

**GOVERNMENT OF INDIA
(Ministry of Railways)**

**TECHNICAL SPECIFICATION FOR STEEL
BLOOMS FOR THE MANUFACTURE OF
TRACTION MOTOR ARMATURE SHAFTS**

Issued by

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TECHNICAL SPECIFICATION FOR STEEL BLOOMS FOR THE MANUFACTURE OF TRACTION MOTOR ARMATURE SHAFTS

1. SCOPE:

This specification covers the technical requirements of steel blooms for the manufacture of armature shafts for traction motors of BG Diesel & Electric locomotives.

2.0 MATERIAL SPECIFICATION:

2.1 Steel Making:

The bloom shall be manufactured from killed quality steel of Arc furnace / BOF route, by hot rolling / forging.

2.1.1 Chemical Composition:

The steel shall be of Nickel based hot rolled / forged designated as EN-25 confirming to 31Ni 10Cr 3MO6, Type D of IS: 5517 / 1993 or BS 970 latest designation 826M31 condition "V".

Typical product analysis shall be of chemical composition:

Element	Percentage
Carbon	0.27 - 0.35
Manganese	0.40 - 0.70
Silicon	0.10 - 0.35
Chromium	0.50 - 0.80
Nickel	2.25 - 2.75
Molybdenum	0.45 - 0.65
Phosphorus	0.050 max
Sulphur	0.050 max

2.1.2 Reduction ratio:

Size of Bloom in mm	Min. reduction ratio (rolled/forged) from min. size of ingot to max. size of bloom
250 ²	2:1

2.1.3 Hydrogen content in the liquid steel determined by standard analysis method shall not exceed 2 ppm

2.1.4 Freedom from defects:

The blooms shall be sound and free from surface defects throughout and without cracks, inclusion, burrs, lack of metal, laps, seams, injurious imperfections or any other internal and external defects detrimental to their end use.

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2.1.5 **Discard:**
Sufficient discard shall be made from either end of each ingot to ensure freedom from piping and harmful segregation.

2.1.6 **COOLING:**
Blooms must be ash cooled.

2.1.7 The steel bloom shall be suitable for hot forging at a temperature range of 1200 °C – 850 °C, and hardening by polymer quenching at a temperature of 830 °C - 850 °C and subsequent tempering at 650 °C max.

3.0 **Mechanical Properties:**

3.1 The supplier shall cut 2 samples from heat and test for the mechanical properties. The sample piece is to be forged down to 150mm diameter and subsequently hardened and tempered. Longitudinal sample shall be selected through the mid radius of cross section as centreline. The test specimen shall be machined and tested as per IS: 1608 / 1995. The second sample shall be used to prepare izod specimen and tested as per IS: 1598 / 1977.

The Mechanical properties shall be as follows:

UTS (Min)	1000-1150 N / sq. mm	(102-118 Kg/mm ²)
YS (Min)	850 N / sq. mm. (min)	(85 Kg/mm ²)
Elongation % (Min) (GL= 5.65 √A)	12 % (min)	
Izod Impact Value In accordance with IS 1598-1977 (1 st revision)	48 Joules Minimum	
Hardness Brinell (3000kg/10mm ball) in accordance with IS:1500- 1968	285 - 341	

3.2 **Metallographic examination and micro structure:**
The steel sample from blooms shall be tested by gradient quench method stipulated as per IS:2853:1964 shall reveal suitably dressed grains. The grain size should exhibit well defined uniform fine grain structure and grain size index shall be of ASTM 6 or finer. Non metallic inclusion rating should not be worse than 1.5.

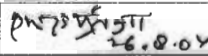
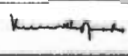
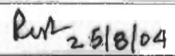
<i>Prasanna</i>		<i>Kumar</i>	<i>Ravi</i>
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- 3.3 **Macro structure:**
- 3.3.1 Macro structure of steel on transverse section shall be free from shrinkage, porosity, laps, blowholes, cracks, cavities inclusions or any other defects detrimental to their end use.
- 3.3.2 Pipe, bleeding, butt, tears, flute marks, internal bursts and flakes are not acceptable to any degree. Central segregation is acceptable up to C-2 level as per ASTM E-381 latest.
- 3.3.3 Suspected blooms having indication of pinholes etc shall be macro etched and tested for its suitability.

- 4.0 **Ultrasonic Requirements:**
 Bloom shall be tested ultrasonically as per Annexure-A (Standard for UT testing of blooms).
 The supplier has to carry out the ultrasonic testing (100%) of the blooms in transverse direction using 2-2.5 MHZ transducer covering the entire cross section from two adjacent faces as per Annexure – A of this specification.

- 5.0 **Test Certificates:**
 The supply shall be accompanied with the test certificate for the following characteristics and the method of test carried out on it as per relevant specification. The final test certificate must include the results of the following tests.
- Ladle analysis,
 - Chemical composition
 - Hydrogen content,
 - Ingot size & reduction ratio (from ingot to bloom),
 - Details of the heat treatment
 - Results of mechanical tests as per clause.3.0 and heat treatment followed on test pieces.
 - Metallographic test report and grain size
 - Ultrasonic test results of individual bars
 - Dimensional inspection

- 6.0 **Inspection:**
- 6.1 RWF's representative or Designated Inspection Agency shall have free entry at all times when the work on the contract of the purchase is being performed to all parts of the manufacturer's works which concern of the ordered material. The manufacturer shall offer necessary assistance to inspect the ordered material at the manufacturer's premises. The general conditions of the inspection shall be as per the guidelines stipulated in IS: 13387/1992 clause.

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6.2 RWF's Inspector/designated agent shall select one sample per batch/heat for testing the characteristics as per clause 2.1.1, 3.0, and 4.0

6.3 The supplier has to carry out pre-inspection or in process inspections for the criteria mentioned in the clauses 2.1.1, 3.0, and 4.0 and only the acceptable materials shall be offered to RWF's inspector.

6.4 RWF's inspector shall select 10% of the bloom/round at random and ultrasonic test to be carried out. If any bar is found to have defects beyond the acceptance reinspection by selecting 30% of blooms at random sampling shall be done and if any bloom is found to have unacceptable defect, the manufacture shall have to arrange for UT testing of the entire quantity in presence of the inspection authority and the blooms meeting the specification requirement only shall be accepted for despatch.

6.5 Bloom of one heat shall be offered at a time for UT test.

7.0 **Marking:**

7.1 The suppliers shall have to paint the bar identification number / Heat number on the end face of the bar. The length of the bar shall be painted on the side.

7.2 The inspecting agency shall stamp the identification for being accepted for despatch and such bars only shall be despatched to RWF

8.0 **GEOMETRY, DIMENSIONS AND TOLERANCES OF BLOOM:**

8.1 The blooms shall be round cornered square or corner chamfered square as follows:

(All dimensions are in mm)

Size of bloom	Type of Armature Shaft	RCS Bloom, Corner Radius	Chamfered Bloom, Diagonal size	Unit length	Length of Bloom, if supplied in unit/multiples	Extra length required for sample coupon
250 +5 -0	Drawing No. 3/DCW/M/TM-121	42 ±5	319 ±5	1080±5	1080 ±5 2180±5 3280±5 4380±5	60

<i>prp 26.8.04</i>	—	<i>Kumar</i>	<i>Rvt 25/8/04</i>
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Note: The unit and multiple lengths given in the above table are liable to change from time to time. If the lengths given in the purchase order differ from that given in the table above, the lengths indicated in the purchase order shall prevail.

8.2 **LENGTH OF BLOOM:**

8.2.1 The length of bloom shall be in multiples of the unit length as shown in clause 7.0. Two blooms from each cast shall have extra length as specified in clause 7.0 above to accommodate sample coupon and this shall be identified by colour coding at both ends with yellow base and black zebra lines. Blooms should be marked for each unit length with white lines.

8.2.2 The blooms shall be straight throughout its length and a deviation of 5 mm in one metre length of bloom may be permissible. The blooms shall be free from tapers, twists and bend ends. Both ends of the bloom shall be saw cut and straight.

8.2.3 The minimum quantity per heat shall be 20 MT.. The manufacturer will clearly indicate size of ingot used by them for manufacture of blooms and reduction ratio so achieved.

9.0 **CONDITIONING OF BLOOM:**

9.1 The conditioning of the bloom if any shall be done by grinding only and shall be free from cracks, laps, scabs and ruptures. The depth of conditioning allowed is 5 mm on surface of bloom. The width of conditioning shall be at least 10 times of its greatest depth to avoid laps while forging.

<i>DRP SINGH</i> 26.8.04	—	<i>Kumar</i>	<i>RWF</i> 26/8/04
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PROCEDURE FOR ULTRASONIC TESTING OF STEEL BLOOMS FOR THE MANUFACTURE OF TRACTION MOTOR ARMATURE SHAFTS:**10.0 SCOPE:**

This specification covers the procedure for detecting the harmful defect / discontinuities in RCS blooms of EN 25, rolled / forged, used for manufacturing Traction Motor Armature shaft to meet the requirement of DCW / Patiala's specification No.4/DCW/SPEC/TM-037.

10.1 PURPOSE:

To ensure uniform structure and freedom from harmful internal discontinuities inside the bars used for forging the armature shaft to meet the requirement of DCW / Patiala's specification No.4/DCW/SPEC/TM-037.

10.2 EQUIPMENT:

UFD of reputed make calibrated to IS:12666/1988 with probe 2 MHz or 2.25 MHz direct beam probe having crystal dia. of 3/4" to 1".

10.3 TEST METHOD:

Pulse echo direct contact

10.4 COUPLANT:

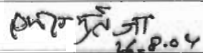
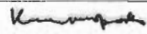
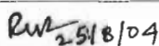
Oil or Water

10.5 SCANNING:

Scanning should be carried out through out the length, transverse direct from two adjacent faces of the RCS blooms with sufficient overlap. Scanning shall be conducted at a temp below 50° C.


10.6 ACCEPTANCE CRITERIA:

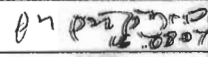
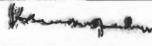

- a) Flakes, piping and porosity are rejected.
- b) Isolated flaw echo max. 40% when back echo adjusted to 100% of the full screen height acceptable and more than 40% is unacceptable for rolled blooms. In case of forged blooms 20% when back echo adjusted to 100% of the full screen height is acceptable and more than 20% is unacceptable.
- c) Minimum distance between such isolated defects shall be 6 inch.
- d) There shall not be more than 3 such isolated flaws within a length of one meter.
- e) Continuous defects more than 4 inch length shall be rejected.

 16-8-04	—		 25/8/04
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AMENDMENT SHEET

Dt. 25.08.2004

Alt	Cl. No	Description	Job No	Sign
'Nil'	---	New Specification	4606	

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