Government of India: Ministry of Railways
Research Designs & Standards Organization
Manak Nagar, Lucknow-226 011

अ॰ ओ॰ मा॰ सं॰
RDSO
अनुमोदित
APPROVED
13/5/2021
For Director

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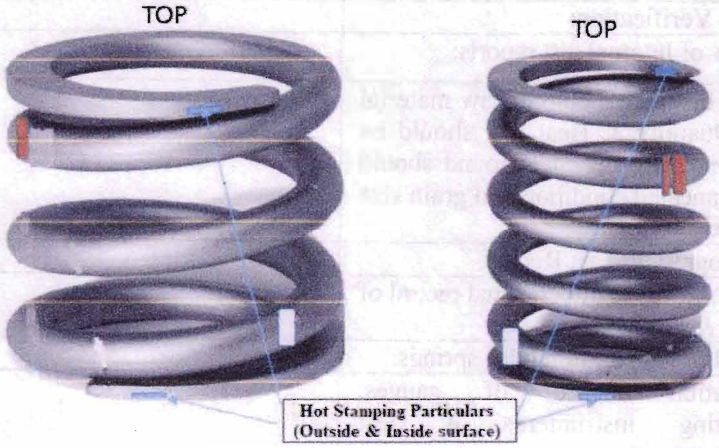
|---|---|
| **Check Sheet No.** | **QM-C-8.1/Primary Spring (VB)/001 Rev. 00** |
| **Inspection & Test Plan for Item** | **Primary Hot Coiled Cylindrical Springs for use in Suspension of I.R. Coaches having Trainset Design Bogies** |
| **Specification No.** | **RDSO Specification No. RDSO/2017/CG-01, Rev. 03 (or latest)** |
| **Spring Type (Primary Outer/Primary Inner)** | ..... |
| **Drawing No.** | ..... |

## A. GENERAL:

| | | |
|---|---|---|
| **1.** | Firm's Name & Works address | |
| **2.** | Date (period) of Inspection | |
| **3.** | Contract Details: | |
| | a. Contract no. and date: | |
| | b. Order placing authority: | |
| | c. Specification No. (as mentioned in contract): | |
| | d. Drawing no. (as mentioned in contract): | |
| **4.** | Quantity on order: | |
| **5.** | Quantity previously passed: | |
| **6.** | Quantity offered for inspection on date: | |
| **7.** | Quantity balance after this: | |
| **8.** | Consignee: | |
| **9.** | Delivery Period: | |
| **10.** | Documents Verification: | |
| | (a) Review of Internal test reports: | |
| | (b) Verify dispatch memo of raw material with Quantity & Heat No. should be mentioned. Spring Steel round should be in annealed condition and grain size must be 6 or finer. | |
| | (c) Metallographic Test Report. | |
| | (d) Surface finish & dimensional record of peeled & ground bar. | |
| | (e) Record of heat treatment of springs. | |
| | (f) Calibration record of gauges, measuring instruments & test equipment. | |
| | (g) Is Prototype approval letter available (Yes/No)? | |

**B. TESTS/CHECKS (TO BE WITNESSED BY INSPECTOR): LOT SIZE 500 NOS. SPRINGS OR PART THEREOF:**

| S. No. | Parameters & Para of Spec. No. RDSO/2017/CG-01 (Rev.03) | Specified Value | Observations/ Remarks |
|---|---|---|---|
| 1. | **Surface Quality of the Springs (Para No. 7.1.2):** | The surface of the springs shall not have any defects (lamination, grooves, machining marks, cracks, crevices etc.) which may be detrimental to spring performance or life. Any surface and sub-surface defects identified during the electromagnetic crack detection test shall not be permitted. **Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 2. | **Stamping (Para No. 7.3):** | The ends of rods (Para 7.2) shall be heated in an electric, oiled or LPG fired indirect heating furnace which are equipped with temperature controller and recorders. Temperature to which these ends shall be heated should be predetermined according to composition of the material. The stamping operation must be completed **before 850 $^0$C.** | |
| | | Following particulars shall be legibly hot stamped on both tapered ends (outer & inner side) in serial order:<br>**Manufac-turer's Code** \| **Month & Year of Producti-on** \| **Draw-ing Code** \| **Heat Code (in three letters/ digits)** \| **Raw Material Supplier's Code (In two digits)**<br>**e.g.** --- \| **MMYY** \| --- \| --- \| -- | |
| | | The location of stamping particulars on springs must be in the middle of the dead-end coils as shown in figure below, so that the chances of initiation of fatigue do not occur.<br>  <br>Hot Stamping Particulars (Outside & Inside surface) | |

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| | | Any deviation or exception from above may be accepted if vendor establishes alternate method will not have any negative implication on quality and traceability & has approval of RDSO. | |
| | | Size of letters of stamping shall be 5 mm on rods having diameter above 20 mm and 3 mm for bars having diameter 20 mm or less. No marking shall be done on springs made from rods of diameter of 9.5 mm and below.<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 3. | **Dimensional Accuracy of Spring (before painting) (Para No. 7.10.2):** | As per drawing & Dimension Sheet at **Annexure - 'A'**.<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 4. | **Scragging & permanent set (Para No. 7.6):** | Each and every spring shall be hot scragged three times in quick succession. Scragging load/height should be as laid down in the drawing. In case there is no indication in the drawing, the springs shall be scragged home. The scragging load in such cases should not exceed 1.5 times the theoretical axial load, corresponding to home length. The hot scragging temperature should be more than 90 $^0$C. After hot scragging process, the scragged spring should normally not show further permanent set on subsequent loading.<br>Results shall be recorded as per **Table 'A'.** (Sample size for Inspection authority verification shall as per Table 6 of EN 13298 (latest), randomly as per sample sheet for quick succession scragging test.<br>**Test records shall be shown to inspection authority.** | |
| | | Long duration scragging is to be introduced as a process check at regular intervals and necessary documents of the test results are to be maintained. For long duration scragging, the spring shall be compressed three times, holding it at the home load for two minutes in the first two strokes and for 48 hours at the last stroke. After long duration scragging, permanent set shall not exceed 2 mm of free height of primary spring, which is measured before scragging. Similarly, permanent set shall not exceed 3.5 mm of free height of secondary spring, which is measured before scragging.<br>**Last test records shall be shown to inspection authority.** | |
| 5. | **Static Load Test-Vertical/Axial Stiffness (Para No.7.10.3 & 7.10.4.3.1):** | For Axial stiffness test of Vande Bharat Coil Springs, the following formula may be used with their usual notations:<br>$$K_S = \frac{F_B - 0.9 \cdot F_A}{L_{0.9 \cdot F_A} - L_{F_B}}$$<br>The tolerance on the axial stiffness (vertical rigidity) shall be according to drawings. In case not specified in the drawings, the axial stiffness (vertical rigidity) shall be within $\pm$**5%** of nominal value.<br>As per drawing & **Table - 'B'.** | |

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| | | **Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 6. | **Static Load Test-Working height (Para No. 7.10.3 & 7.10.4.1):** | As per drawing & **Table - 'B'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 7. | **Maximum spacing between two active coils under 85% deflection (Para No. 7.10.3.4):** | Under 85% of nominal free to solid deflection, the maximum spacing between any two adjacent active coils shall not exceed 40% of the nominal free coil spacing. The nominal free coil spacing is equivalent to the specified total travel divided by the number of active turns.<br>As per drawing & **Table - "B'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 8. | **Transverse Stiffness/Lateral Rigidity (Para No. 7.10.4.4, & 8.1):** | As per drawing & **Table - "B'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 9. | **Chasse Value (Para No. 7.10.4.5, & 8.1):** | As per drawing & **Table - "B'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 10. | **Pitch Uniformity (Para No. 7.10.3.1, 7.10.3.2 &7.10.3.3):** | 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.<br>In the remaining vertical load zone i.e. up to about 85% of the block length load (Para 7.10.4.2), the contact between end coil and first active coil at both the ends must follow in a continuously rolling manner and may not be toppling over support points and no 'kinks'.<br>The turn interval is to be held so exactly that no additional contact at any other point on the spring upto load given in Para 7.10.3.2 occurs.<br>As per drawing & **Table - 'C'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 11. | **Length of Contact Line (Para No. 7.10.3.5):** | The length of contact line during testing at load as per A.4 of Annexure 'A' of EN 13298 shall be equal to or more than 20% of mean coil diameter but not less than 20 mm for both primary and secondary outer & inner coil springs. The beginning of the line of contact may not be further than $60^0$ from the end at load $F_A$ (minimum operational force). | |
| | | The measurement of the contact length must be carried out on a spring testing machine, dully calibrated according to the relevant standards by an independent institute. For the measurement of the contact length between first active and the end coil, 02 thickness gauges with thickness 0.10 mm shall be used. | |

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| | | **Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| **12.** | **Arc/Grinding Angle & Taper Length (Para No. 7.2.1 & 7.7.3):** | Both the ends of the rod shall be tapered by Taper rolling to a length which shall be equivalent to an arc angle of **270° (minimum)** formed by end coils of the spring. This is meant to ensure a firm bearing of about 75% of the mean coil circumference at support surfaces of the finished springs. Formation of ends by hammering is totally unacceptable. The tapered faces should not have steps, pits or crack.<br>As per drawing/specification & Dimension Sheet at **Annexure-'A'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| | | The rod should be heated up to **910 $^0$C to 920 $^0$C** during end tapering operation and the stamping operation must be completed **before 850 $^0$C.** Temperature controlling system equipped with sensors shall be installed compulsorily in spring manufacturing units for 100% effective controlling of process temperature for bars and springs.<br>**Temperature records shall be shown to inspection authority.** | |
| | | The grinding angles at the ends of the springs shall be **$270^0 + 15^0/-0^0$.** For grinding angles measurement, **calibrated gauges** should be available with the spring manufacturers. | |
| | | End grinding **feed rate** shall be decided on the basis of mean coil diameters & rod diameters of coil springs. **Chart for deciding the feed rate should be displayed and shown to the inspection authority during inspection.** | |
| **13.** | **Tip Thickness (Para No. 7.2.2, 7.2.3 & 7.2.4):** | End taper the rod in such way that tip thickness is normally d/3 mm and then making coil spring perfectly to achieve its tip thickness of specified range of d/4 to d/8 after coiling and end grinding operations. Alternatively, spring manufacturers may opt different end taper thickness (other than d/3 mm) as per their process requirements and same should be clearly mentioned in the QAP. In both the cases, tip thickness of finished coil springs should be in the range of minimum d/8 to maximum d/4 subject to the condition that it shall not be less than 3 mm in any case, where d is the rod diameter in mm.<br>As per drawing/specification & Dimension Sheet at **Annexure-'A'.**<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| | | Proper care should be taken during the formation of ends of the springs. Correct ends formation shall be ensured as shown in Figure below: | |

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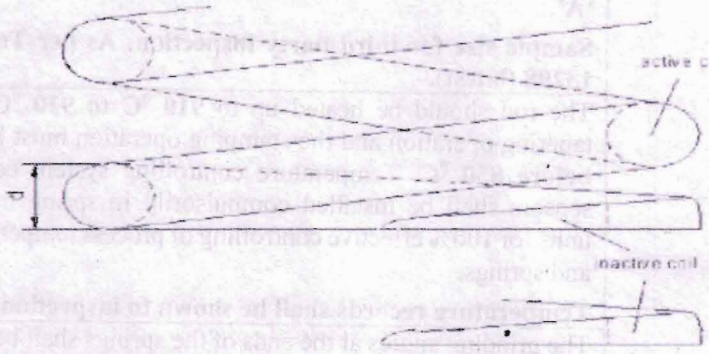
| | | To avoid spring end biting on first active coil at exactly 1.0 turn, **sharp corners** at the taper ends should be avoided. The tips should be **smooth, uniform in thickness & rounded** at the ends as shown in Figure below:   | |
| **14.** | **Crack Detection (Para No.7.8 & S. No. 3 of Para 18.0):** | `100% of the springs shall be tested for crack detection (Magnetic Particle Test) in accordance with Annexure E of EN13298 for both longitudinal and transverse cracks. Additionally, the Standards/ Specifications DIN EN ISO 9934-1, DIN EN ISO 9934-2, DIN EN ISO 9934-3, DIN EN ISO 3059 & DIN EN ISO 9712 shall be followed for various requirements associated with magnetic particle testing. | |
| | | ASNT/ISNT Level II certified operator for Magnetic Particle Testing shall be deployed. **Certificate of operator should be shown to Inspection authority for verification.**<br>Crack detection as per sheet at **Table - 'C'.**<br>**(Sample size for Inspection authority verification shall as per Table 6 of EN 13298 (latest), randomly).** | |
| **15.** | **Shot Peening (Para No. 7.9.1, 7.9.1.1, 7.9.1.2, 7.9.1.3, 7.9.1.4, 7.9.1.5 & 7.10.6):** | Before shot peening process, all springs should be thoroughly cleaned/shot blasted followed by Magnetic Particle Testing (MPT) process. The springs shall be shot peened in a continuous type shot peening machine, preferably with self-sieving arrangement in accordance with EN 13298 Annex C to improve fatigue life of the spring. During shot peening, it should be ensured that the springs are shot peened uniformly over the entire area of the springs. The intensity and coverage should be checked with the help of Almen strip in accordance with EN 13298 Annex C. Almen Intensity should be checked minimum two times per shift of production. The minimum coverage (When checked visually) should be 90% and intensity when checked with Almen strip Type - A in accordance with EN 13298 Annex C should be between 0.4 mm and 0.6 mm. | |

<table>
<tr><td></td><td></td><td>Internal test record should be checked at the time of inspection.<br>Shot peening/Almen Test as per sheet at Table - 'D'.<br>Sample size for inspection authority during inspection shall be as per Table 6 of EN 13298 (latest).</td><td></td></tr>
<tr><td></td><td></td><td>The characteristics of the Almen test samples shall comply the Table C.1 of Annex C of EN 13298 (latest).</td><td></td></tr>
<tr><td></td><td></td><td>The number of samples to be mounted on the "sample carrying spring" depends on the free length ($L_o$) of the spring and shall be as follows:
<table>
<tr><th>Free length ($L_o$) of Spring</th><th>Nos. of Almen test samples & Locations</th></tr>
<tr><td>$L_o \geq 500$ mm</td><td>6 samples to be mounted, 3 on the inside of the spring, the 3 remaining samples on the outside of the spring, the samples shall be located at the two ends and in the middle section of the spring.</td></tr>
<tr><td>$500 > L_o \geq 300$</td><td>4 samples to be mounted, 2 on the inside of the spring, the 2 remaining samples on the outside of the spring, the samples shall be located at the two ends of the spring.</td></tr>
<tr><td>$L_o < 300$ mm</td><td>2 samples to be mounted, 1 on the inside of the spring, the other one sample on the outside of the spring, the samples shall be located in the middle section of the spring.</td></tr>
</table></td><td></td></tr>
<tr><td></td><td></td><td>To ensure effective shot peening on more critical inside of the spring, the mounting locations of 4 Almen strip holders shall be, 2 on bottom inside & outside and remaining 2 on top inside & outside of the springs. The Almen strip holder shall be fixed between in-active coil and first active coil at approx. 0.1 turn from the end tip of the spring.</td><td></td></tr>
<tr><td></td><td></td><td>Ensure use of rounded jet grains for effective shot peening. Rounded jet grains of size 0.45 -1.0 mm as per IS:4606 shall be used.</td><td></td></tr>
<tr><td></td><td></td><td>Speed chart of rotational speed and linear movement of coil spring based on wire diameter, mean coil diameter and other relevant parameters for shot peening operation should be displayed.</td><td></td></tr>
<tr><td></td><td></td><td>Following values must be guaranteed after shot-peening operation of springs.<br>Almen value (mm): 0.40-0.60 mm on A - Stripe<br>Blasting medium Ø (mm): According to EN13298 Annex C. Rounded jet grains of size 0.45 -1.0 mm as per IS:4606 shall be used.</td><td></td></tr>
<tr><td>16.</td><td>Surface Hardness (Para No.7.5.5):</td><td>The values for the surface hardness shall be between 419 - 486 BHN**.<br>**Conversion of hardness from HRC to BHN is taken from conversion table.<br>As per Hardness Sheet at Table - 'E'.</td><td></td></tr>
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| | | **Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| **17.** | **Core Hardness & Hardness difference (Para No. 7.5.5):** | Difference between Surface and Core Hardness should not be more than 20 BHN.<br>Hardness difference sheet at **Table 'E'.**<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| **18.** | **Raw Material Traceability (Para No. 9.1.5 & 9.2.1):** | Material consumed in offered lot to be mentioned on original invoice by IE conducting inspection.<br>Ledger for ensuring accountal of raw material showing co-relation between raw material received and consumption for each lot of inspection must be maintained by the supplier which will be endorsed by IE and record kept of inspection documents. | |
| | | The steel and rolled bar manufacturer shall submit to the spring manufacturer necessary test certificates of the following tests, carried out by him apart from the documents pertaining to the steel manufacture and refining details, ingot shape and size of the rolled product, cropping yield etc.<br>a) Chemical composition of the ladle analysis and product analysis.<br>b) Inclusion contents in bars<br>c) Reduction Ratio.<br>d) Depth of decarburization<br>e) Surface hardness<br>f) Grain size<br>g) Dimensions<br>h) End quench hardenability test for each heat/lot (As per ISO 683-14 & EN 10089)<br>i) Surface Integrity (Auto MFL & Auto UT)<br>In case of foreign manufacturer of springs, Railway officials posted in foreign countries can conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis. | |
| | | In case of foreign manufacturer of springs, not having any RDSO approved vendor for raw material (Spring Steel Rounds) in the country in which springs are being manufactured, raw material shall be sourced from the sources approved in QAP only. Moreover, as Railway officials posted in foreign countries can also conduct inspection, inspection procedure for supply of springs can be decided by purchaser as per feasibility on case to case basis. | |
| **19.** | **Raw Material & Chemical Composition (Para** | For finished rod diameter **25-65mm**, material shall be grade **52CrMoV4** to specification ISO 683 Part-14 or EN 10089. In case dia. is out of this range, material must be stated in the relevant drawing. | |

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| | **4.1, 4.2, 4.3, 5.1.1 & 5.1.2)** | Maximum Sulphur (**S**) content: **0.010%** by weight<br>Maximum Phosphorous (**P**) content: **0.015%** by weight<br>Vanadium (**V**) content: **0.14 to 0.20%** by weight<br>Molybdenum (**Mo**) content: **0.20 to 0.30%** by weight<br>***Note:***<br>*Permissible deviation between specified analysis and product analysis as per EN 10089, Table 4.*<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| **20.** | **Depth of De-carburization & Structure (S. No. 4 & Note (iii) of Para No. 8.1):** | 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. As per **Table 'F'.**<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| **21.** | **Micro-structure (Para No. 7.5.5 & 8.1):** | The tempered martensitic distribution across the complete cross-section of the active coil should be uniformly distributed.<br>As per **Table 'F'.**<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| **22.** | **Macro etching (Para No. 5.2.4.1, S. No. 22 of Para 9.4.2):** | In the cross-section (micro-section surface), no microscopic defects such as cavities, pores, cracks or liquidations are permitted. Macro etch level shall not be worse than C2, R2, S2, of ASTM -381 Plate I. As per **Table 'F'.**<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| **23.** | **Phosphatizing (Para No. 7.9.2):** | 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).<br>**It should be verified by inspecting authority through firm's internal tests record.** | |
| **24.** | ****Final Painting (Para No. 7.9.3):** | After phosphate treatment, all the springs shall be painted as per **RDSO Specification No. M&C/PCN/132/2021 (latest)** for Painting of Helical Coil Springs of LHB Coaches and Similar Applications (Single Pack).<br>**Any other proven painting scheme, may also be permitted** with approval by RDSO, depending on case to case basis subject to complying at least the following tests requirements: | |

| S. No. | Tests | Requirements |
|---|---|---|
| 1. | Resistance to Salt Spray Test (**minimum 1000 hours**) according to EN ISO 9227 | No rusting, cracking, flaking, blistering & corrosion |
| 2. | Evaluation of Degree of Rusting according to EN ISO 4628-3 | Ri1 or better |
| 3. | Evaluation of Degree of Cracking according to EN ISO 4628-4 | 1(S3) or better |

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| | | 4. | Evaluation of Degree of Flaking according to DIN EN ISO4628-5 | 0(S0) or better |
| | | 5. | Evaluation of Degree of Blistering according to EN ISO 4628-2 | 2(S2) or better |
| | | 6. | Evaluation of Detachment and corrosion around the scratch according to EN ISO 4628-8 | ≤ 3 mm, no delamination |
| | | 7. | Evaluation of Adhesion according to EN ISO 2409 | Cross-cut Rating (GT): ≤ GT0-1 |
| | | 8. | Fire Protection according to EN 45545-2 | Hazard level-HL3 R9 |
| | | **Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | | |
| | | The **Type and Acceptance Test Reports of brand and make of paint, which are applied on springs shall be kept ready during Inspections**. As quality control measure, type tests of brand and make of paint which is used for applications on springs, shall be conducted once in a year from NABL certified Lab and report of the same shall be kept ready during Inspections. | | |
| **25.** | **Paint Quality: (Para No. 9.4.2, S. No. 23)** | There should be **no sign of any sagging, blistering, checking, chalking, flaking, spotting, peeling and mechanical damage** when checked on finished coated spring.<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | | |
| **26.** | **Salt Spray Test: (Para No. 7.9.8)** | A salt spray test shall be carried out to verify the quality of paint system. For springs fully painted as per painting scheme permitted with approval by RDSO, the test piece shall be passed in salt spray test performed according to ISO 9227 for minimum 1000 hours as per applicable specification and shall not indicate any sign of corrosion & deterioration up to duration indicated in the specification.<br>**One sample of any type of spring (primary or secondary), randomly selected** by Inspecting official, shall be subjected to salt spray test once in every year or after supply of every cumulative quantity of 25000 coil springs as per this specification, whichever is later. It shall be process check point. In event of failure any sample in salt spray test, process shall be considered as failed.<br>**Table – G. It should be treated as Process Check.** | | |
| **27.** | **Grouping and Colour Coding: (Para No. 7.9.6, S. No. 24 of Para No. 9.4.2)** | **Grouping & Colour Coding of Vande Bharat Coil Springs** | | |

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

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| | | *Note: In case of Vande Bharat coil springs, it is suggested to use same coloured primary outer springs in bogie, primary inner springs can be any. Because matching of both primary inner and outer colour will result in few springs left over unused, which can not be grouped with any other set to use in bogie. Some bogies can have different sets also for the same reason, will not a problem as static load testing shimming is to be carried out by spring manufacturers accordingly.*<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest).** | |
| 28. | **Tensile Strength of Springs: (S. No. 30 of Para No 9.4.2)** | As per Clause 6.4.2 & 7.7.2 of EN 13298 (latest).<br>Test rods of **1-1.5-meter length** shall be given same heat treatment as to springs of the lot which will be certified by the firm. **(Table - H).**<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| 29. | **Ductility/Impact Test of Springs (S. No. 31 of Para No 9.4.2):** | As per Clause 6.4.3 & 7.7.3 of EN 13298 (latest).<br>Test rods of **1-1.5-meter length** shall be given same heat treatment as to springs of the lot which will be certified by the firm. **(Table - I).**<br>**Sample size for third party inspection: 01 Sample per heat.** | |
| 30. | **Creep Test (Para 8.4 & S. No. 27 of Para No 9.4.2):** | The purpose of creep test of hot coiled helical spring is to ascertain that the value of creep under the gross load ($F_2$) shall not exceed 1% of the gross height ($L_2$) of spring after 96 hours. The clearance between the coils shall remain within the limits as defined in Annex A.6 of EN 13298. The creep test shall be performed on Creep Test Fixture for 96 hours as per Para 7.2.3 of EN 13298. The Creep Test shall be done on any one spring randomly selected from first lot of any type of spring in every six months.<br>**It should be treated as process check. (Table - J).** | |
| 31. | **Fatigue Test (Para 8.5 & S. No. 29 of Para No 9.4.2):** | The purpose of fatigue testing of hot coiled helical spring is to ascertain that the springs meet the expected life during service. Fatigue testing of the spring shall be done **during the initial approval of a manufacturer** for the spring by RDSO. It shall **subsequently be done on any one spring randomly selected from first lot of any type of spring in every alternate year**.<br>In case of new spring manufacturer not registered in RDSO Vendor Directory, fatigue testing during the initial approval shall be carried out at RDSO on any one spring randomly selected from first lot of any type of spring.<br>**It should be treated as process check (Table - K).** | |
| 32. | **Special Spring Marking (Besides Stamping) (Para No 7.9.4.1):** | Coil spring must be marked with a band fixed in the direction of the bowing with following information:<br>• **Serial No., $L_A/F_A$** and **Angle engraved**. The bands are placed in the direction of the deflection.<br>• Angle between bowing directions of a spring submitted to axial force $F_{C0}$ (usually equal to Tare Load $F_A$) on one hand and to an axial force $F_{C1}$ (usually equal to a static axial force $F_j$ | |

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|---|---|---|---|
| | | corresponding to a functioning mode of the vehicle which it belongs) on the other hand shall be $\leq 30^0$.<br>• Copper (Cu) band adhesion should be such that it last through the life of coil spring in service.<br>• In addition to Copper (Cu) band, a one-inch-wide translucent **strip of yellow colour** over the **entire height** of coil spring & a band of aluminum adhesive tape (e.g. Tesaflex 171) at the same location just under the copper (Cu) band shall also be provided to indicate bowing direction.<br>Bowing (angle, force, direction) for primary outer & inner springs shall be as per Cause 9 of EN 13298:2003.<br>**Sample size for third party inspection: As per Table 6 of EN 13298 (latest). (Table - L).** | |
| **33.** | **Packing & Transportation (Para No 13.0):** | Spring is to be placed first in "**Ethylene Vinyl Acetate" Sheet of 1.5 mm thick** bag or bubble sheets. The open end of the bag shall be sealed and folded in the spring ensuring that no portion of the spring remains exposed or likely to get exposed during handling.<br>The inner and outer springs each should be suitably wrapped with bubble sheet and suitable separator shall be inserted between inner and outer springs placed concentric. Suitable separators shall also be used between each outer springs.<br>The springs must be packed and transported in such a way that the coating lacquer is protected from any damage.<br>Transportation of spring shall be done in wooden pallets /boxes. Any other precaution in packing as may be deemed fit for safe transportation shall be taken by the spring manufacturer to avoid damage during transportation.<br>The general arrangement of wooden boxes shall be as per Annexure-II, III & IV. Arrangement may be modified as per requirement after taking approval from RDSO.<br>The packing should be as per with the one provided by overseas suppliers.<br>Any other packing arrangement better than above may be approved by RDSO depending on case to case basis. | |

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Government of India: Ministry of Railways
Research Designs & Standards Organization
Manak Nagar, Lucknow-226 011

## DIMENSIONAL SHEET

**ANNEXURE- 'A'**

**Drawing No. .....** **Sample size: As per Table 6 of EN 13298 (latest)** **Actual Nos. of Sample .....**

| S. No. | Parameters (Specified value, & Spec. Para No.) | As per Drg. / Spec. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | **Visual:** No defects (lamination, grooves, machining marks, cracks, crevices etc.) **(Para No. 7.1.2)** | | | | | | | | | | | | | | | | | | | | | |
| 2. | **Stamping:** Manufacturer's Code, Month & Year of Production, Drawing Code, Heat Code (in three digits), Raw Material Supplier's Code (in two digits) **(Para No. 7.3)** | | | | | | | | | | | | | | | | | | | | | |
| 3. | **Free Height:** According to drawing. In case not specified in drawing, it shall be as per Clause 7.1 of DIN 2096 Part 1 (latest). **(Para No. 7.10.2)** | | | | | | | | | | | | | | | | | | | | | |
| 4. | **Spring Height ($L_1$) at Tare Load ($F_1$):** According to drawing. In case not | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | specified in drawings then ± **1%** of the nominal value of ($L_1$). **(Para No. 7.10.2)** | | | | | | | | | | | | | | | | | | | | |
| **5.** | <table><tr><th>Rods Dia. (mm)</th><th>Tolerance (mm)</th></tr><tr><td>18 - 30</td><td>± 0.10</td></tr><tr><td>30 - 50</td><td>± 0.12</td></tr><tr><td>50-80</td><td>± 0.15</td></tr></table> **(Para No. 6.2.2.2)** | | | | | | | | | | | | | | | | | | | | |
| **6.** | **External Coil Diameter ($D_{Outer}$):** According to drawing. In case not specified in drawing then ± **1.5%** of $D_{Outer}$ **(Para No. 7.10.2)** | | | | | | | | | | | | | | | | | | | | |
| **7.** | **Internal Coil Diameter ($D_{Inner}$):** According to drawing. In case not specified in drawing then ± **1.5%** of $D_{Inner}$ **(Para No. 7.10.2)** | | | | | | | | | | | | | | | | | | | | |
| **8.** | **Perpendicularity ($e_1$) or Squareness:** As per drawing. In case not specified in drawing, it shall be: i. For Springs with a free length of ($L_0$) | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | > 150 mm, should be ≤ 1.5% of ($L_0$).<br>ii. For Springs with a free length of ($L_0$) ≤ 150 mm, should be ≤ 2% of ($L_0$).<br>(Para No. 7.10.2) | | | | | | | | | | | | | | | | | | | | |
| 9. | **Parallelism ($e_2$):**<br>As per drawing. In case not specified in drawing, it shall be:<br>**($e_2$) = ± 1.5% of $D_{Outer}$**<br>(Para No. 7.10.2) | | | | | | | | | | | | | | | | | | | | |
| 10. | **No. of total coils ($n_t$):**<br>As per drawings. | | | | | | | | | | | | | | | | | | | | |
| 11. | **No. of active coils (n):**As per drawings. | | | | | | | | | | | | | | | | | | | | |
| 12. | **Formation of Ends:**<br>Ensure a firm bearing of about **75% of the mean coil circumference** at support surfaces of the finished springs. The **tapered faces should not have steps, pits or crack.**<br>(Para No. 7.2.1) | | | | | | | | | | | | | | | | | | | | |
| 13. | **Arc/Grinding Angle of End Coils:**<br>Support surfaces (**min. 270$^0$**) formed by end coils of the | **End 1** | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | spring. The grinding angles at the ends of the springs shall be **$270^0 + 15^0/- 0^0$.** (Para No. 7.2.1 & 7.7.3) | End 2 | | | | | | | | | | | | | | | | | | | | |
| 14. | **Taper Length of End Coils:** **75%** of the mean coil circumference of the finished springs. (Para No. 7.2.1) | End 1 | | | | | | | | | | | | | | | | | | | | |
| | | End 2 | | | | | | | | | | | | | | | | | | | | |
| 15. | **Tip thickness of End Coils:** Should be in the range of **minimum d/8 to maximum d/4,** subject to condition that **not less than 3 mm** in any case. (Para No. 7.2.2) | End 1 | | | | | | | | | | | | | | | | | | | | |
| | | End 2 | | | | | | | | | | | | | | | | | | | | |
| 16. | **Plainness of the support (End) surface:** i. For Turn Diameter **Dm ≤ 250 mm**, should be **0.5 mm (max.).** ii. For Turn Diameter **Dm > 250 mm**, should be **1.0 mm (max.).** (Para No. 7.10.2) | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17. | **Concentricity of wound Rods:**<br>i. For **Rod dia. ≤ 30 mm**, should be **0.2 mm (max.).**<br>ii. For **Rod dia. > 30 mm**, should be **0.4 mm (max.).**<br>(Para No. 7.10.2) | | | | | | | | | | | | | | | | | | | | | |
| 18. | **Biting Clearance of End Coils (under no load) condition):**<br>The end gap between the tip and the adjacent effective coil is such that **tip does not bite the effective coil under load as well as no load conditions.**<br>(Spec. Para No. 7.4.6) | **End 1** | | | | | | | | | | | | | | | | | | | | |
| | | **End 2** | | | | | | | | | | | | | | | | | | | | |
| 19. | **Direction of Coiling:**<br>The direction of coiling should be as per drawing. In case not specified in the drawing, shall be to the **'Right'**.<br>(Para No. 7.10.1) | | | | | | | | | | | | | | | | | | | | | |

**Table 'A'**

**S. No. (B.4) Scragging & Permanent Set:**

**Sample size: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**
**Scragging load.....** **Solid height.....**

| S. No. | Height after one stroke (in mm) | Height after 4th stroke (in mm) | Permanent Set (in mm) | S. No. | Height after one stroke (in mm) | Height after 4th stroke (in mm) | Permanent Set (in mm) |
|---|---|---|---|---|---|---|---|
| 1. | | | | 11. | | | |
| 2. | | | | 12. | | | |
| 3. | | | | 13. | | | |
| 4. | | | | 14. | | | |
| 5. | | | | 15. | | | |
| 6. | | | | 16. | | | |
| 7. | | | | 17. | | | |
| 8. | | | | 18. | | | |
| 9. | | | | 19. | | | |
| 10. | | | | 20. | | | |

**Table - 'B'**

**S. No. (B.5) Static load Test - Vertical/Axial Stiffness:**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

**Load of $F_A$ or $F_1$ .....** **Load of 1.1 $F_A$.....** **Load of 0.9 $F_A$ .....**
**Specified Spring Rate: .....**

| Sample No. | Free Height ($L_0$) (in mm) | Height ($L_1$) at Load $F_1$ (in mm) | Height at Load 1.1 of $F_1$ ($L_{1.1\ FA}$) (in mm) | Height at Load 0.9 of $F_1$ ($L_{0.9\ FA}$) (in mm) | Stiffness N/mm $(1.1\ F_A - 0.9\ F_A)/(L_{0.9\ FA} - L_{1.1\ FA})$ |
|---|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |
| 11. | | | | | |
| 12. | | | | | |
| 13. | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 14. | | | | | |
| 15. | | | | | |
| 16. | | | | | |
| 17. | | | | | |
| 18. | | | | | |
| 19. | | | | | |
| 20. | | | | | |

**S. No. (B.6) Static Load Test - Working height:**

**Sample Size: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

| Samples | | At Load $F_A$ | | At Load $F_B$ | | At Load $F_M$ | |
|---|---|---|---|---|---|---|---|
| | | As per drawing (mm) | Observed Value (mm) | As per drawing (mm) | Observed Value (mm) | As per drawing (mm) | Observed Value (mm) |
| 1. | Height | | | | | | |
| 2. | Height | | | | | | |
| 3. | Height | | | | | | |
| 4. | Height | | | | | | |
| 5. | Height | | | | | | |
| 6. | Height | | | | | | |
| 7. | Height | | | | | | |
| 8. | Height | | | | | | |
| 9. | Height | | | | | | |
| 10. | Height | | | | | | |
| 11. | Height | | | | | | |
| 12. | Height | | | | | | |
| 13. | Height | | | | | | |
| 14. | Height | | | | | | |
| 15. | Height | | | | | | |
| 16. | Height | | | | | | |
| 17. | Height | | | | | | |
| 18. | Height | | | | | | |
| 19. | Height | | | | | | |
| 20. | Height | | | | | | |

**S. No. (B.7) Maximum spacing between two active coils under 85% deflections:**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

| S. No. | Free height ($L_0$) (in mm) | Solid Height (Lc) (in mm) | No. of active coils (n) | Nominal Spacing $X = (L_0 - Lc)/n$ (in mm) | Maximum spacing between two acting coils (A) (in mm) | $B = \frac{A \times 100}{X}$ % |
|---|---|---|---|---|---|---|
| 1. | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10. | | | | | | |
| 11. | | | | | | |
| 12. | | | | | | |
| 13. | | | | | | |
| 14. | | | | | | |
| 15. | | | | | | |
| 16. | | | | | | |
| 17. | | | | | | |
| 18. | | | | | | |
| 19. | | | | | | |
| 20. | | | | | | |

**Note:** ***'B' should not be more than 40%.***

**S. No. (B.8) Transverse Stiffness/Lateral Rigidity:**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**
**Static Axial Force ($F_I$) .....**
**Specified Spring Rate- As Per Drawing.....**

**Step 1- Offset of Spring Support Plates & corresponding Transverse Forces in the direction of Bowing:**

| S. No. | Free Height (mm) | Test Load $Q_{AI}$ | Deflection $r_{AI}$ (mm) | Test Load $Q_{BI}$ | Deflection $r_{BI}$ (mm) | Deflection ($r_{AI}$-$r_{BI}$) (mm) |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10. | | | | | | |
| 11. | | | | | | |
| 12. | | | | | | |
| 13. | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14. | | | | | | |
| 15. | | | | | | |
| 16. | | | | | | |
| 17. | | | | | | |
| 18. | | | | | | |
| 19. | | | | | | |
| 20. | | | | | | |

**Step 2- Offset of Spring Support Plates & corresponding Transverse Forces in the direction opposite to the Bowing direction:**

| S. No. | Free Height (mm) | Test Load $Q_{A2}$ | Deflection $r_{A2}$ (mm) | Test Load $Q_{B2}$ | Deflection $r_{B2}$ (mm) | Deflection ($r_{A2}$-$r_{B2}$) (mm) |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
| 10 | | | | | | |
| 11. | | | | | | |
| 12. | | | | | | |
| 13. | | | | | | |
| 14. | | | | | | |
| 15. | | | | | | |
| 16. | | | | | | |
| 17. | | | | | | |
| 18. | | | | | | |
| 19. | | | | | | |
| 20. | | | | | | |

*(Alternatively, direct value of Offset of Spring Support plates & corresponding transverse forces in the direction of bowing and opposite to the Bowing direction is obtained through computer software).*

**Step 3- Calculation of Transverse Stiffness/Lateral Rigidity:**

| S. No. | Free Height (mm) | Static Axial Force ($F_1$) in N | Transverse Stiffness/Lateral Rigidity ($K_t$) $= 1/2[\{(Q_{B1}-Q_{A1})/(r_{B1}-r_{A1})\} + \{(Q_{B2}-Q_{A2})/(r_{B2}-r_{A2})\}]$ in N/mm |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |

| | | | |
|---|---|---|---|
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10 | | | |
| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |
| 15. | | | |
| 16. | | | |
| 17. | | | |
| 18. | | | |
| 19. | | | |
| 20. | | | |

*(Alternatively, direct value of transverse static stiffness is obtained through computer software. In case of using computer software, print of result should be attached with check sheet).*

**S. No. (B.9) Chasse Value:**

**Chasse Value (C) in mm at normal gross load ($F_2$) condition must not exceed the following limit:**
**$C = 0.018L + 0.0072\ L^2/D$ where, L = Nominal free length of spring in mm and D = Nominal mean coil diameter in mm.**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample…….**

| S. No. | Free Height (mm) | Normal gross load ($F_2$) in N | Specified value of Chasse $C = 0.018L + 0.0072\ L^2/D$ (in mm) | Observed value of Chasse (mm) |
|---|---|---|---|---|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |
| 5. | | | | |
| 6. | | | | |
| 7. | | | | |
| 8. | | | | |
| 9. | | | | |
| 10 | | | | |
| 11. | | | | |
| 12. | | | | |
| 13. | | | | |
| 14. | | | | |
| 15. | | | | |
| 16. | | | | |
| 17. | | | | |
| 18. | | | | |
| 19. | | | | |
| 20. | | | | |

**S. No. (B.11) Length of Contact Line:**

- The length of contact line during testing at load as per A.4 of Annexure 'A' of EN 13298 shall be equal to or more than **20% of mean coil diameter but not less than 20 mm** for both primary and secondary outer & inner coil springs. The beginning of the line of contact may not be further than $60^0$ from the end at load $\mathbf{F_A}$ (minimum operational force).
- The measurement of the contact length must be carried out on a **spring testing machine, dully calibrated** according to the relevant standards by an independent institute. For the measurement of the contact length between first active and the end coil, **02 thickness gauges with thickness 0.10 mm shall be used.**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample……...**

**Specified length- As Per Drawing……...**

| **Sample 1** | | **Sample 2** | | **Sample 3** | | **Sample 4** | | **Sample 5** | |
|---|---|---|---|---|---|---|---|---|---|
| Top | | Top | | Top | | Top | | Top | |
| Bottom | | Bottom | | Bottom | | Bottom | | Bottom | |
| **Sample 6** | | **Sample 7** | | **Sample 8** | | **Sample 9** | | **Sample 10** | |
| Top | | Top | | Top | | Top | | Top | |
| Bottom | | Bottom | | Bottom | | Bottom | | Bottom | |
| **Sample 11** | | **Sample 12** | | **Sample 13** | | **Sample 14** | | **Sample 15** | |
| Top | | Top | | Top | | Top | | Top | |
| Bottom | | Bottom | | Bottom | | Bottom | | Bottom | |
| **Sample 16** | | **Sample 17** | | **Sample 18** | | **Sample 19** | | **Sample 20** | |
| Top | | Top | | Top | | Top | | Top | |
| Bottom | | Bottom | | Bottom | | Bottom | | Bottom | |

**Table 'C'**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **S. No. (B.10)** | **Pitch uniformity** | **Specified No. of Samples: As per Table 6 of EN 13298 (latest)** | | **1.** | **2.** | **3.** | **4.** | **5.** | **6.** | **7.** | **8.** | **9.** | **10.** |
| | | **Actual No of Sample** | …….. | **11.** | **12.** | **13.** | **14.** | **15.** | **16.** | **17.** | **18.** | **19.** | **20.** |
| **S. No. (B.14)** | **Crack Detection** | **Specified No. of Samples: As per Table 6 of EN 13298 (latest)** | | **1.** | **2.** | **3.** | **4.** | **5.** | **6.** | **7.** | **8.** | **9.** | **10.** |
| | | **Actual No of Sample** | …….. | **11.** | **12.** | **13.** | **14.** | **15.** | **16.** | **17.** | **18.** | **19.** | **20.** |

*Note: ASNT/ISNT Level II certified operator for Magnetic Particle Testing shall be deployed.* ***Certificate of operator should be shown to Inspection authority for verification.***

## Table 'D'

**S. No. (B.15) Shot Peening:**

- Before shot peening process, all springs should be thoroughly **cleaned/shot blasted** followed by Magnetic Particle Testing (MPT) process.
- The minimum coverage (When checked visually) should be 90% and intensity when checked with Almen strip Type - A in accordance with EN 13298 Annex C should be **between 0.4 mm and 0.6 mm.**
- **Internal test records of shot peening process should be checked at the time of inspection.**
- The number of samples to be mounted on the "sample carrying spring" depends on the free length ($L_o$) of the spring and shall be as per Annex C.2.2 (b) of EN 13298 (latest).
- **During shot peening of springs, Almen test samples type A should be clamped on spring and reading to be noted.**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

| S.N. | Specified Value | | Observations |
|---|---|---|---|
| 1. | Almen Value (mm) | **0.40-0.60 mm** on A-Strip | |
| 2. | Blasting Medium Ø (mm) | According to EN13298 Annex. C. Rounded jet grains of size **0.45 -1.0 mm** as per IS:4606. | |
| 3. | Minimum coverage | **90%** (when checked visually) | |

**Remarks:**

## Table 'E'

**S. No. (B.16) Surface Hardness:**
**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**
**Specified value: 419-486 BHN.**

| S. No. | Dia. of Indentation (mm) | | | Hardness (BHN) | S. No. | Dia. of Indentation (mm) | | | Hardness (BHN) |
|---|---|---|---|---|---|---|---|---|---|
| | After 1st | After 2nd | Average | | | After 1st | After 2nd | Average | |
| 1. | | | | | 11. | | | | |
| 2. | | | | | 12. | | | | |
| 3. | | | | | 13. | | | | |
| 4. | | | | | 14. | | | | |
| 5. | | | | | 15. | | | | |
| 6. | | | | | 16. | | | | |
| 7. | | | | | 17. | | | | |
| 8. | | | | | 18. | | | | |
| 9. | | | | | 19. | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10. | | | | | 20. | | | | |

**S. No. (B.17) Core hardness & Hardness Difference:**

**Samples size -01 Sample per heat** **Actual no. of Samples.....**

**Specified Value of Variation between Surface and Core hardness: 20 BHN (Max.)**

| Sample | 1. | | | | 2. | | | | 3. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | Average | BHN | I | II | Average | BHN | I | II | Average | BHN |
| Surface hardness | | | | | | | | | | | | |
| Core hardness | | | | | | | | | | | | |
| Variation between surface and core hardness | | | | | | | | | | | | |

**S. No. (B.19) Chemical Compositions:**

**Samples size -01 Sample per heat** **Actual no. of Samples.....**

| Chemical composition | | C% | Mn% | Si% | S % (Max.) | P% (Max.) | Cr% | V% | Mo% | Ni% | (Cu + Sn)% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material Grade 52Cr MoV4 | Heat No. ..... | | | | | | | | | | |
| | Heat No. ..... | | | | | | | | | | |
| | Heat No. ..... | | | | | | | | | | |
| Specified value (as per ISO 683 Part-14, EN10089 & RDSO/2017/CG-01, Rev.03 (or latest) | | 0.48-0.56 | 0.70-1.10 | 0.40 max. | 0.010 max. | 0.015 max. | 0.90-1.20 | 0.14-0.20 | 0.20-0.30 | - | Cu+10Sn $\leq$ 0.60 |

*Note: Permissible deviation between specified analysis and product analysis as per EN 10089, Table 4.*

Table 'F'

**S. No. (B.20) Depth of De-carburization & Structure:**

**Samples size -01 Sample per heat** **Actual no. of Samples.....**

| Specified value | 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. |
|---|---|
| Sample No. | Observations |
| 1. | |
| 2. | |
| 3. | |

**S. No. (B.21) Microstructure:**

**Samples size -01 Sample per heat** **Actual no. of Samples.....**

| Specified value | Uniformly distributed tempered martensite structure across the complete cross section. |
|---|---|
| Sample No. | Observations |
| 1. | |

| | |
|---|---|
| 2. | |
| 3. | |

**S. No. (B.22) Macro-Etching (1:1 hot HCL):**

**Samples size -01 Sample per heat** **Actual no. of Samples.....**

| **Specified value** | **Free from inherent defects. In the cross-section (micro-section surface), no microscopic defects such as cavities, pores, seams, cracks or liquidations and non-metallic inclusions are permitted.** | | |
|---|---|---|---|
| **Sample No.** | **Observations (Micro-Etch Level)** | | |
| | **C** | **R** | **S** |
| **1.** | | | |
| **2.** | | | |
| **3.** | | | |

**S.N. (B.23) 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).

**It should be verified by inspecting authority through firm's internal tests record.**

| **Remarks:** |
|---|
| |

**S.N. (B.24) Final Painting:**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

| **Specified value as per Specification No. M&C/PCN/132/2021 (or latest)** | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **Cumulative DFT 70-80 microns** | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
| | | | | | | | | | | |

*OR As per alternative proven painting scheme permitted by RDSO*

| **Specified value (Cumulative DFT in microns)** | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| ..... | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
| | | | | | | | | | | |

**S.N. (B.25) Paint Quality:**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

| **Specified value as per Specification No. RDSO/2017/CG-01, Rev.03 (or latest)** | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **There should be no sign of any sagging, blistering, checking, chalking, flaking, spotting, peeling and mechanical damage when checked** | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
| | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **on finished coated spring.** | | | | | | | | | | |

## Table 'G'

**S. No. (B.26) Salt Spay Test:**

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

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

| Marking of Spring | Finding of records (Verification of internal records) |
|---|---|
| | |

**S. No. (B.27) Grouping & Colour Coding:**

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample……...**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Specified Colour to be done on the middle coil** | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
| | | | | | | | | | | |
| …… | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
| | | | | | | | | | | |

## Table 'H'

**S.N. (B.28) Tensile Strength of Springs:**

**Sample Size: 01 Sample. The test pieces shall be prepared from heat treated bar.**
**Tensile strength of springs to be conducted as per EN 13298 (latest).**

| Heat No. of test piece …… | Testing Parameters | | |
|---|---|---|---|
| | Yield Limit at 0.2% ($R_{p0.2}$) | Ultimate Tensile Strength ($R_m$) | Elongation at rupture (A%) |
| Specified values | ($R_{p0.2}$) $\geq$ 1150 MPa | ($R_m$) $\geq$ 1400 MPa | (A%) $\geq$ 6 |
| Test result value | | | |

## Table 'I'

**S.N. (B.29) Ductility/Impact Test of Springs:**

**Sample Size: 01 Sample. The test pieces shall be prepared from heat treated bar.**
**Ductility test of springs to be conducted as per EN 13298 (latest). The ductility of the material of the spring is obtained by the relative impact test.**

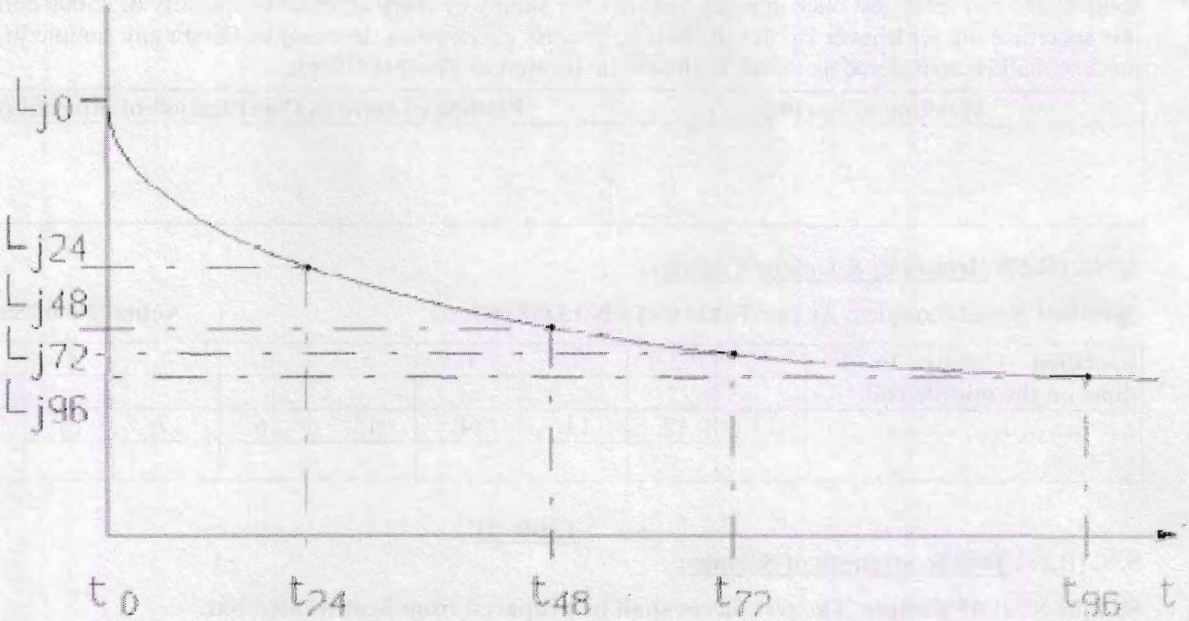
| Heat No. of test piece …… | Specified values |
|---|---|
| | The value of the impact strength (KU) shall be greater or equal to 10 Joules (at a temperature of 20 $^0$C). |

| Test result value | |
|---|---|

**Table 'J'**

**S.N. (B.30): Creep Test:**

The **value of creep under the gross load ($F_2$) shall not exceed 1% of the gross height ($L_2$) of spring after 96 hours.** The clearance between the coils shall remain within the limits as defined in Annex A.6 of EN 13298. The creep test shall be performed on Creep Test Fixture for 96 hours as per Para 7.2.3 of EN 13298. The Creep Test shall be done on any one spring randomly selected from first lot of any type of spring in every six months. **It should be treated as process check.**




| Marking/details of Spring | Finding of records (verification of internal records) |
|---|---|
| ..... | |

**Table 'K'**

**S.N. (B.31): Fatigue Testing as per Para 8.5 of Specification No. RDSO/2017/CG-01, Rev.03 (or latest):**

Fatigue testing of the spring shall be done during the initial approval of a manufacturer for the spring by RDSO. It shall subsequently be done on any one spring randomly selected from first lot of any type of spring in every alternate year. **It should be treated as process check.**

| | | |
|---|---|---|
| 1. | Fatigue Testing previously done for this Spring (Yes/No.). If no, then the following procedure is to be followed: | ..... |
| 2. | Fatigue testing is to be done for this lot (Yes/No.). If yes, then the following procedure is to be followed: | ..... |
| 3. | **Particulars of Spring before Fatigue Testing:** | |
| | a) Free height ($L_0$) | =..... mm |
| | b) Solid height ($L_C$) | =..... mm |
| | c) Actual height ($L_B$) at the Gross load ($F_B$) specified in the drawing | =..... mm |
| | d) Actual load ($F_B$) for the Gross height ($L_B$) specified in the drawing | =..... KN |
| | e) Static deflection = [Free height ($L_0$) - Gross height ($F_B$)] | =..... mm |
| 4. | **Particulars of Spring during Fatigue Testing:** | |
| | a) Frequency of test (not less than **1.5 $H_z$**) | =..... $H_z$ |
| | b) Stroke (Gross height **± 22%** of static deflection or as per drawing) | =..... mm |

c) Static height measurement (on Gross load):

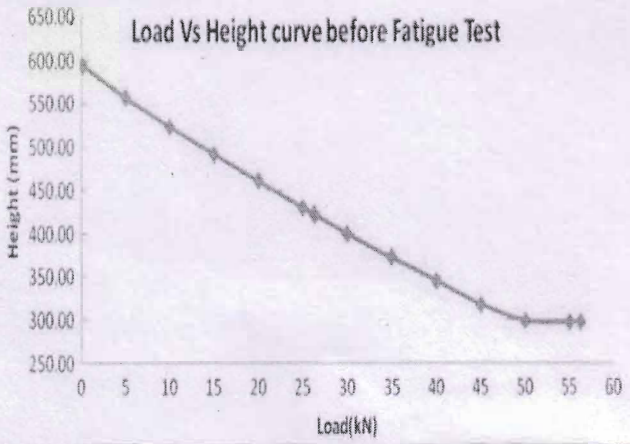
| Measurement Cycle | Load ($F_B$) at Gross height ($L_B$) in KN | Static Height (mm) |
|---|---|---|
| 2,50,000 | | |
| 5,00,000 | | |
| 7,50,000 | | |
| 10,00,000 | | |
| 12,50,000 | | |
| 15,00,000 | | |
| 17,50,000 | | |
| 20,00,000 | | |

| | | |
|---|---|---|
| 5. | **Particulars of Spring after Fatigue Testing (After 2 Million Cycles):** | |
| | a) Free height ($L_0$) | =..... mm |
| | b) Solid height ($L_C$) | =..... mm |
| | c) Actual height at the Gross load ($F_B$) specified in the drawing | =..... mm |
| | d) Actual load ($F_B$) for the Gross height ($L_B$) specified in the drawing | =..... KN |
| | e) Static deflection = [Free height ($L_0$) - Gross height ($F_2$)] | =..... mm |
| 6. | **Actual Load Verses Height Graph** from Free to Static height and Free to Solid height for both (before and after fatigue testing) is to be plotted. | |

a) Actual Load Verses Height Graph before Fatigue Testing:

Load -Deflection Data of Spring before fatigue test

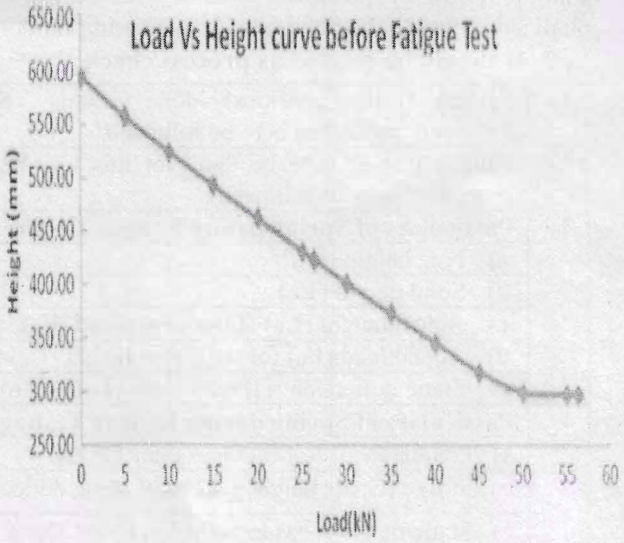
| Load (kN) | Height (mm) | |
|---|---|---|
| 0.10 | | |
| 5. 00 | | |
| 10 | | |
| 15 | | |
| 20 | | |
| 25 | | |
| | | Measured Height at design gross Load |
| | | Measured Load at design gross Height |
| 30 | | |
| 35 | | |
| 40 | | |
| 45 | | |
| 50 | | |
| 55 | | |
| 60 | | |



b) Actual Load Verses Height Graph after Fatigue Testing:

Load –Deflection Data of Spring after fatigue test

| Load (kN) | Height (mm) | |
|---|---|---|
| 0.10 | | |
| 5. 00 | | |
| 10 | | |
| 15 | | |
| 20 | | |
| 25 | | |
| | | Measured Height at design gross Load |
| | | Measured Load at design gross Height |
| 30 | | |
| 35 | | |
| 40 | | |
| 45 | | |
| 50 | | |
| 55 | | |
| 60 | | |




| | | |
|---|---|---|
| 7. | **Magna flux testing** after Fatigue Test is to be done – Crack detected/Not detected | ..... |
| 8. | Failure of Spring during Fatigue Testing observed: - Yes/No. | ..... If yes, full details are to be given. ..... |

**Table – 'L'**

**S.N. (B.32): Special Spring Marking (Besides Stamping):**

Coil spring must be marked with a band fixed in the direction of the bowing with following information:

- **Serial No., $L_A/F_A$** and **Angle engraved**. The bands are placed in the direction of the deflection.
- Angle between bowing directions of a spring submitted to axial force $F_{C0}$ (usually equal to Tare Load $F_A$) on one hand and to an axial force $F_{C1}$ (usually equal to a static axial force $F_j$ corresponding to a functioning mode of the vehicle which it belongs) on the other hand shall be $\leq 30^0$.
- Copper (Cu) band adhesion should be such that it last through the life of coil spring in service.
- In addition to Copper (Cu) band, a one-inch-wide translucent **strip of yellow colour** over the **entire height** of coil spring & a band of aluminum adhesive tape (e.g. Tesaflex 171) at the same location just under the copper (Cu) band shall also be provided to indicate bowing direction.

**Specified No. of Samples: As per Table 6 of EN 13298 (latest)** **Actual No of Sample.....**

| S. No. | Free height $L_0$ (mm) | Test Load ($F_A$) in N | Spring Length $L_A$ (mm) under test load $F_A$ (in N) | Value "$r_i$" in (mm) under test load $F_A$ (in N) | Angle $\theta_C$ between bowing directions of spring to axial forces $F_A$ & $F_B$ (shall be $\leq 30^0$) |
|---|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |
| 11. | | | | | |
| 12. | | | | | |
| 13. | | | | | |
| 14. | | | | | |
| 15. | | | | | |
| 16. | | | | | |
| 17. | | | | | |
| 18. | | | | | |
| 19. | | | | | |
| 20. | | | | | |

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