# Inspection Plan (Check Sheet) for FIAT Springs
# QM-C-8.1/SS Rounds/0004/FIAT

**Item : Spring Steel Rounds (Peeled & Ground Bar)**

**Spec. : RDSO/2017/CG-01, Rev.01 of Aug-2019 with Corrigendum No.-01 of October, 2019 & Material- EN10089/ ISO- 683 Pt-14.**

**Drg. No.& Alt.:**

1. Firm's Name:-
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 passed:-
8. Quantity balance after this:-
9. Consignee:-
10. Delivery Period:-
11. Documents Verification:
    a) Internal test reports/documents as per Approved QAP.
    b) Crack detection report (MPI) OF 100% peeled rod offered for inspection.
    c) Reduction ratio 16:1 to be ensured by Inspecting official as per clause no. 5.1.1 & 5.1.2 of RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019.
    c) Record of heat treatment cycle of Bars/Rods (Annealing, heat- treatment).
    e) Calibration records of gauges, measuring instruments & testing equipment.

**(Check sheet duly filled for first stage inspection of annealed black bar should be attached).**

| Sr. No. | SUMMARY OF RESULTS | | | |
|---|---|---|---|---|
| 1. | Heat No. ---------- | Bar/Rod size ----------mm | Material Gr.---------- | |
| 2. | Visual Check | As per clause no. 5.2.1.1 of specification No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | Observation :---------- | |
| 3. | Dimensional check | As per clause no. 6.2.2.2 of specification No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019 or as specified in PO. | Observation : ---------- | |
| 4. | Microstructure | Annealed & free from "Primary" dendrite structure.<br>As per clause no. 5.1.1 & 5.2.4.2 of specification No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | Observation:---------- | |
| 5. | Grain Size | ASTM Size No.6 or finer.<br>As per clause no. 5.2.4.2 of specification No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | Max | Min |
| 6. | Hardness | 248 BHN Max (Annealed condition) for grade – 52SiCrNi5, 51CrV4 & 52CrMoV4, As per Table 6 of EN 10089. | Max | Min |
| 7. | Depth of decarburization | No decarburization (Partial total) shall be permitted on centre-less ground bars. | Max | Min |
| 8. | Inclusion rating | Not worse than 1.5 A,B,C,D for both thick and thin series when compared to the chart for determining the inclusion content of secondary refined steels (Fig.2) of IS: 4163(latest). Alternatively, non-metallic inclusion at every heat may be checked by the steel procedure in accordance to ASTM E45.<br>As per clause no. 5.2.4.2 of spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | Max | Min |
| 9. | Straightness | As per clause no.6.2.2 of spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | Ok/Not/Ok | |
| 10. | Macro- etching | As per clause no. 5.2.4.1 of spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | Observation:---------- | |
| 11. | Magna-flux testing | Magna-flux testing of 100% bars according to EN 10228-1/ASTM E 709 (latest) should indicate surfaces completely free of cracks, seam, inclusions, lap, etc. | Observation:---------- | |
| 12. | Surface roughness | Ra values of 5 microns (µm), As per clause no. 6.2.1.3 of spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | | |

| 13. | Chemical Composition: As per EN10089/ISO: 683 Pt-14 & spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S. No. | Material Grade | C% | Mn % | Si % | S % (Max.) | P% (Max.) | Cr % | V % | Mo % | Ni % | (Cu + Sn)% |
| | 1. | 51Cr V4 | | | | | | | | | | |
| | Specified as per ISO 683 Part-14 Or EN10089 & RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019. | | 0.47-0.55 | 0.70-1.10 | 0.40 max. | 0.015 max. | 0.015 max. | 0.90-1.20 | 0.10-0.25 | - | - | Cu+10 Sn±0.60 |
| | 2. | 52CrMoV4 | | | | | | | | | | |
| | Specified as per ISO 683 Parts - 14 Or EN10089 & RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019. | | 0.48-0.56 | 0.70-1.10 | 0.40 Max. | 0.015 max. | 0.015 max. | 0.90-1.20 | 0.14-0.20 | 0.20-0.30 | - | Cu+10 Sn±0.60 |
| | 3. | 52SiCrNi5 | | | | | | | | | | |
| | Specified as per ISO 683 Part-14 Or EN10089 & RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019. | | 0.49-0.56 | 0.70-1.00 | 1.20-1.50 | 0.015 max | 0.015 max | 0.70-1.00 | - | | 0.50-0.70 | Cu+10 Sn±0.60 |

***Note:***

*(i) Permissible deviation between specified analysis and product analysis shall be as per Table 4 of EN 10089.*

*(ii) In case of steel manufactured by electric, duplex or a combination of these processes routed through secondary refining furnace, the permissible limit of hydrogen and nitrogen contents in liquid steel shall be 2.0 ppm (Max.) and 0.007% (Max.) respectively.*

*(iii) In case of spring steel rounds manufactured through Ingot-forging-rolling route, hydrogen content shall be limited to 1.5 ppm (Max.) and nitrogen content shall be limited to 0.007% (Max.).*

(iv) *For Permissible limit of hydrogen and nitrogen contents in steel, test certificates should be provided by the bar manufacturers during raw material stage. These test certificates should be checked by the inspecting official.*

**1. Heat No. ---------- Bar/rod size---------- Material Gr. ----------**

**2. <u>Visual Checks for Defects:</u>**

Sample Size: 2% of bars per heat per section. Actual Sample:

| **Sr. No.** | **Sample No.** | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Freedom from defects | | | | | | | | | | |
| 2. | Marking (clause no. 5.3 of spec. No. RDSO/2017/CG-01, (Rev.01) with Corrigendum No.-01 of October, 2019. | | | | | | | | | | |
| 3. | Colour coding | | | | | | | | | | |

Total nos. of defectives. -------

Please use following defect codes for visual check while filling up the check sheets:

0 No defect
1 Cracks
2 Wrinkling
3 Longitudinal Grooves
4 Inclusions
5 Burned spots
6 Tool marks
7 Dent marks
8 Depressions
9 Twist
10 Depressions from handling and transport
11 Kinks
12 Seams
13. Folds
14. Laps
15. Deep Pits/Deep rooted seams
16. Distortion
17. No Marking
18. Marking at wrong location
19. In complete marking
20. In correct marking
21. No colour coding
22. Wrong colour coding
23. Colour coding at in correct location
24. In complete colour coding

**3. <u>Verification of Dimensional Tolerances:</u>**

Sample Size: 5 samples per heat per section. Heat No……..Actual Sample:

Value Specified: (i) Dia……mm (Tolerance in diameter as per clause no. 6.2.2.2 of spec. No. RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019 or as specified in PO.

(ii) Length… mm as per PO

| Sr. No. | Sample No. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Length | | | | | | | | | | |
| 2 | Diameter | | | | | | | | | | |

Total nos. of defectives. -------

**Please use following defect codes while filling up the check sheets:**

0 No defect

1 Excess Length,

2 Shorter Length,

3 Excess Diameter,

4 Lesser diameters.

**4. Macro-examination:**

Sample Size: 0.5% subject to min. of 5 bars per heat Heat No……..Actual No. of Samples……

Specified value: Entire cross section should have even annealed structure with depth of rim decarburization not more than 0.4 mm.
**(**As per clause no. 5.2.4.2 of specification No. RDSO/2017/CG-01, (Rev. 01) with Corrigendum No.-01 of October, 2019.)

| Sample No. | Observation |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**5. Grain Size:**

Sample Size: 3 bars per heat per section. Heat No… Actual Sample……

Value Specified: Average grain size of the bar shall be as ASTM no. 6 or finer.
**(**As per clause no. 5.2.4.2 of specification No. RDSO/2017/CG-01, (Rev. 01) with Corrigendum No.-01 of October, 2019.)

| Sample No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Average Grain Size (ASTM NO.) | | | | | |
| Defect Code | | | | | |

Total nos. of defectives. -------

Defect Codes

0 No Defect , 1 Coarser than ASTM NO. 6

## 6. Hardness:

Sample size: 10 bars per heat (Test to ensure per section per heat treatment batches).

Actual Samples:

Value Specified: 248 BHN Max (Annealed condition) for grade – 52SiCrNi5, 51CrV4 & 52CrMoV4, As per Table 6 of EN 10089.

| Sample No. | Material Grade | Heat No. | Bar Diameter | Dia. of Indentation | | | Hardness (BHN) | Defect code |
|---|---|---|---|---|---|---|---|---|
| | | | | 1st | 2nd | Average | | |
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| 4. | | | | | | | | |
| 5. | | | | | | | | |
| 6. | | | | | | | | |
| 7. | | | | | | | | |
| 8. | | | | | | | | |
| 9. | | | | | | | | |
| 10. | | | | | | | | |

**Total nos. of defectives…….**

**Defects Code:**

**0 Hardness as specified, 1 Hardness more than specified, 2 Hardness less than specified.**

## 7. Depth of Decarburization

Sample Size: 3 bars per heat per section. Heat No…….Size of section.....

Actual Sample:

**Value Specified**: No decarburization (Partial or total) shall be permitted on centre less ground bars.

| Material Grade | Sample No. | Observation Value | Defect code |
|---|---|---|---|
| | 1 | | |
| | 2 | | |
| | 3 | | |

Total nos. of defectives……

Defect codes

0 No Defect, 1 Depth of Decarb more than specified

## 8. Inclusion rating

Sample Size: 3 bars per heat per section. Heat No…… Size of section……

Actual Sample:

Value Specified: Not worse than 1.5 A,B,C,D for both thick and thin series when compared to the chart for determining the inclusion content of secondary refined steels (Fig.2) of IS: 4163(latest). Alternatively, non-metallic inclusion at every heat may be checked by the steel procedure in accordance to ASTM E45.

**As per clause no. 5.2.4.2 of spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019.**

| Sample No. | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| Rating | Thin | Thick | Thin | Thick | Thin | Thick | Thin | Thick |
| 1. | | | | | | | | |
| 2. | | | | | | | | |
| 3. | | | | | | | | |
| Defect code | | | | | | | | |

Total nos. of defectives----------

**Defect Codes**

0 No Defect
1 Worse than Specified in A Thick Series
2 Worse than Specified in A Thin Series
3 Worse than Specified in B Thick Series
4 Worse than Specified in B Thin Series
5 Worse than Specified in C Thick Series
6 Worse than Specified in C Thin Series
7 Worse than Specified in D Thick Series
8 Worse than Specified in D Thin Series

**9. Straightness:**

Sample size: - 2 bars per heat per section Actual sample size:-

Value Specified: **As per clause no. 6.2.2 of specification No. RDSO/2017/CG-01, .Rev. (01) with Corrigendum No.-01 of October, 2019.**

| S.N. | Sample No. | 1 | 2 |
|---|---|---|---|
| 1. | OK/Not OK | | |

**10. Macro-Etching :**

Sample Size: 0.5% subject to min. of 5 bars per heat per section. Heat No…….

Actual Sample:

Value Specified: As per clause no. 5.2.4.1 of specification no **RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019.**

| Sample No. | Observations |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| Specified | **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.** |

**11. Magna-flux Test:**

Sample Size: - 5 bars per heat per section (by the inspecting agency) and **100% bars (by the manufacturer)**.

Actual Sample:-

Value Specified:- Magna-flux testing of 100% bars according to EN 10228-1/ASTM E 709 (latest) should indicate surfaces completely free of cracks, seam, inclusions, lap, etc.

| Sr. No. | Sample No. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 1 | Ok/Not Ok | | | | | |

**12. Surface Roughness:**

Sample Size: - 10 bars per heat per section

Actual Sample:-

Value Specified:- **Ra value of 5 microns (µm), As per clause no. 6.2.1.3 of** spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019.

| Sr. No. | Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ok/Not Ok | | | | | | | | | | |

## 13. Chemical Composition.

Sample Size: 2 Samples per heat per section. Heat No……. Size of section……

Actual Sample:

Specified: **As per EN10089/ISO: 683 Pt-14 & spec. No. RDSO/2017/CG-01, Rev. (01) with Corrigendum No.-01 of October, 2019.**

| S. No. | Material Grade | C% | Mn% | Si % | S % (Max.) | P% (Max.) | Cr % | V % | Mo % | Ni % | (Cu + Sn)% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 51Cr V4 | | | | | | | | | | |
| Specified as per ISO 683 Part-14 Or EN10089 & RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019. | | 0.47 - 0.55 | 0.70 - 1.10 | 0.40 max. | 0.015 max. | 0.015 max. | 0.90 - 1.20 | 0.10 - 0.25 | - | - | Cu+10 Sn±0.60 |
| 2. | 52CrMoV4 | | | | | | | | | | |
| Specified as per ISO 683 Parts - 14 Or EN10089 & RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019. | | 0.48 - 0.56 | 0.70 - 1.10 | 0.40 Max. | 0.015 max. | 0.015 max. | 0.90 - 1.20 | 0.14 - 0.20 | 0.20 - 0.30 | - | Cu+10 Sn±0.60 |
| 3. | 52SiCrNi5 | | | | | | | | | | |
| Specified as per ISO 683 Part-14 Or EN10089 & RDSO/2017/CG-01, Rev.01 with Corrigendum No.-01 of October, 2019. | | 0.49 - 0.56 | 0.70 - 1.00 | 1.20 - 1.50 | 0.015 max | 0.015 max | 0.70 - 1.00 | - | | 0.50 - 0.70 | Cu+10 Sn±0.60 |

***Note:*** *(i) Permissible deviation between specified analysis and product analysis shall be as per Table 4 of EN 10089.*

*(ii) In case of steel manufactured by electric, duplex or a combination of these processes routed through secondary refining furnace, the permissible limit of hydrogen and nitrogen contents in liquid steel shall be 2.0 ppm (Max.) and 0.007% (Max.) respectively.*

*(iii) In case of spring steel rounds manufactured through Ingot-forging-rolling route, hydrogen content shall be limited to 1.5 ppm (Max.) and nitrogen content shall be limited to 0.007% (Max.).*

(iv) *For Permissible limit of hydrogen and nitrogen contents in steel, test certificates should be provided by the bar manufacturers during raw material stage. These test certificates should be checked by the inspecting official.*

**Defect codes for Chemical Composition:**

| | |
|---|---|
| 0 | No Defect. |
| 1 | C Less than specification. |
| 2 | C more than specification. |
| 3 | Si Less than specification. |
| 4 | Si more than specification. |
| 5 | Mn Less than specification. |
| 6 | Mn more than specification. |
| 7 | S more than specification. |
| 8 | P more than specification. |
| 9 | Cr Less than specification. |
| 10 | Cr more than specification. |
| 11 | V Less than specification. |
| 12 | V more than specification. |
| 13 | Mo Less than specification |
| 14 | Mo more than specification |