the following information:

a) Name of Supplier
b) Wire Diameter
c) Grade
d) Coil Identification Number
e) Weight of Coil / Bundle
f) Heat No/ Batch Code No.
g) Date of Supply

2.4.11 Inspection Report duly marked with quality status shall be provided by the manufacturer of hardened and tempered wire along with each batch supply.

2.4.12 Heat treatment & wire drawing process specified in above clause may be outsourced from the spring manufacturer with complete quality control.

2.5 Sampling (Random) Procedure

Table 2: Sampling of Spring Steel wire

No.	Attributes	Relevant Spec.	Sampling
a.	Chemical Analysis	IS:228	2 Samples per heat per section.
b.	Tensile strenght	IS:1608	2 Samples per lot quantity.
c.	Macro Examination	IS:7739	0.5% subject to min. of 5 samples per heat.
d.	Depth of Decarburization	IS:6396	3 samples per heat per section
e.	Inclusion Content.	IS:4163	3 samples per heat per section
f.	Micro structure	ASTM Handbook Vol.9	3 samples per heat per section
g.	Visual checks for defects.	IS:4454(Part-I& Part-II)	2% of per heat per section.
h.	Verification of wire dia and Ovality	-do-	5 samples per heat per section.
i	Macroeatch	IS:13015	2 Samples per lot

Note-

1. Unless otherwise mentioned in drawing, the tensile strength & % reduction area of oil hardened and tempered spring steel wire to be calculated on actual wire diameter and shall be maintained as per IS:1608

2. The permissible maximum radial depths of partial decarburized layer shall not exceed the limit of 1% of nominal Wire Diameter (Refer Table-9 of IS: 4454-Part-2).

2.5.1 Records for all the above tests shall be made available for scrutiny of Inspector. Samples of the above test shall be preserved for at least 3 months for counter check by Inspector, if he so desires.

2.5.2 RDSO Inspector/authorized inspecting agency may pick up two samples per heat 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.

2.6 Rejection

2.6.1 In case the material offered for inspection fails in one or more of the criteria in 2.1, 2.2 & 2.3 or any other meter specified in this specification (Part-B), "double" the samples will be drawn and tested against the criteria in which the failure had occurred. If the "double" samples pass, the lot shall be accepted. Failure of the "double" sample will, however, result in the rejection of the complete lot. No further inspection shall be carried out until the firm has investigated and come up with satisfactory reason for the failure as well as the remedial action to improve the quality of material and also implemented the same.

2.6.2 In the event of rejection, the entire lot offered for inspection shall be made unusable for Railway application in the presence of the inspecting /purchasing authority.

3.0 MANUFACTURE OF HELICAL SPRINGS

3.1 General

Springs shall be made from Hardened and tempered spring steel to IS 4454 Part 2 as specified in the clause 2.1. The spring manufacturer before taking up manufacturing of springs shall inspect and check all steel rounds for conformance with the requirements for the raw material as given in this specification. Only when the raw material is found to be within the specific standards, will it be taken up for manufacture of the springs.

3.1.1 Generally the sequence for cold coil springs manufacturing shall be as given below:

1. Coiling
2. Stress Relieving (Ist Tempering)
3. Ends Grinding
4. Shot Peening
5. Strain Aging (2nd Tempering)
6. Scragging
7. Crack Detection
8. Surface Protection

9. Grouping and Colour Coding
10. Marking

3.2 Coiling

3.2.1 The automatic cold coiling machine for the production of springs shall be proven and to international standards. The machine shall be capable of bending the wire into the form required by feeding it against a suitably shaped tools utilizing three point bending or suitable bending technique. Series of one or more pairs of feed rollers shall be provided to feed the coil into the coiling machine. The drive power to the feed rollers shall be either via clutch mechanism or any other technique to allow adjustment of the length of wire feed through an adjustable cam or any other mechanism.

3.2.2 High speed cold form coiling machines are either completely mechanically controlled by means of cam, levers, gears and screws OR computerized numerical controlled. Production shall be started and continued only if first sample piece are found confirming.

3.2.3 Free Length of coiled spring and outer diameter/ inner diameter shall be monitored periodically and shall be recorded during coiling operation. The coiled springs shall be collected in a Basket/ Bin/ trolley and shall be moved for stress relieving operation with properly filled identification Tag.

3.3 Stress Relieving (Ist Tempering)

3.3.1 After coiling, the springs shall be conveyed through a continuous conversed tempering furnace. During Tempering the springs shall be heated to desired pre-determined temperature range and for a sufficient length of time to produce the required spring hardness throughout the section. The furnace shall be heated in electric or oil or gas fired indirect heating with automatic temperature controller and recorder.

3.3.2 In order to ensure the uniform heating of spring steel wire, it is recommended that each zone of the furnace should be provided with independent pyrometer for temperature control. The temperature shall be controlled within +/-10 ^{0}C in each zone of the furnace. The temperature of the tempering furnace should also be maintained within this range of variation.

3.3.3 The Furnace shall be equipped with automatic temperature controllers, indicators and conveyer speed control system. Proper record of Stress relieving shall be maintained.

3.4 Spring End Grinding

Both the end faces of the spring should be ground to ensure proper seating of the spring. The ends shall not have any sharp edges/burrs. The actual ground end surface shall be at least 75% of the mean coil circumference of the spring and the ends should not bite the effective coil. The minimum tip thickness of end coil should be at least 25% of wire dia. The end faces of the spring should not have blue marks due to end grinding as the same leads to temper

brittleness.

3.5 Shot Peening

3.5.1 All the springs shall be shot peened in shot peening machine, in accordance with IS: 7001 to improve fatigue life of the spring. Machine meters like Hot Spot, Size of Steel Shots, Current during peening period and time cycle need to be controlled during the process. It is important to limit the lot size (in case of tumblast shot peening machine) in order to get adequate peening coverage. Using the control lot size of springs, springs were then shot peened using a 0.80 to 1.00 mm diameter steel shots to achieve 14 - 16 A (0.350~0.400mm) intensity.

3.5.2 During shot peening it shall 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 almenstrip in accordance with IS: 7001. The minimum coverage (When checked visually) should be 90% and intensity when checked with Almen strip Type A.

3.6 Strain Aging (2nd Tempering)

Strain aging operation (2nd stress relieving) is done within a temperature of 200~230 Degree C for approx. 15~20 minutes after shot peening operation. The process shall be monitored as per this specification.

3.7 Scragging

Each and every spring should be scragged 3 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 spring should be scragged home. The scragging load in such cases should not exceed 1.5 times the theoretical axial load, corresponding to block length.

3.7.1 Long duration scragging is to be introduced as a process check at regular intervals and necessary documentation 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 2 minutes in the first two strokes and for 48 hours at the last stroke.

3.7.2 The scragged spring should not show further permanent set on subsequent loading.

3.8 Crack Detection

3.8.1 Crack detection of 100% springs shall be done through Magnetic Particle Testing by Wet method or dry powder method. The test procedure for detecting longitudinal as well as transverse cracks on the surface of springs should be as per IS 3703:2004.

3.8.2 Crack detection machine should be calibrated before testing of springs with standard block

for comparing the depth of surface defects.

3.8.3 Components which have been tested by magnetic particle flaw detection method often remain magnetized for a considerable time after testing. All tested springs shall be demagnetized A simple and effective method of accomplishing this is to insert the springs in the field of an alternating-current solenoid and gradually to withdraw it from the field.

3.9 Surface Protection

3.9.1 The springs should be covered with suitable protective coating, to protect against corrosion. The protective coating to be applied/anti-corrosive treatment to be given to the springs as specified in the drawing.

3.9.2 Alternatively the springs may be rust preventive oil coated, nickel-chrome plating, Powder Coating, Electro Coating or coating of enamel paint. The functional properties of the springs should not be impaired as a result of protective coating.

3.10 Grouping and Colour Coding:

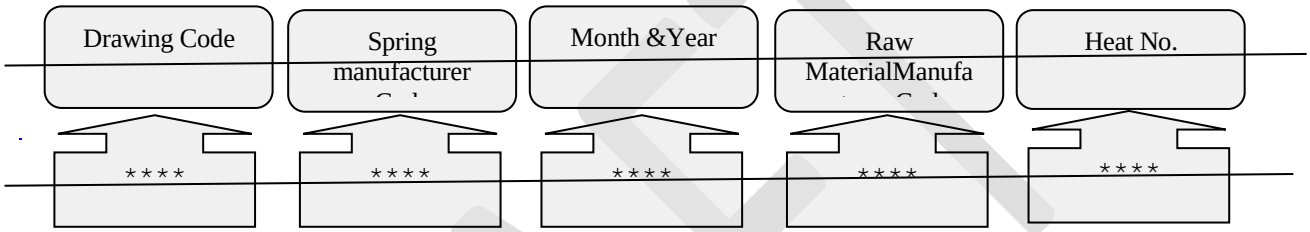
100% of the springs shall be compressed with specified working load and the loaded height of the individual springs shall be measured in spring testing machine. The working height of the spring shall be within the tolerances specified in the drawing. The springs shall be grouped and painted with suitable colour code for identification as specified in the drawing/tender document. Any spring which is found to be defective or which does not confirm to the test and other requirements of the specification should be rejected.

3.11 Marking-Digital Inkjet Printing

~~3.11.1 Each spring shall be identified for :~~

~~(i) Drawing Code~~
~~(ii) Spring manufacturer Code (XXXX)~~
~~(iii) Month & Year of production (e.g.Jan 2021as 0121)~~
~~(iv) Raw material manufacturer Code (XXXX)~~
~~(v) Material Heat Number (last 4 Digit)((YYYY)~~

~~3.11.2 The serial order in which the particulars are to be digitally printed on each spring shall be as given below:-~~

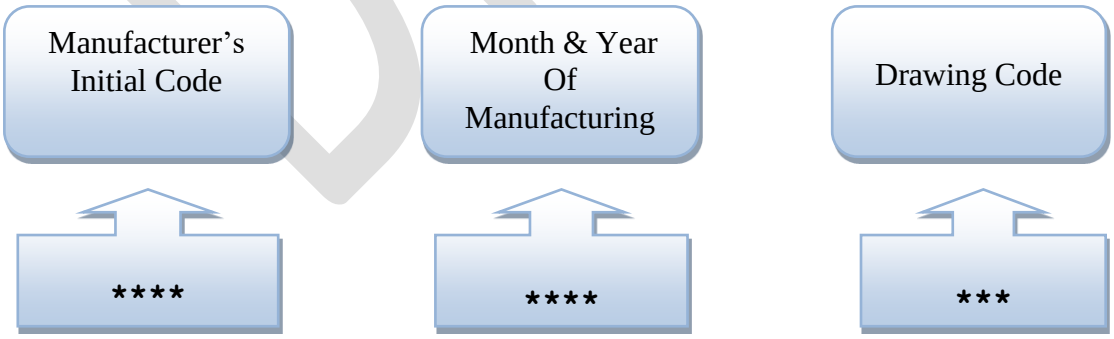


~~The Above Coding series order shall be fixed from left to right and should not be changed.~~

3.11.1 Each spring shall be identified for :

(i) Spring manufacturer (Code Not more than four character-XXXX)
(ii) Month & Year of production (e.g.Jan 2024 as 0124)
(iii) Drawing Code

3.11.2 The serial order in which the particulars are to be digitally printed on each spring shall be as given below:-



The Above Coding series order shall be fixed from left to right and should not be changed.

3.11.3 The Size of Letters and Digits shall be used in such a way that the digitally printed material is easily readable.

3.11.4 The colour of printing shall be in contrast colour in respect to the base coat on the surface of spring

3.11.5 Since, springs are used in all types of tough climatic conditions, hence the marking should be durable and long lasting.The ink for digital printing shall be used in such a way that it should not be erased by oil or grease or simply rubbing by hand.

3.12 The tentative sequence for manufacturing of cold coil spring has been specified as above. The firm may opt for any other manufacturing sequence for production of spring.

4.0 GEOMETRICAL CHARACTERISTICS

4.1 General

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

4.2 Dimensional Accuracy

The dimensional accuracy of the springs shall conform to the tolerances given in the Indian Standard IS:7906 Part-2 or specified in the drawing.

4.2.1 The solid height (LB) of the spring made from steel wire should be:

Solid height of a compression spring is the point at which all its coils touch each other. For Closed and Ground Ends Compression Spring,
Solid Height or Block Length Lb≤ Total Number of Coils x Wire Dia meter (Refer #3.4 of IS 7906 Part 2).

4.3 Pitching

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.

4.4 Lateral Deflection

When prescribed on the drawing, the lateral deflection characteristics shall be checked by means of suitable device approved by the Purchaser.

5.0 LOAD TESTING

5.1 The spring shall be tested on a spring testing machine, as per load chart of the drawing. Each load is maintained till the load is stabilized after which the corresponding height of the spring (under load) is determined. The tolerance on the height of the spring under static load shall

be as indicated on the drawing or in the absence thereof, should not be more than ±3% design deflection value at nominal working load and + 6% / -4% of design deflection value at other loads.

5.2 The spring stiffness shall be within + 3.4% of the design value. It should be determined by dividing the difference of load between 70% and 30% of the designed home load by the difference of measured deflection between these two loads.

6.0 FATIGUE TESTING

The purpose of fatigue testing of cold coiled helical spring is to ascertain that the springs meet the expected life during service. Fatigue testing of the springs shall be done during the initial approval of a manufacturer for the spring by RDSO. It shall subsequently be done in first lot of each type of spring supplied in every alternate year.

6.1 Test Setup

The test setup primarily consists of a fatigue test machine and spring fixture. The machine should have the facility to record deflection as well as load simultaneously. The springs can be tested as a single spring or together with other spring in the fixture. The fixture should be designed in such a way that both the ends of the spring remain llel and perpendicular to the loading direction. The end plates of the fixture should not allow spring to move sideways.

6.2 Test and Measurements

6.2.1 All spring samples should be marked before commencing the fatigue test.

6.2.2 The following meters of the springs are to be measured before and after the fatigue test.

a) Free height of spring.
b) Actual load at static (working) height as per RDSO drawing.
c) Load verses height graph from free height to static height and free height to solid height.

6.2.3 The fatigue test is to be displacement controlled from the static height of the spring. The displacement of the test is +/- 30% of the static deflection of the spring.

6.2.4 The frequency of the test should be maximum obtainable safely as per actual displacement and fatigue test machine capability. (But not less than 2Hz). The frequency at which spring is fatigue tested should be recorded.

6.2.5 The springs shall be fatigue tested for two million cycles or as specified in the drawing. 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.

6.2.6 After completion of fatigue testing, spring shall be checked by magnaflux testing for any crack/indication of cracks.

6.3 Test Report

The test report shall be furnished that includes the data of spring before fatigue test, during fatigue test and after the fatigue test. It should also include the failure analysis of the spring failed during fatigue test.

7.0 HANDLING OF SPRINGS

The springs should be properly handled during manufacture. Springs should not be thrown on floor or roll at any stage of manufacture to avoid any damage to the springs.

8.0 INSPECTION OF HELICAL SPRINGS

8.1 General

The material to be used in the manufacture of springs and the finished springs shall be subjected to inspection by the Purchaser's 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.

8.1.1 The Inspecting Officer or the Purchaser shall have free access to the works of the manufacturer at all reasonable times. He shall be at liberty to inspect the manufacture of the springs at any stage and to reject any material that does not conform to the Specification.

8.1.2 The manufacturer shall provide the Inspecting Officer, free of charge, all reasonable facilities by way of labour, appliances and necessary assistance for such tests 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.

8.1.3 The finished spring shall be presented for inspection in batches of not more than 1000. The springs shall be presented for inspection after the application of the protective coating against corrosion. The Inspector is free to have the sample springs shot peened for various tests.

8.2 Stage-I (Raw Material)

Shall be done as per Clause 2 of Part-B.

8.3 Stage-II during Manufacture

8.3.1 The **manufacturer** shall carryout all necessary checking of all the spring steel bars for surface finish, crack detection, the depth of decarburization of springs during the heat treatment, surface hardness etc. and maintain records for each tests as per QAP.

8.3.2 The Inspecting officials shall also conduct Process/Stage inspection on monthly basis or as decided by DG/wagon, of different Process/Stages of production as included in the approved QAP.

8.3.3 These **records** must be presented to the Inspecting official during the purchase inspection.

8.4 Stage-III Finished Spring

For each batch of finished springs or part thereof presented for inspection the following tests shall be made out of springs selected at random by the Inspecting official:-

8.4.1 Checking of records for quality verification of raw materials used by the firm.

The inspecting official shall check the records and ensure that verification has been done by the firm on the spring material used before commencing the manufacture of springs as per checks specified in this specification.

8.4.2 The inspecting official shall carryout following checks on the finished springs:

Table 3: Checks on the finished springs

S. No.	Description of check	Sample Size	Equipment used	Specification Used
1.	Spring surface	100% springs	Visual as finished	---
		2% springs	Visual after shot peening	
2.	Digital Inkjet Printing	5% or 20 springs whichever is less	Visual	---
3.	Free height measurement	5% or 20 springs whichever is less	Gauge	---
4.	Squareness	5% or 20 springs whichever is less	--	IS:7906
5.	Parallelism	5% or 20 springs whichever is less	--	IS:7906

6.	End preparation	5% or 20 springs whichever is less	Visual	
7.	Tip thickness	5% or 20 springs whichever is less	Vernier caliper	
8.	Scragging	5% or 20 springs whichever is less	Spring testing machine	
9.	Static load test-stiffness	5% or 20 springs whichever is less	Spring testing machine	
10.	Static load test-working height	5% or 20 springs whichever is less	Spring testing machine	
11.	Minimum spacing between two active coils under 85% deflection	5% or 20 springs whichever is less	Spring testing machine	
12.	Uniformity of pitch	5% or 20 springs whichever is less	Spring testing machine	
13.	Crack detection	5% or 20 springs whichever is less	---	Appendix-B of UIC- 822
14.	Shot peening	Internal test records	Almen Gauge	IS:7001
15.	Ultimate Tensile strength	1% or 3 Springs whichever is less	UTM	IS:1608
17.	Chemical Composition.	1% or 3 Springs whichever is less	Spectrometer/ chemical testing equipment/3rd Party Test Report (NABL)	IS:228
18.	Depth of Decarburization.	1% or 3 Springs whichever is less	3rd Party Test Report (NABL)	IS:6396
19.	Grain Structure	1% or 3 Springs whichever is less	Photo microscope/3rd Party Test Report (NABL)	ASTM E-112
20.	Inclusion Rating	1% or 3 Springs whichever is less	Photo microscope/3rdParty Test Report (NABL)	IS:4163
21.	Macro etching	1% or 3 Springs whichever is less	Photo microscope/3rd Party Test Report (NABL)	IS:7739
22.	Paint quality/Powder	5% springs	DFT Meter	IS:2074 &

	Coating			IS2932
23.	Grouping and colour coding	5% springs	Spring testing machine	---

Crack Detection test shall be done before surface treatment of the springs.

8.4.3 Records for all the above tests shall be preserved for at least 5 years and samples one year for counter check if so desired.

8.4.4 The spring manufacturer should submit a certificate to the effect that spring steel rounds purchased by the firm against specific purchase order from RDSO approved source and inspected as per corresponding Dispatch Memo No. has been used for manufacturing a particular batch of springs against particular purchase order and no other material has been used.

9.0 REJECTION

9.1 During the sampling inspection if any spring fails in one or more of the criteria specified in this specification (Part-B), "double" the samples will be drawn after removing the defective sample and tested against the criteria in which the failure had occurred. If the "double" samples pass, the lot shall be accepted. Failure of the "double" sample will, however, result in the rejection of the complete lot. No further inspection shall be carried out until the firm has investigated and come up with satisfactory reason for the failure as well as the remedial action to improve the quality of material and also implemented the same.

9.2 In the event of rejection, the entire lot offered for inspection shall be made unusable for Railway application in the presence of the inspecting /purchasing authority. 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 stages. This should be done in the presence of the Inspecting Officer immediately after the spring batch has been rejected.

10.0 PACKING OF SPRINGS FOR TRANSPORTATION

The springs are one of the most stressed components of the vehicle suspension. Hence, they should be suitably packed to ensure their safe transportation.
For packing the springs, a seamless polythene sleeve of minimum 500 micron thickness and appropriate diameter (matching the finished spring bar diameter) should be slide on the finished spring wire/bar and sealed from both the ends. The whole spring bar should then be wrapped with a thick jute strip such that no portion of the spring is exposed open. Transportation of spring in wooden boxes / pallets shall be preferable. Any other precaution in packing as may be deemed fit for safe transportation should be taken by the

spring manufacturer to avoid damage during transportation.

11.0 GUARANTEE FOR SPRINGS

The spring shall be guaranteed for a period of five years against any defect imputable to manufacture from the date of manufacture of the spring, as indicated in para 3.11 of this Specification. 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.

12.0 FIELD TRIAL:

12.1 To consider a new vendor for registration for developmental orders, a field trial must be conducted for LWLH bogie's springs (approximately 200 springs total) in minimum 20 wagons (CC Rake). The field performance should be monitored as per the format provided in Annexure-F2. After 6 months of installation, 20 spring should be removed from wagons and inspected according as Annexure-F2. Approval may be granted after installation and satisfactory field performance of the springs in wagons over the 6 month period.

12.2 The firm shall submit all copies of the purchase order (issued by the purchaser) to RDSO. The wagon depots(s) where the spring shall be supplied and fitted will be nominated by RDSO (Wagon Directorate) in order to monitor their field performance.

12.3 Wagon directorate shall monitor all springs manufactured by the firm for field performance on CC rakes. Firm shall be permitted to supply maximum 20000 nos. springs during the trials duly inspected by inspecting agency for ascertaining performance & reliability evaluation.

12.4 The Vendor shall also ensure that they do not secure total order quantity more than the limited quantity mentioned in the Vendor Directory.

12.5 Failure criteria shall be as follows:-

12.5.1 During field performance monitoring, Railways shall maintain and provide Quarterly performance details of springs to Wagon Directorate.

12.5.2 The performance details shall include Monthly fitment details (Month & Year of Manufacturing, Month & Year of Fitment and Fitment Quantity), Monthly failure details (Month & Year of Manufacturing, Month & Year of Failure and Failure Quantity).

12.5.3 During field performance monitoring, failure of springs shall not be more than 1 % of spring fitted during the entire trial period.

12.5.4 If the spring failure is more than 1% of total spring under field performance monitoring period (six months), the field trials may be extended for another six months again. However, the failure upto the extended period should not be more than 1.5%. Springs not meeting this extended field trial criteria shall investigate the cause/s and the firm's application for registration of it's name for the subject item may be considered failed and a fresh application

shall be made for.

12.6 During field performance monitoring, detailed field performance of spring shall also be monitored. For this, 100 springs shall be fitted in nominated wagons in presence of Wagon Directorate Officials. Firm shall provide a unique serial number to each of these 100 springs.

12.7 After completion of six months, 10 springs of each type out of these 200 springs shall be randomly picked from the field for detailed testing. These springs shall be checked as per Annexure-F2. The spring shall be considered as "failed" if the permanent set of spring has crossed the specified limit or any cracks appeared on springs.

12.8 After successful field trial, firm shall be registered as 'RDSO Vendor for Developmental Orders'. Final approval shall be accorded as per existing procedure prevailing at that time.

13.0 QUALITY AUDIT

The quality audit of the firm shall be carried out to ensure the adherence to its quality assurance plan and its general quality consciousness as per extant RDSO ISO procedures. This quality audit may also be carried out on the need basis in case of reports of severe premature failures of the product are received from Railways. For establishing this, the samples shall be collected from Railways and sent to RDSO, Lucknow as and when required for carrying out the tests mentioned in this Specification.

14.0 QUALITY ASSURANCE PLAN (QAP)

14.1 The manufacturer shall prepare a quality assurance program (QAP) as per the relevant ISO Document i.e. QO-F-8.1-7 (latest) of Annexure-A7 and submit it for approval to the DG/Wagon/RDSO and shall obtain his approval before commencing the manufacture of the spring. Besides other aspects, the following salient points shall be taken into consideration for the pretion of QAP to be submitted to the Approving Authority.

14.2 There should be at least one full time metallurgist 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 should be free from day-to-day production, testing & quality control responsibility. He should be mainly responsible for development for product, analysis of products, control over raw material and corrective action in case of difficulties in achieving the meters.

14.3 The in-charge of the Quality Control Section should 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 should be actively involved in day-to-day activities of quality control / stage inspection / compliance of QAP etc.

14.4 There should be a system to ensure use of correct raw material and traceability of the product from raw material stage to finished product stage. This system should also facilitate to identity the raw material composition from the finished product stage.

14.5 Ensure that there is a system to identify defective components at various stages of manufacture, the reasons for occurrence of defects and also a system for disposal of those

defective rejected components.

14.6 Ensure that proper analysis is being done on monthly basis to study the rejection/defect at various in internal stages, and to take corrective action thereafter.

14.7 Ensure that a proper documentation of all the above steps is there, which is to be presented on demand inspecting agency/RDSO officials

14.8 Ensure the proper record of complaints received from customers and corrective action take thereof, is maintained.

14.9 Following meters to be included in QAP, Section- (E)

(i) Details of Incoming Raw Materials: Details that includes Grade of the material, Supplier Certificate including test meters, meters for Inspection, Mode of Inspection, Equipment used for testing, Acceptable Limit, National/International Standards if any of following raw material shall be incorporated.

a) Spring Steel Wire
b) Paints
c) Steel Ball for Shot Peening
d) Any Others

(ii) Details of In-process Inspection: Details that includes manufacturing Process meters to be controlled and checked, Quality Check Points, Characteristics of Product meters Characteristics of Process meters, Mode of Inspection, Equipment used for testing, Acceptable Limit, National/International Standards if any of following major process shall be incorporated.

a) Coiling
b) Stress Relieving (1st Tempering)
c) End Griding
d) Shot Peening
e) Strain Aging (2nd Tempering)
f) Scragging
g) Crack Detection
h) Surface Protection
i) Load Test
j) Marking
k) Any Others

15.0 PROCESS FOR VENDOR REGISTRATION AND PROTOTYPE TESTING

All manufactures seeking approval for supply of Cold coiled helical springs covered under this specification, to Indian Railways shall follow the procedure outlined below:

15.1 RDSO document 'Vendor application processing' ISO QO-D-8.1-6 (latest) shall be followed for the registration and approval of the firm. For document scrutiny the firm shall refer the ISO document No QO-F-8.1-1 and No QO-F-8.1-7. For Capability assessment the firm shall refer the ISO document No ISO QO-F-8.1-8, RDSO Document No STR (QMS-17:2000 latest), this specification and QAP.

15.2 Based on successful completion of above, prototype testing shall be undertaken.
For this purpose manufacturer shall manufacture 50 nos. of each. type of spring for prototype testing of Springs following this specification along with provisionally approved QAP.

15.3 On receipt of permission for prototype manufacturing, the manufacturer shall then give 15 days' notice to DG (Wagon)/RDSO for witnessing complete manufacturing and testing process as per specified in this Specification and provisionally approved QAP for process inspection of prototypes manufacturing. Besides witness by RDSO complete process shall be video graphed and submitted to RDSO in a hard drive duly labeled.

15.4 After successful completion of above, confirmatory testing as mentioned in this specification (Part-B) shall be carried out at RDSO or any other lab approved by DG (Wagon)/RDSO for which firms shall submit samples to Director General (Wagon), RDSO, and necessary charges shall be paid by firm in advance as applicable. Five samples each shall be submitted, which shall be drawn by the Inspecting Officer or as nominated by DG (Wagon)/RDSO from a minimum lot of 50 numbers.

15.5 The manufacturing of proto samples of springs shall be done strictly as per relevant drawings, specification and provisionally approved QAP. Quality conformance shall be checked with respect to the requirements of this specification. All tests listed in this specification shall be done.

15.6 During prototype testing if any sample fails/not meeting requirements, the manufacturer has to review the process and report has to be submitted to the approving authority i.e. DG(Wagon)/RDSO for consideration. Sample type testing will be carried out as per RDSO's ISO document no. QO-D-8.1-10 (latest) & other related documents that are applicable.

15.7 Based on the satisfactory prototype test results , manufacturing facilities found to be meeting the requirements in respect of infrastructure and field trial as mentioned above other requirements as covered in specification, the firm shall be considered for approval as a RDSO vendor for Developmental Orders for the manufacture and supply of Cold coiled helical springs as per the relevant and applicable RDSO procedure (s) for the same.

15.8 A manufacturer shall be considered from "RDSO approved vendor for Developmental order" to "approved" for manufacture and supply of coiled helical springs after satisfactory field performance of 6 month and supply for a minimum quantity as specified in item master on UVAM or as specified in the relevant RDSO document, in accordance to RDSO document no. QO-D-8.1-11 (latest).

15.9 The firm has to apply to RDSO for up gradation of their status from "RDSO vendor for developmental order" to "approved" and the same shall be processed as per relevant procedures applicable time to time.

15.10 All the provisions contained in RDSO's ISO procedures laid down in document No. QO-D-8.1-11 (Latest version) (titled "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.

15.11 All terms and conditions for vendor registration/approval of foreign firms shall be applicable as stipulated in RDSO ISO document QO-D-8.1-5 (latest version) title "Application for registration of vendor". In case of any contradiction between the clauses of this specification and ISO document QO-D-8.1-5 regarding the vendor registration/approval of foreign firms, the clauses of ISO document shall prevail.

15.12 Vendor-Changes in Approved status: All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 version No:1.7 date effective 22.01.2021 (titled "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.

Annexure-F2

Proforma for Field Trial Scheme of Cold Coiled Helical Spring used in Wagon

Spring Manufacturer Name-

Date of Fitment- Type of Bogie-

Place of Fitment-

SN	Check During Fitment				Check After 6 month					
	Wagon no.	Spring Type/Drawing no.	Marking Details	Free Height of Spring(mm)	Free Height of Spring(mm)	Permanent Set (mm)	Permanent Set within Limit (Yes/No)	Date of failure (if any)	Type of Failure	Remark

RDSO Representative Sign. SSE/Incharge Sign. Firm Representative Sign.