Document Title: Schedule of Technical Requirement for fabrication of High Strength Friction Grip Bolting Assemblies with Direct Tension Indicator Washer (suitable for preloading) for use in Railway Bridges, ROB & FOB

AMENDMENT HISTORY:

<table>
<thead>
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<th>S.No.</th>
<th>Amendment Date</th>
<th>Version</th>
<th>Reasons for Amendments</th>
</tr>
</thead>
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<tr>
<td>1.</td>
<td>04-04-2019</td>
<td>1.0</td>
<td>STR approved by Railway Board.</td>
</tr>
</tbody>
</table>
SCHEDULE OF TECHNICAL REQUIREMENT FOR FABRICATION OF HIGH STRENGTH FRICTION GRIP BOLTING ASSEMBLIES WITH DIRECT TENSION INDICATOR WASHER (SUITABLE FOR PRELOADING) FOR USE IN RAILWAY BRIDGES, ROB, & FOB

1. **Scope**

This specification covers the norms for objective evaluation of capability and capacity of any firm for manufacture and supply of HSFG bolting assemblies with direct tension indicator washer (suitable for preloading) for use in railway bridges, ROB, & FOB.

2. **Procedure for Registration of Firms for manufactures and supply of HSFG bolting assemblies with direct tension indicator washer (suitable for preloading) for use in railway bridges, ROB, & FOB.**

2.1 The firm interested in getting registered shall study this document carefully and will ensure availability of:

   (i) The required infrastructure, machinery, tools & plant.
   (ii) Space required for manufacturing, testing and storage viz. manufacturing floor, Godown, store, office and test lab etc.
   (iii) Testing and measuring equipment duly calibrated.
   (iv) Trained technical manpower.
   (v) Past Experience Criteria
   (vi) Quality Assurance Aspects.

2.1 In case manufacturer is satisfied that the infrastructure and other available requirements listed above are commensurate with the stated requirements, then firm shall apply for registration ON-LINE on the RDSO website. All relevant documents like vendor approval guidelines, application form, schedule of technical requirement (STR), latest version of relevant specifications (if applicable), etc. are available on the RDSO website. The requisite charges as specified on website are to be deposited through the means as specified on the RDSO website.

2.2.1 The firm has to submit ONLINE the complete application form, self compliance of STR along with all necessary documents in support of self compliance of STR and documents in support of other important aspects of application. The firm has also to submit the undertakings as mentioned in Document No. BS-G-4.2.3-1 (latest version) titled “Guidelines for Registration and Quality Audit of Vendors in Bridge & Structure Directorate” available on RDSO Website.

2.2.2 For detailed procedure for Registration and other related aspects, refer to Document No. BS-G-4.2.3-1 (latest version) titled “Guidelines for Registration and Quality Audit of Vendors in Bridge & Structure Directorate” available on RDSO Website.
3. **Norms for Acceptance:**

To qualify for manufacture and supply of HSFG bolting assemblies with direct tension indicator washer (suitable for preloading) for use in Railway Bridges, ROB, & FOB, the firm must satisfy the requirements laid down in para 4, 5, 6, 7, 8, 9 & 10 below. The specifications/codes commonly referred in this document considered with latest correction slips/Versions in vogue.

**Note:** Kindly note that after registration, the firm has to supply the HSFG Bolts, Nuts & Washers for use in Railway Bridges, ROB & FOB as per approved QAP of RDSO, which is available on RDSO Website.

4. **General and Infrastructural Requirements:**

Detailed information with necessary documents in support is required for following items:-

4.1 The manufacturer must have adequate organization including supervisors, skilled worker and other categories of manpower to execute the work in competent manner. (Enclose list of staff along with Qualification & experience of employees).

4.2 A proper organization must exist to perform the functions of purchasing of various raw materials, bought-out components, consumables, etc. and for maintaining the purchasing documents including inspection certificates, test certificate etc. (Enclose list of staff along with Qualification & experience of employees).

4.3 A proper procedure for maintenance of records for receipt and consumption of raw material including steel should be in vogue or developed so as to allow verification by railway's representative.

4.4 Adequate power supply should be arranged through distribution agencies with back up through captive generation. (Necessary documents in support to be enclosed).

4.5 Covered bay area with proper handling facilities should be available to handle day-to-day manufacturing of HSFG Bolts, Nuts & Washers for use in Railway Bridges, ROB & FOB.

4.6 The premises should have covered storage area to store raw material and finished products.

4.7 Covered shed area protected from rain, dust etc. should be provided for surface preparation and coating. Adequate space for storing manufactured component awaiting painting shall be available.

**Note:** For para 4.5 to 4.7 Applicant has to submit ONLINE a neat copy of plan of work premises & show detail of items given below:-
(a) Covered bay area with proper handling facilities available to handle day-to-day production of HSFG bolting assemblies with direct tension indicator washer (suitable for preloading) for use in railway bridges, ROB, & FOB.

(b) Area for storing raw material & finished products etc.

(c) Area for separate line for inspection and testing of HSFG bolting assemblies.

(d) Covered shed area protected from rain, dust etc., available for surface preparation and Hot dip galvanization and Zinc flakes.

4.8 An adequately equipped and drawing Office is required for preparation of drawings. (Enclose list of staff along with Qualification & experience of employees).

4.9 The manufacturer should be capable of designing required fixtures, templates etc. as required for manufacturing work (Enclose list of staff with qualification and experience).

4.10 Firm should submit the details of equipments/machinery i.e. make, model, year of manufacture, machine no. etc. for Equipments and Machineries mentioned in para 5 to 7 preferably in a chart form (machinery owned by sister concerns will not be accepted).

4.11 After registration of firm it is mandatory to inform RDSO through FAX (followed by confirmation copy through courier/speed post) as soon as any machinery is removed from the firm's premise (even for repair etc.). RDSO should be informed again, when the machinery is brought back and made operational.

4.12 Firm is required to give an undertaking that if at any time after approval is accorded, some machinery is found deficient without intimation to RDSO, then it will be presumed that machinery was not there since beginning and firm's approval will be withdrawn immediately.

5.0 Facilities required for manufacturing and supply of HSFG Bolts, Nuts & Washers for use in Railway Bridges, ROB, FOB.

5.1 Following machines/equipment shall be available with the manufacturers for supply of HSFG bolting assemblies with direct tension indicator washer (suitable for preloading).

Provide quantity, make, model no., S.No., capacity, year of manufacture/commissioning, Machine number etc. preferably in a chart form as applicable):

i. Continuous Heat Treatment Furnace (Hardening, Oil Quenching & Tempering) + Thermal Blackening.

ii. Cold Forging Machines with min. & max. Dia. & Length.

iii. Hot Forging Machines with min. & max. Dia. & Length.

iv. Head Trimming Machines
Schedule of Technical Requirement for fabrication of High Strength Friction Grip Bolting Assemblies with Direct Tension Indicator Washer (suitable for preloading) for use in Railway Bridges, ROB & FOB

v. Threads Rolling Machines
vi. Bull block wire drawing machine
vii. Hot dip galvanizing facilities in accordance to ISO 10684 (Latest version)
viii. Zinc flake coating facility in accordance to ISO 10683. (Latest version)
ix. Elcometer.
x. Adequate no. of measuring instruments (micrometers, dial gages, vernier calipers, Go-No-Go gauges).
xi. Automatic weighing system.

Note: If Zinc flake coating facility is not in house, it can be outsourced. If outsourced, submit a copy of MOU with outsourced agency, and copy of some previous satisfactory completion certificate work of Zinc Flaking by outsourced agency. The MOU should have validity of minimum 66 months. The outsourced agency shall have Zinc flake coating facility in accordance to ISO 10683, and it shall be clearly mentioned in MOU.

5.2 (a) Heat mark of the raw material shall be embossed on the bolt head, Apart from heat mark, length of bolt shall also be embossed on the bolt head, in addition to name of manufacturer and grade of bolt material. [Refer specification no BS-S-7.5.3.1-5 Latest Version Available on RDSO Website]

(b) Preferably the heat mark of the raw material shall also be embossed on the nut and washers. [Refer specification no BS-S-7.5.3.1-5 Latest Version Available on RDSO Website]

5.3 Material to be procured and manufacturing process must meet the requirement of relevant specifications (Latest version).


6.1 Following machines/equipment shall be available with the manufacturer, as required in manufacturing of HSFG bolts as per EN 14399: (Provide quantity, make, model no., S.No., capacity, year of manufacture/commissioning, Machine number etc. preferably in a chart form as applicable).
   • Microscope/Profile projector for threads laps.
   • Spectroscope (For chemical composition testing)
   • Hardness Tester
   • Universal/Tensile testing machine
   • Impact testing machine
   • Microscope for measurement of decarburization
   • Hardness testing and tempering furnace
Magna Flux for crack detection.
- Adequate no. of measuring instruments and gauges (Vernier calipers/Screw Gauges, Thread Plug Gauge, Thread Ring Gauge, Go-No-Go gauges).
- Elecometer.
- Torque Tester
- Electric torch wrench

6.2 The following requirements specified in 4.2 to 4.5 of EN 14399-1:2015, are assessed through the verification of the properties of the involved components and/or bolting assemblies, as applicable

<table>
<thead>
<tr>
<th>SN</th>
<th>Type (bolting Assemblies)</th>
<th>Test procedure</th>
<th>Testing Apparatus</th>
<th>Result after testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Angle to failure during tightening</td>
<td>Bolting assemblies shall be tested according to EN 14399-2:2015, 6.5, to evaluate the margin against over tightening.</td>
<td>Testing apparatus and set up shall be in accordance with EN 14399-2:2015, Clause 6.</td>
<td>The results shall meet the requirements specified in EN 14399-3, EN 14399-9 for the relevant type.</td>
</tr>
<tr>
<td>2</td>
<td>Axial load</td>
<td>Suitability for preloading of bolting assemblies shall be carried out in accordance with EN 14399-2:2015, Clause 6.</td>
<td>Testing apparatus and set up shall be in accordance with EN 14399-2:2015, Clause 6.</td>
<td>The results shall meet the requirements specified in EN 14399-3, for the relevant type.</td>
</tr>
<tr>
<td>3</td>
<td>Compression load (Bolting assembly with DTI)</td>
<td>Compression load testing of assemblies which include direct tension indicators shall be carried out in accordance with EN 14399-9:2009, 5.3.</td>
<td>Testing apparatus and set up shall be in accordance with EN 14399-9:2009, 5.3.</td>
<td>The results shall meet the requirements specified in EN 14399-9.</td>
</tr>
</tbody>
</table>

6.3 The following requirements specified EN 14399-1:2015 are assessed through the verification of the properties of the involved components and/or bolting assemblies, as applicable:

<table>
<thead>
<tr>
<th>SN</th>
<th>Property class (bolting assemblies)</th>
<th>Test procedure</th>
<th>Testing Apparatus</th>
<th>Result after testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Elongation (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013,9.7.</td>
<td>Tensile test meter shall be in accordance with ISO 7500-1</td>
<td>The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
</tr>
<tr>
<td>No.</td>
<td>Requirement</td>
<td>Description</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tensile strength (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013, 9.2 or 9.7. Tensile test meter shall be in accordance with ISO 7500-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Strength under wedge loading (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013, 9.1. Tensile test meter shall be in accordance with ISO 7500-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tensile yield strength (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013, 9.7. Tensile test meter shall be in accordance with ISO 7500-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Proof load (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013, 9.6. Tensile test meter shall be in accordance with ISO 7500-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Proof load (nuts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-2:2012, 9.1. Tensile test meter shall be in accordance with ISO 7500-1, Class 1 or better. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Impact strength (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013, 9.14. Impact testing machine shall be in accordance with ISO 148-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Hardness (bolts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-1:2013, 9.9. Hardness tester shall be in accordance with ISO 6507-1, ISO 6506-1, ISO 6508-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hardness (nuts)</td>
<td>Testing shall be carried out in accordance with EN ISO 898-2:2012, 9.2. Hardness tester shall be in accordance with ISO 6507-1, ISO 6506-1, ISO 6508-1. The results shall meet the requirements specified in EN 14399-3, for the relevant property class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hardness (washers)</td>
<td>Testing shall be carried out in accordance with EN ISO 6507-1 or EN ISO 6508-1. Hardness tester shall be in accordance with ISO 6507-1 or ISO 6508-1. The results shall meet the requirements specified in EN 14399-5, or EN 14399-6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hardness (direct tension indicators and nut face washers)</td>
<td>Testing shall be carried out in accordance with EN ISO 6507-1. Hardness tester shall be in accordance with ISO 6507-1. The results shall meet the requirements specified in EN 14399-9.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.4: The manufacturer shall submit relevant documents related to compliance of testing equipment/apparatus as per specification given in EN 14399 or referred specification.

6.5: The chemical composition of materials used in manufacturing of HSFG bolting assemblies shall be in accordance to IS 898-1:2013, 6.

6.6 The HSFG bolting assemblies shall meet all the applicable mechanical and physical properties in accordance to IS 898-1:2013, 7.

7. Qualifying criterion:

Firm should have certified “Satisfactory Performance” of these Bolts from at least three past users at the time of application. Satisfactory Performance certificate issued by Government organizations, Public sector undertakings or corporations, Private companies having minimum annual turnover of Rs. 500 crores will only be considered valid for this requirement.

8. Quality Assurance

To ensure good and consistent quality of product, there shall be:

8.1 Assessment and Verification of Constancy of Performance (AVCP) shall be strictly followed in accordance to Clause 6 of EN 14399-1:2015.

8.2 Proper packing procedure to avoid corrosion during transportation and storage before actual use of HSFG bolts assembly is required. HSFG bolt, nut, plain washer and DTI washers should be assembled in manufacturer’s premises and packed in carton box. Weight of each carton box shall not exceed 20 Kg. These carton boxes should be packed in wooden box and should be transported to site.

8.3 HSFG bolts, nuts, washers, and DTI shall cover tolerances on dimensions and shape as specified in Clause 4.4 of EN 14399-1:2015. It is relevant for the ability of components to be matched together in order to provide the declared performances of the bolting assemblies.

8.4 The number of samples of high-strength structural bolting assemblies for preloading to be tested and/or assessed shall be in accordance with Table 6 of EN 14399-1:2015. The results of the determination of the product-type shall be part of the test reports. All test reports shall be retained by the manufacturer for at least 10 years.

Testing shall be carried out in accordance with EN14399-9:2009, Clause 3.4.

Testing shall be carried out in accordance with EN14399-9:2009, Clause 3.4.

The results shall meet the requirements specified in EN 14399-9 for the relevant property designation.
after the last date of production of the high-strength structural bolting assemblies for preloading to which they relate.

8.5 All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

8.6 All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use; wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

8.7 The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring their compliance.

8.8 Individual components of high-strength structural bolting assemblies as well as their packages shall be identifiable and traceable with regard to their manufacture (manufacturer's identification mark). The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes on labels and markings on high-strength structural bolting assemblies are inspected regularly.

8.9 A system should be in force for analysis of defects noticed during internal and external inspections of the final product and sub-assemblies. A dynamic arrangement for a feedback to the source of defects and for rectification should be in vogue. Perforam which is being followed shall be enclosed.

9.0 Quality Audit

9.1 Quality Audit of the Registered Vendors will be done every five year.

9.2 The firm should satisfy the following requirements to continue as approved vendor
   a) The firm should continue to maintain the infrastructure, facilities and Machineries & plants as required at the time of Quality Audit as per prevailing STR.
   b) The firm should have successfully executed/completed at least three works of Railway Bridge HSFG bolting assemblies with direct tension indicator washer. For the purpose of this clause, successful fabrication of at least one span against a multiple span will be considered/treated as completed work.
   c) The firm should not have any adverse report from any of the Railways.

9.3 For Quality Audit, firm will be inspected for facilities provided as per para 4 to 8 of this STR, which in turn will be verified, after inspection by the RDSO team. The firm should also give an undertaking that organizational and infrastructural requirement as required at the time of Quality Audit have been maintained.

9.4 If the firm does not satisfy the criteria given in prevailing STR, its name will be removed from approved list and firm shall have to apply afresh in case it desires to be registered again.
10.0 Following specifications/codes (Latest version) commonly referred in connection with manufacturing of HSFG bolt must be available with manufacturer.

EN 14399 with following parts
Part 1: General requirements
Part 2: Suitability of preloading
Part 3: System HR-Hexagon bolt and nut assemblies
Part 5: Plane washers
Part 6: Plain chamfered washers
Part 9: System HR or HV –Direct tension indicators for nut and bolt assemblies

Notes:-1. The other specifications mentioned in above specifications are also to be adhered as detailed in the relevant specifications.
2. Above codes/documents are to be considered with latest correction slips/Version in vogue.

11.0 RESPONSIBILITY AND AUTHORITY:

The following table indicates responsibility related to this document:-

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<tr>
<th>Activity</th>
<th>Responsible</th>
<th>Approver</th>
<th>Supporting</th>
<th>Consulted</th>
<th>Informed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creation, maintenance of this document</td>
<td>DBS/Inspection</td>
<td>ED/B&amp;S</td>
<td>DD Insp., ADE/Insp. and Staff of DD/Insp.</td>
<td>-</td>
<td>Through intranet/ soft copy.</td>
</tr>
<tr>
<td>Compliance of Directive contained in this document</td>
<td>ADE/B&amp;S/InsOffice DD/InsP</td>
<td>DBS/T&amp;I</td>
<td>Directorate staff</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

ABBREVIATION:

ED = Executive Director/B&S
DBS = Director/Joint Director(B&S)/Inspection
ADE/Ins. = Assistant design Engineer/Inspection
ADE = Assistant Design Engineer/Inspection
SE = Section Engineer/Inspection