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SCHEDULE OF TECHNICAL REQUIREMENTS FOR ENHANCE

CAPACITY (ALLOY STEEL) SCREW COUPLINGS

USED ON RAILWAY COACHES

(SUPERSEDES C-9505)

(NOVEMBER 1996)

Screw Couplings

MASTER COPY

Controlling Officer

Signature :

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## SECTION-A

## SCHEDULE OF TECHNICAL REQUIREMENTS FOR ENHANCED CAPACITY (ALLOY STEEL) SCREW COUPLINGS USED ON RAILWAY COACHES

## 1 SCOPE

This schedule has got two sections i.e. Section-A and Section-B. Section-A covers the technical requirements, methods of sampling and tests for screw coupling used in BG coaches. Section-B covers schedule of infrastructure requirements for manufacturing, testing facilities, quality control requirements and inspection.

## 2 MATERIAL

- 2.1 The material shall conform to grade 35Mn<sub>6</sub>Mo<sub>3</sub> of IS: 5517-93 with the following additional requirements:

## 3 MANUFACTURE

- 3.1 The steel shall be melted in Electric Arc furnace followed by secondary refining. The molten metal shall be degassed through vacuum degassing arrangements to ensure freedom from harmful gaseous content.

- 3.1.1 The hydrogen content in the liquid steel shall be 2 ppm max.

- 3.1.2 The sulphur and phosphorus content during ladle analysis shall be 0.025% (Max.) each.

- 3.1.3 The size of ingots or concast billets for the given size of the finished steel product shall be such that a minimum reduction ratio of 8:1 from the minimum cross-section area of the ingot or concast billets to the maximum cross-section area of the product is ensured.

- 3.1.4 Elements not mentioned in IS: 5517-93 shall not be, intentionally or otherwise, added to the steel.

## 3.2 CHEMICAL COMPOSITION

- 3.2.1 The ladle analysis of steel, when analysed in accordance with IS: 228 shall be to IS: 5517-93 Table-2 read in conjunction with requirements detailed in clause Nos. 2.1.1.2 and 2.1.1.3 above.

### 3.3 FREEDOM FROM DEFECTS

- 3.3.1 The screw couplings and/ or spares such as bent coupling links, pins etc. shall be free from harmful surface and sub- surface defects, which may impair the end use of the product. When ingot practice is adopted, the internal defects of steel, as evaluated by macro etching test as per IS:11371-85 shall not be worse than S-2 (Sub- surface), R-2 (Random condition) and C-2 (Centre segregation) as per ASTM E-381. When continuously cast billets/blooms are used, the internal defects of steel, shall not be worse than SB-2 (Sub-surface blow-holes), SC1 (Sub-surface cracks), CS-2 (Centre segregation) and CL-2 (Centre looseness) as per IS: 13352-92 (Stock for forging produced from continuously cast blooms, billets and slabs Spec.)
- 3.3.2 During processing the billets, blooms or slabs shall be conditioned to remove injurious surface defect, provided the depth of conditioning does not exceed 1 mm for every 15 mm of concerned dimension, upto a maximum depth of 20 mm, and provided that the width of the conditioning is at least four times its greatest depth; except that in case of slabs, the depth of conditioning on the wide surface may exceed this allowance by 50%, upto a maximum depth of 20 mm. The maximum depth of conditioning on two parallel sides at opposite locations shall not exceed one and half times the maximum allowed for one side. The transition between conditioned and non-conditioned areas shall be gradual. All heavy swarf and/or slag shall be removed. After removal of surface defects from the billets, magnetic particle testing and ultrasonic examination may be carried out on all the billets to ensure freedom from surface defects and internal defects respectively. Standard for testing method and acceptance criteria may be prepared and RDSO's approval obtained.
- 3.3.3 In special cases, particularly where it is necessary on large material and is not injurious, greater depth of conditioning may be permitted by agreement between the Purchaser/Inspecting Authority and the Manufacturer. The method of conditioning employed for removal of surface defects shall be such that it does not impair the properties of the billet material.
- 3.3.4 The Manufacturer shall be at liberty to choose the method of conditioning, subject to prior approval of the Purchaser.
- 3.4 The raw material shall be procured from RDSO approved sources only. Complete details of chemical composition and other tests shall be obtained from steel maker and shall be produced to the inspector.
- 3.5 The screw coupling assembly shall conform to RDSO/SK-99001 with latest alterations.

#### 4 QUALITY OF SCREW COUPLINGS

- 4.1 The link, bent coupling link and trunnions shall be forged solid, and all holes in them must be drilled. The bottom end of the weight lever must be split to prevent the cast iron weight from working loose or dropping off. The pin for securing the links with draw hook shall be turned or alternatively closed die forged and then machined. Links, bent coupling link and trunnions shall also be closed die forged. Care is to be taken to cut the threads of the screw accurately to the dimensions shown in the drawing and generally to finish them in the best and most accurate manner. The screw should not be too good a fit in the trunnion nuts, as it is found, if too good fit is made, the couplings are soon rendered inoperative owing to slight distortion of the screws due to stresses set up in use. Trunnion with L.H threads (item 5 of Sk.99002) to be assembled with bent coupling before heat treatment. Procedure should be by heating the bent portion of the coupling link and then opening / closing up reasonably for insertion of the trunnion. After fitment, arms of the coupling link to be closed. The marking of the raw material used i.e., IS:5517 on item No. 1,2,3,5,6, & 8 of Sk.99002 to be strictly done in the location shown in the drawing. After assembly, each screw coupling must be fixed as it in actual practice and screw both in and out to the full length of the travel.

#### 5 HEAT TREATMENT (Hardening & Tempering)

- 5.1 The screw coupling components i.e., link, screw, pin & trunnion with R.H thread shall be heat treated separately in a component wise batch. Bent coupling link with trunnion L.H thread to be heat treated in assembled condition and in a batch. The threads of the screw and trunnion should be given suitable protective masking to avoid any damage of the thread during heat treatment. Heat treatment cycle should be as per procedure given below to meet the requirements stipulated in clause 6 of this ST
- i) Put the above components in the furnace at temperature lower than 500°C.
  - ii) Heat it progressively upto 860°C in minimum 2 hours.
  - iii) Soak at 860°C. Soaking time should be as per the thickness of the component
  - iv) Quench in circulating oil.
  - v) Temper at 550-650°C followed by normal cooling. Soaking time should be as per the thickness of the component.

#### 6 SAMPLING

- 6.1 Screw coupling assemblies, spare parts shall be offered for inspection in separate lot. Lot size for complete screw coupling will, however, not to exceed 100 screw couplings. Two nos. of sample shall be drawn from the lot for conducting test as per clause 7.1 to 7.3.2 and remaining screw coupling shall be subjected to proof load testing as per clause 7.3.3. For spare parts lot size shall be of a maximum of 300 Nos. or part thereof from one heat treatment batch.

## 7 TESTS

### 7.1 Chemical Tests

#### 7.1.1 Chemical Composition

Chemical composition shall be checked on the finished products. The variation of this chemical analysis when compared to limits specified in IS:5517-93 Table-2, read in conjunction with the requirements detailed in clause Nos.3.1.2 and 3.1.3 shall conform to clause 6.2 of IS:5517-93.

### 7.2 Metallographic Examination

#### 7.2.1 Inclusion Ratings

The inclusion rating level of steel when determined as per IS: 4163-82 (Method for determination of inclusion content in steel by microscopic method) shall not be worse than 2.0 A, B, C, D in thin and 1.0 A, B, C, D in thick series.

#### 7.2.2 Micro Structure

Structure should be tempered martensite.

### 7.3 Mechanical Tests

#### 7.3.1 Impact Test

One coupling per lot shall be subjected to impact test by the Purchaser or the Inspecting Authority, and must withstand not less than three blows each of 1500 kg meters intensity without fracture. The total extension after the 3rd. blow shall not exceed 50 mm on the whole of coupling or 3 mm on the screw. Test is to be conducted on a impact testing machine having minimum capacity of 2000 kg meters. The sample after testing shall be destroyed by oxy cutting in the presence of purchaser/Inspecting Authority.

#### 7.3.2 Destruction Test

One coupling per lot shall be tested by direct pull and it must not break with a load of 130 tonnes. For the purpose of this test, the coupling chosen shall not be the one previously subjected to impact test (under clause 7.3.1). The test must be conducted on a hydraulically operated machine having minimum capacity of 150 tonnes. The sample after testing shall be destroyed by oxy cutting in presence of purchaser / Inspecting Authority. For spare parts refer to clause-9.

### 7.3.3 Proof Load Test

Each remaining coupling of the batch which has complied with the requirements of clause 7.1.1 to 7.3.2 will be subjected to a direct pull of 75 tonnes and must not show any signs of permanent set under the pull, after release of pull. Any coupling not complying with this clause shall be rejected. The test must be conducted on a hydraulically operated machine being used for destruction test.

### 7.4 Periodical Test

In addition to the above test, at random sample shall be sent to NTH once in six month for conducting the Impact & Destruction test as enumerated in clause No.7.3.1 & 7.3.2.

## 8 ADDITIONAL TESTS

8.1 If any sample of any heat treatment batch fails to withstand either impact test or destruction test, the Manufacturer with the approval of the Inspecting Authority may reheat-treat the sample batch and submit samples for retest as given in Table-1. If any of the retest sample fails to comply with the requirements of either impact test or destruction test, the whole batch represented by the samples shall be rejected. Each coupling of the batch which has successfully complied the additional tests, shall be subjected to proof load test as per clause 7.3.3.

**TABLE-1 - RETEST SAMPLES**

| Original sample failed in |                                  | Number of retest samples per hundred couplings or part thereof of a heat treatment batch |                          |           |
|---------------------------|----------------------------------|--|--------------------------|-----------|
|                           |                                  | No. for impact test  | No. for destruction test | Total No. |
| 1.                        | Impact Test                      | Two  | One                      | Three     |
| 2.                        | Destruction Test                 | One  | Two                      | Three     |
| 3.                        | Both Impact and Destruction Test | Two  | Two                      | Four      |

## 9. SPARES

9.1 Only those vendors approved for the supply of complete screw coupling assembly are eligible for the supply of spare parts of the screw coupling. When spare i.e. link, bent link with trunnion, screws etc are ordered, one sample from each heat treatment batch shall be tested as per clause 7.1 to 7.2.2 & 7.3.2. For destruction testing of the spares, a special test screw coupling assembly having a load capacity in excess of 130 tonne is to be developed by the vendor and these spare parts shall be fitted in this test screw coupling and tested as per clause 7.3.2. the



spare parts, after testing, shall be destroyed by oxy cutting. When testing the spares, if the test screw coupling breaks before required loading is attained, the test shall be terminated. After successful compliance of the above requirements, the remaining spare parts shall be subjected to proof load test. To test these spare parts they shall be fitted in standard screw coupling assembly and the complete assembly subjected to test enumerated in clause 7.3.3. Bent link with LH trunnion shall be supplied in assembled condition duly heat treated.

## 10 TESTING AND INSPECTION FACILITIES

- 10.1 The Manufacturer shall supply free of charge the material required for testing and shall at his own expense, furnish and prepare the necessary test pieces, and provide labour and appliances for such testing as may be carried out in the premises in accordance with this schedule. Failing to provide facilities at his own works for carrying out the prescribed test, the Manufacturer shall bear the cost of conducting the tests elsewhere.

## 11 REJECTION

- 11.1 The screw couplings and/or spares such as link, bent coupling link, trunnions, screw pins, etc, found defective due to improper workmanship or not complying with the provisions of this schedule shall be rejected. The manufacturer should ensure that the rejected material are not re-offered for inspection/testing. Procedure for disposal of the rejected materials should be clearly spelt in the QAP of the manufacturer.

## 12 MARKING

All parts of the screw couplings shall be stamped with such marks of identification as indicated in the drawing and in the absence of which as mutually agreed to between the Purchaser and the Manufacturer. "IS: 5517" should be stamped for material.

## 13 PROTECTION AND PACKING

All screw couplings and/or spares, after acceptance, shall be painted with one coat of boiled linseed oil to IS:77 and packed securely in rigid cases ensuring that each case does not weigh more than 750 kg. Alternatively, to be packed securely in double gunny bag. The thread of the screw shall be given additional rigid protection.



**SECTION-B****1 Requirements**

The vendors seeking approval shall comply all the below mentioned requirements:

**General & Manufacturing Facilities**

- 1.1 Covered area with adequate space underneath for storage of raw materials e.g. billets, round corner squares, rounds, etc. The covered area should have display board showing different colour shades nominated to different grades of steel to avoid mix up of materials. Arrangement of painting the billets, RCS, rounds etc with particular pain shade previously nominated ac-cording to the grade of steel should be available.
- 1.2 At least 1 No. fork lift and/or 1 No. over head crane of 2T capacity shall be available for material handling.
- 1.3 Minimum 1 No. band saw / billet shearing machine to should be available. ✓
- 1.4 At least 2 Nos. of drop hammer with minimum capacity of 2 MT or double acting pneumatic hammer / forging press of equivalent capacity along with at least 2 Nos. of trimming press of minimum 300 MT capacity for removal of flash etc shall be available.
- 1.5 Minimum 2 Nos. compressors of 75 cfm minimum capacity each are to be installed. In addition, blower of minimum 5 HP
- 1.6 Minimum 2 Nos. of batch type oil fired or gas-fired or induction furnace of adequate capacity for heating cut pieces of billets / RCS / rounds etc shall be available. The temperature range of these furnaces should be up to 1200°C and should be provided with automatic temperature controllers. The controller should be calibrated once in six month. The desired temperature shall be achieved within an accuracy of ±10°C.

OR

Minimum one number of pusher type oil-fired / gas-fired / induction furnace shall be available. The pusher type arrangement should be hydraulic / mechanical operated. The furnace should have adequate capacity to heat cut pieces of billets/RCS/rounds upto 1200°C temperature. The furnace should be provided with automatic temperature controllers. The controller should be calibrated once in six month. The desired temperature shall be achieved within an accuracy of ±10°C.

- 1.7 2 Nos. batch type electrically heated or oil fired furnaces each having a capacity of 500 kg for heating or components up to 1000°C. The furnaces should be provided with automatic temperature controllers and recorders and temperature-time graph recording facilities. Hardening temperature to be maintained shall be controllable within  $\pm 10^\circ\text{C}$ . The furnace shall have facility for controlling the internal atmosphere to avoid undesirable scaling and decarburisation.
- 1.8 One number oil quenching tank of approx. 6,000 litre capacity with necessary heat exchanger and continuous circulation of oil facilities should be available. The quenching tank should be provided with automatic temperature recorder.
- 1.9 2 Nos. forced air circulation, pit type electric or equivalent tempering furnace of adequate capacity having automatic temperature controllers and recorders.
- 1.10 One shot blasting machine with table dia of at least 3 ft. The shot blasting machine shall have in-built facility of sieving undersize shots.
- 1.11 1 No. slot type oil-fired/gas-fired/induction furnace of 250 kg capacity for heating the shackles before bending.
- 1.12 The firm should be equipped with CAD facility for designing its own forging and trimming dies.
- 1.13 A die shop having adequate die sinking facilities comprising of spark erosion machines etc. capable of accommodating die blocks up to 1T weight and 400mm height.
- 1.14 Adequate machining facilities comprising of vertical milling machine/radial drilling machines / horizontal lathes with tapping arrangements etc. of suitable capacities and standard makes are required for preparation of die blocks and machining of forged components.
- 1.15 1 No. bending fixture for shackles for each type of screw coupling shall be available.
- 1.16 Adequate Nos. of hand grinders are required for removal of fins & Burrs.
- 1.17 Minimum 1 No. semi-automatic / automatic thread cutting lathe for formation of knuckle threads upto 4" diameter for making screws is required.
- 1.18 1 No. gas-fired or equivalent smith furnace for heating of Rivets is required.
- 1.19 Prior to release of dies for production, it should be ensured that the dies are checked dimensionally in all respects including its mounting on the forging hammer / press. The firm must list out the method of checking the dies i.e. either on plaster of Paris blocks or on auto-cad arrangement. Proper records of die

inspection / checking showing the date of checking, important dimensions and contours must be maintained. Any ill effect of dies or forged components or their mismatching with forging hammers/press must be recorded. The remedial measures taken should also be documented.

- 1.20 Ensure that critical inspection of the first forging and last forging of a production run is essentially carried out to ascertain behavior of the dies in operation and product quality.

## 2 Testing Facilities

### 2.1 Chemical Lab:

- 2.1.1 The firm must possess a fully equipped chemical lab with following facilities:

- i) Arrangement to carry out the analysis of C and S by Strohle's apparatus and those of Si, P, Cr, Ni, Mo, V by conventional method shall be available.
- ii) Metallurgical microscope of standard make having 1000 magnification and with photographic attachment to check inclusion content, grain size, micro structure and decarb etc.
- iii) The firm should have permanent arrangement with NABL certified Lab or a reputed steel making company for arranging the spectro analysis of the material.
- iv) The lab should possess facilities of making sulphur prints, hot etching for macro examination of materials.
- v) Muffle furnace with temp. range upto 1000°C.

### 2.2 Physical Testing Lab:

- 2.2.1 The firm must possess a well equipped physical lab with following facilities:

- a) Universal Testing machine of 40 t capacity with load / deflection plotting arrangement to conduct UTS, Yield strength and bending tests etc.
- b) Impact testing machine of 30 kgm minimum capacity to conduct Izod / Charpy tests.
- c) BHN testing machine with necessary standard test pieces. The hardness testing machine shall have capacity to apply 3000 kgs load on one test specimen.
- d) One number Portable Hardness tester with standard calibration blocks.

### 2.3 Non-destructive testing:

#### 2.3.1 The firm must possess the following NDT facilities:

- i) 1 No. magnetic particle testing machine (wet method) with ultra violet light facilities. The bed of the machine should be of adequate length to accommodate the full length of test pieces. The machine shall have arrangement for both longitudinal and circular magnetisation. Magnetizing current capacity shall be appropriate to the work piece (1500 amps minimum).
- ii) One number dye penetrant kit for detection of surface cracks.
- iii) One number surface comparator to compare the surface finish of machined surfaces.
- iv) One number shadow graph equipment for verification of part profiles under 10x magnification.
- v) One number optical pyrometer to measure temp. ranging from 800°C to 1600°C.

### 2.4 Destructive Test:

2.4.1 Impact Test: The firm must possess in house one impact testing machine having minimum capacity of 2000 kg meter for conducting the impact test on the screw coupling in the assembled condition.

2.4.2 Destruction Test: Firm must possess in house one number hydraulically operated destruction testing machine with minimum capacity of 150 tonnes.

### 2.5 Other Testing Facilities:

#### 2.5.1 The firm shall possess the following:

- a) The firm shall have adequate facilities for preparation of sample. Facilities like machining, grinding, polishing etc. should be available in house.
- b) Adequate number of fine punches for stamping marking particulars on finished components.
- c) Adequate numbers measuring instruments such as:
  - i) Vernier Calipers - 150.00mm to 500mm
  - ii) Measuring scales - 1 metre to 2 metre
  - iii) Micrometers - Ranging from 50 to 100mm
  - iv) GO & NO-GO gauges

### 3 Quality Control Requirements

- 3.1 There should be a system to ensure the traceability of the product from raw material stage to finished product stage. This system should also facilitate to identify the raw material composition from the finish product stage.
- 3.2 Ensure that there is a QAP for the product detailing various aspects:-
- Flow Process Chart ✓
  - Stage inspection details ✓
  - Various parameters and to ensure control over them
- 3.3 There should be at least one full time technologist having a minimum bachelor's degree in relevant field & 5 years experience or a person with diploma in relevant field with 12 years experience. He should be free from day-to-day production, testing and quality control responsibilities. He should be mainly responsible for development of a product, analysis of products, control over raw material, corrective action in case of difficulties in achieving the parameters.
- 3.4 The firm should have acquired ISO:9000 series certification and the product for which an approval is sought should be broadly covered in the scope of the certification for manufacture and supply.
- 3.5 The Quality manual of the firm for ISO: 9000 should clearly indicate at any stage the control over manufacturing and testing of the said railway product.
- 3.6 Ensure that proper analysis is being done on monthly basis to study the rejection at various internal stages and it is documented.
- 3.7 Ensure that all the relevant specifications, IS standards are available with the firm.

### 4 Inspection

#### 4.1 Purchasing / Inspecting Authority

- 4.1.1 The manufacturer shall furnish the Purchasing / Inspecting authority the details of internal inspection and test records and other relevant records as required under the quality control system in force. The records & reports shall be open to examination by the Purchasing / Inspecting authorities at all reasonable times.
- 4.1.2 The Purchasing / Inspecting authority at their discretion may draw samples at any stage of production for conformity tests either at the works of the manufacturer or in an approved laboratory. In case the samples do not conform to the requirements of the specifications, double the number of samples from the same lot / batch shall be drawn for re-testing. Should any of the re-test samples do not conform to the requirements, the entire lot / batch shall be rejected.

- 4.1.3 The Purchasing / Inspecting authority shall in his presence destroy the samples after the impact & destruction test in such a way that the same can not be usable. These samples are to be preserved for at least three month in a designated area. The Purchasing / Inspecting authority shall verify the accountal of these samples visa-a-vis quantity supplied during the period.

4.2 Consignee Railway

- 4.2.1 The consignee Railway, on receipt of the consignment, shall verify:

- a) The condition of the packing.
- b) Facsimile of the inspector's stamp on each screw coupling.
- c) Quantity received as per the inspection certificate.
- d) At random checking of the markings on the screw coupling as per the drawing.

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